

# OCEAN CONSERVATION RESEARCH



*Science and technology serving the sea*

## **Assessing acoustical transmission characteristics of San Ignacio Lagoon land and water interface with regards to the potential bio-acoustic impacts of traffic noise on the lagoon marine habitat from the proposed paved road between San Ignacio, San Ignacio Lagoon and La Purisima**

### **1.0 Overview**

San Ignacio Lagoon has been and continues to be an important breeding and birthing habitat for the Eastern Pacific Gray whale (*eschrictius robustus*). Over the past two decades this has lent to an ecotourism industry that has become a significant income source for the lagoon fishing Ejido. Under these premises the lagoon has been identified as a World Heritage site and protected under the auspices of the Vizcaino Biosphere Reserve. The lagoon has also been a federally protected whale sanctuary since the 1980's

Heretofore access to the lagoon has been limited by way of a dirt road from the town of San Ignacio to the Lagoon. Currently the Junta Estatal de Caminos de Baja California Sur (State Highway Board of Southern Baja California) is paving the road to the lagoon with plans to extend this road southward to La Purisima, connecting with the paved road there that connects to Highway M-1.

The environmental impacts of the paving of the road on the reserve have been reviewed and reported in a document submitted by the Secretaria de Medio Ambient y Recursos Naturales (Secretary of the Environment and Natural Resources, hereinafter "SEMARNAT"). The SEMARNAT document deals primarily with terrestrial impacts of the project, and there are provisions in the plan to modify the project – including re-routing the road – in the event that adverse biological impacts are discovered during the course of construction.

The SEMARNAT document does not identify any potential bio-acoustic impacts of the road on the Lagoon habitat. These potential impacts include the noise impacts of increased regional traffic, diversification of lagoon area uses as a consequence of improved access, seismic level noise and vibration transmitted into the lagoon from the road traffic (addressed in this proposal), or the cumulative or synergistic effects of these noises on other lagoon habitat stressors.

The paved road will be a significant asset to the residents of the lagoon, improving access to commerce and tourism. The road will also significantly improve access to medical services for the residents of the lagoon.

Once the road connects to La Purisima, it will also become a preferred route for automotive and cargo traffic running north and south between the U.S. Mexico border and Cabo San Lucas because it bypasses the current, and fairly treacherous M-1 that runs between San Ignacio and Loreto.

The concern is that once the paved road becomes a main thoroughfare for heavy traffic, that seismic scale vibrations from the road will transfer low frequency noise into the lagoon and potentially compromise the habitat for the Gray whales.

In order to determine the potential acoustical impacts of the road, low frequency acoustical transmission characteristics of the lagoon/land interface should be evaluated in situ before the completion of the project.

This proposal is for testing, evaluating and reporting of these acoustical characteristics, and for the publication of this report.

## **1.1 Document Resources**

Information in this document was developed through conversations and e-mail correspondence between Michael Stocker with Ocean Conservation Research (the writer), Steve Swartz, with Pro-Peninsula's Laguna San Ignacio Ecosystem Science Program (LSIESP), Aaron Thode, Bio-acoustic researcher with University of California, San Diego (also with LSIESP), and Pancho Mayoral with Baja Ecotours and San Ignacio lagoon ejido member.

Information in this document was also derived through the following documents:

1. Manifestation de Impacto Ambiental, modalidad Regional (MIA-R) para el proyecto "Ampliación y Pavimentación del Camino San Ignacio–La Laguna, Tramo km 3+000-Km 58+000 Municipio de Mulagé, BCS" submitted and stamped by SEMARNAT and dated Oct. 1 2007 (hereinafter the "MIA-R")
2. Summary Report of Acoustic Measurements in San Ignacio Lagoon Winter Season, 2008, by Melania Guerra, a graduate student advised by Aaron Thode at the Scripps Institution of Oceanography (SIO).

## **2.0 Methods/Procedures**

In accordance with the MIA-R document, the paved road will be placed directly over the existing dirt road in order to avoid damaging untrammeled areas of the reserve. As such the proposed paved road from San Ignacio will intersect the lagoon at 26° 52' 33"N : 113° 08' 09"W. The road will then flank the lagoon heading south for approximately 8 km before heading east-south-east and inland. (see Fig. 1 and Fig. 2)



Figure 1

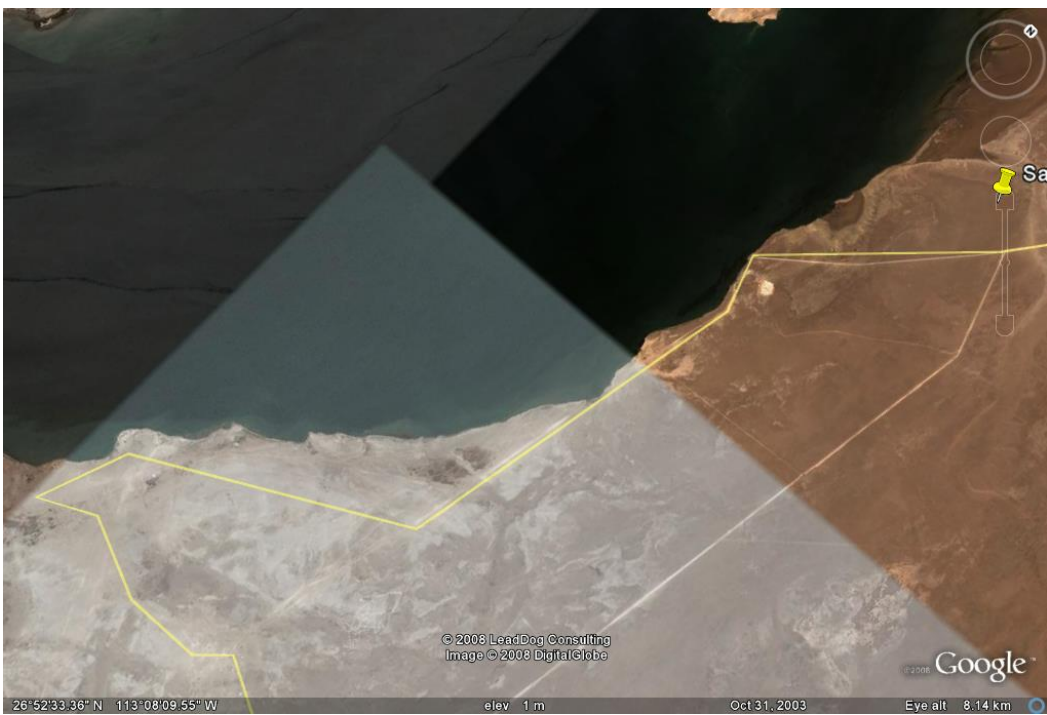


Figure 2

Traffic noise along this stretch of road has the highest potential of transmitting noise into the lagoon due to a number of factors, including road's proximity to the mudflats, and the high water content of the mudflats which would increase acoustical coupling from road vibrations into the lagoon waters.

In order to investigate these the sound transmission of road noise into the lagoon, we propose testing propagation characteristics along this stretch of road, either directly at the intersection or further south around the road tangent at 26° 52' 27"N : 113° 08' 16"W. (The exact site and instrument locations will be chosen after a more thorough site evaluation.)

The test will involve monitoring the noise levels in the lagoon for a two week period by way of two stationary bottom-mounted data-logging hydrophones. These hydrophones will be level-calibrated to each other and set on the lagoon bottom, spaced at a calibrated distance from each other and from the road along a line perpendicular to the road.

The test stimulus will involve driving a heavy piece of construction equipment over the existing dirt roadbed for a couple of hours, then repeating the experiment twice more over the following week, in order to determine if, and to what degree, construction activity sounds propagate through the lagoon environment.

Deploying two instruments will allow for magnitude calibration of the sound source and allow for a reasonable estimate of propagation characteristics from the roadbed into the lagoon.

Other system stimulus will occur over the time frame as supply trucks and other vehicles traverse the road. The heavy (10 Ton) supply trucks make trips to and from the lagoon at predictable intervals throughout the week. Additional broadband stimuli will come from occasional *pangas* moving through the subject area as well as ongoing and changing weather conditions.

## **2.1 Instrumentation**

Aaron Thode and Melania Guerra have been working with acoustical recording instruments in the lagoon and have agreed to make these instruments available to this project. The instruments sample between 10Hz and 25 kHz and can record continuously at this rate for one week, or for one month at 3 kHz sampling rate. Aaron Thode has also agreed to analyze the datasets after data recovery.

Data from the hydrophone instruments will be correlated to weather conditions provided by an existing HOBO S-WCA\_M003 wind sensor mounted at the “Baja Discovery” campsite (also part of the Thode/Guerra instrument set).

## **2.2 Performance of persons outside of this proposal**

The field test procedures described herein will depend on the availability heavy road construction equipment at a specified times to serve as the source of road noise to be measured. We will ask the Vizcaino biosphere reserve officials for assistance with obtaining the cooperation and coordination of the road construction companies, and ask that they provide the construction equipment to produce the road noise at the proposed study site.

The specifics and availability of this equipment have yet to be determined. We hope that the cost of providing this equipment will be contributed to the project by the construction company

as a contribution to the investigation of the potential impacts of road noise on the lagoon and surrounding wetlands.

### 3.0 Data Evaluation

Data from the two hydrophone instruments and the wind sensor will be evaluated and presented in a summary report. The report will present the following:

- The overall noise profile at the hydrophones over the time frame.
- The nature and levels of the various sources of noise.
- The acoustical propagation characteristics of the subject site, in terms of a simple power law propagation loss mechanism.
- Discussion of the potential acoustical effects of continuous traffic at the site.

Random continuous background noise levels will be expressed in terms of power spectral density (dB re 1uPa<sup>2</sup>/Hz), and impulsive/transient sounds will be characterized in terms of peak, sound exposure level, and RMS levels at both broadband and 1/3 octave bands. This data evaluation will also be discussed with qualified subject-matter experts (e.g. marine mammal bio-acousticians) for potential biological impacts on the lagoon habitat. These discussions will inform the summary report.

Once completed, the author will submit the report for publication in a peer reviewed journal such as the Journal of the Acoustics Society of America (JASA) or Marine Mammal Science.

### 4.0 Project costs

Project costs in US Dollars are estimated and based on available information and resources. Project coordination, evaluation, writing and publication will be performed by Michael Stocker of Ocean Conservation Research (OCR), which is under the fiscal sponsorship of The Ocean Foundation (TOF).

This project will be co-sponsored by Pro-Peninsula’s Laguna San Ignacio Ecosystem Science Program (LSIESP) and The Ocean Foundation (TOF). The findings of this investigation will be provided to the local state and federal authorities, and to the local businesses and community of the Laguna San Ignacio area. Fiscal sponsorship for the project will be shared by NGO non-profit organizations Pro-Peninsula and TOF, and their indirect costs will be 10% of the direct costs of the project.

#### 4.10 Project Staff

	Project Cost	Agency	Contribution
Project coordination	7500.00	OCR	
Evaluation	1500.00	OCR	
Writing	1500.00	OCR	
Publication	1000.00	OCR	
<b>Staff total</b>	<b>11500.00</b>		<b>11500.00</b>

#### 4.11 Instrumentation

	Project Cost	Agency	Contribution
Provision, placement and retrieval of two data-logging hydrophones, review of the hydrophone data, and provision and use of correlated weather station data.	3500.00	LSIESP	
Reserve for replacement of lost or damaged instrument	5000.00	LSIESP	
<b>Instrumentation total</b>	<b>8500.00</b>		<b>8500.00</b>

#### 4.12 Travel costs

	Project Cost	Agency	Contribution
RT Flight SFO/Loreto	1360.00	OCR	
Car rental	525.00	OCR	
Fuel Costs	250.00	OCR	
Lodging	700.00	LSIESP	<700.00>
Meals	210.00	LSIESP	<210.00>
<b>Travel Costs total</b>	<b>3065.00</b>		<b>2155.00</b>

#### 4.13 Analysis Costs

Data analysis	3000.00	SIO	
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#### 4.14 Publication Costs

Four pages in a peer reviewed journal	400.00	OCR	
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### 4.2 Project Costs Summary

	Project Cost	Agency	w/Contribution
Staff total	11500.00	OCR	11500.00
Instrumentation total	8500.00	LSIESP	8500.00
Travel Costs total	3063.00	OCR/LIESP	2155.00
Data analysis	3000.00	SIO	3000.00
Publication	400.00	OCR	400.00
<b>Project Total</b>	<b>26463.00</b>		<b>25555.00</b>
Fiscal Sponsor	2646.30	TOF	
<b>Total with Fiscal Sponsorship</b>	<b>29109.00</b>		

## 5.0 Schedule

The testing procedure will require coordination of various parties and agencies outside of the influence of this proposal, so specific dates and delivery times may reflect unanticipated schedule constraints.

The general agreement in our discussions is that the testing will occur in the month of March 2009. The hypothetical schedule as follows:

Day	Task	By Whom
1	Coordination meeting with Instruments team	M. Stocker, Melania Guerra, pangero
2	Calibration and placement of instruments	M. Stocker, Melania Guerra, pangero
3	Coordination with construction equip. team	M. Stocker, Construction operators
4	Moving and running construction equipment	Construction operators
5-16	Tests and data gathering	M. Stocker, Construction operators
17	Instrument retrieval	Melania Guerra, pangero
18-20	Review and collation of data	Melania Guerra
21	Discussions about data	M. Stocker, M. Guerra, Aaron Thode
22-26	Writing report	M. Stocker, M. Guerra, Aaron Thode

The final report will be submitted to a peer reviewed journal for review and publication.

End of Proposal