How can we study acoustic behavior of gray whales in Laguna San Ignacio ?

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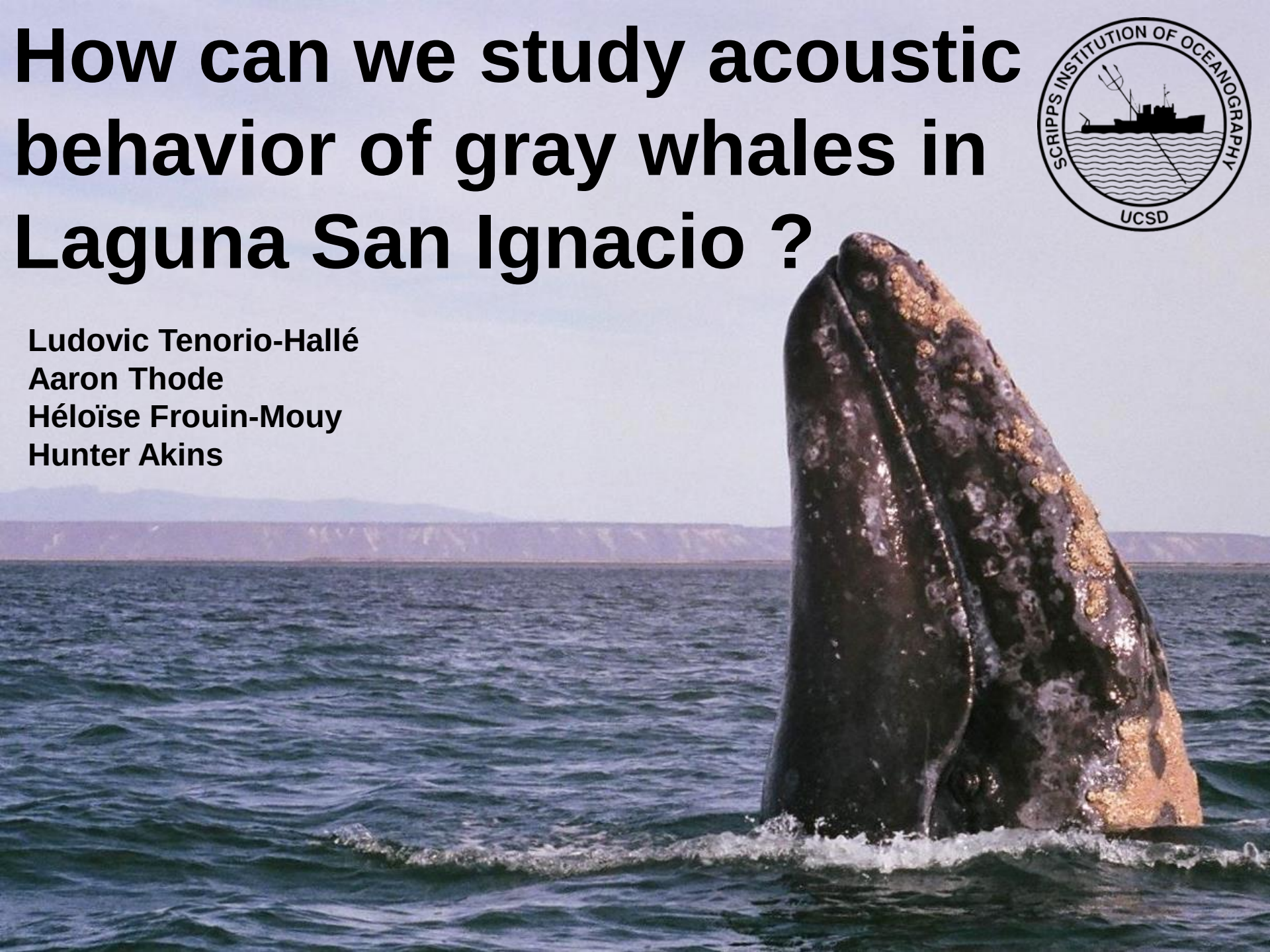


Gray whale calls

(Dahlheim, 1987)

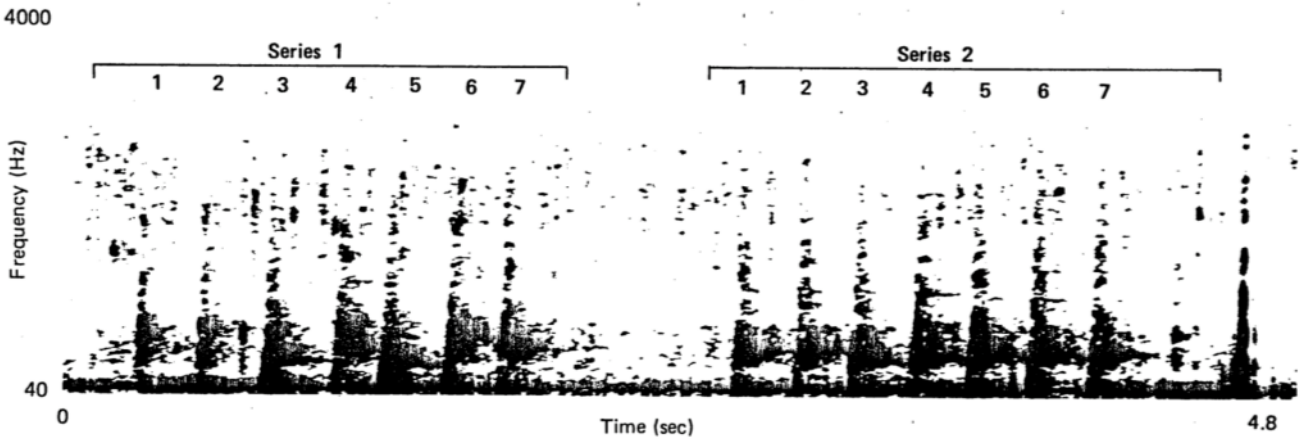


Table II. A Classification of Sounds Produced by the Gray Whale in Laguna San Ignacio, Mexico.*

Sound type	n	Frequency Range Low	Frequency Range High	Energy Concentration Low	Energy Concentration High	Duration of Series	Number of Pulses Per Series	Pulses Per Second	Received Levels
S1	1000	90 (120-1250)	1940 (1000-3000)	332 (100-1250)	824 (400-1600)	1.8 (0.3-4.6)	9.4 (2-30)	5.9 (2.2-14.7)	118 (90-160)
S2	100	250 (100-300)	300 (200-350)	250 (200-275)	300 (250-350)	0.3 (0.2-0.4)	---	---	102 (92-127)
S3	100	125 (80-200)	1250 (750-1800)	170 (125-625)	430 (300-750)	2.0 (1.0-4.0)	---	---**	94 (90-113)
S4	100	150 (125-200)	1570 (1500-1600)	225 (125-300)	600 (450-750)	0.9 (0.7-1.4)	---	---**	92 (88-108)
S5	100	130 (20-250)	840 (600-1500)	200 (20-250)	500 (300-750)	3.2 (1.8-4.5)	---	---	118 (97-124)
S6	100	250 (125-300)	850 (600-1000)	250 (125-300)	700 (300-800)	3.3 (1.2-3.6)	---	---	102 (96-113)

2018

2019

Héloïse
Frouin-Mouy

Aaron Thode

Ludovic
Tenorio-Hallé

“Visual” drone

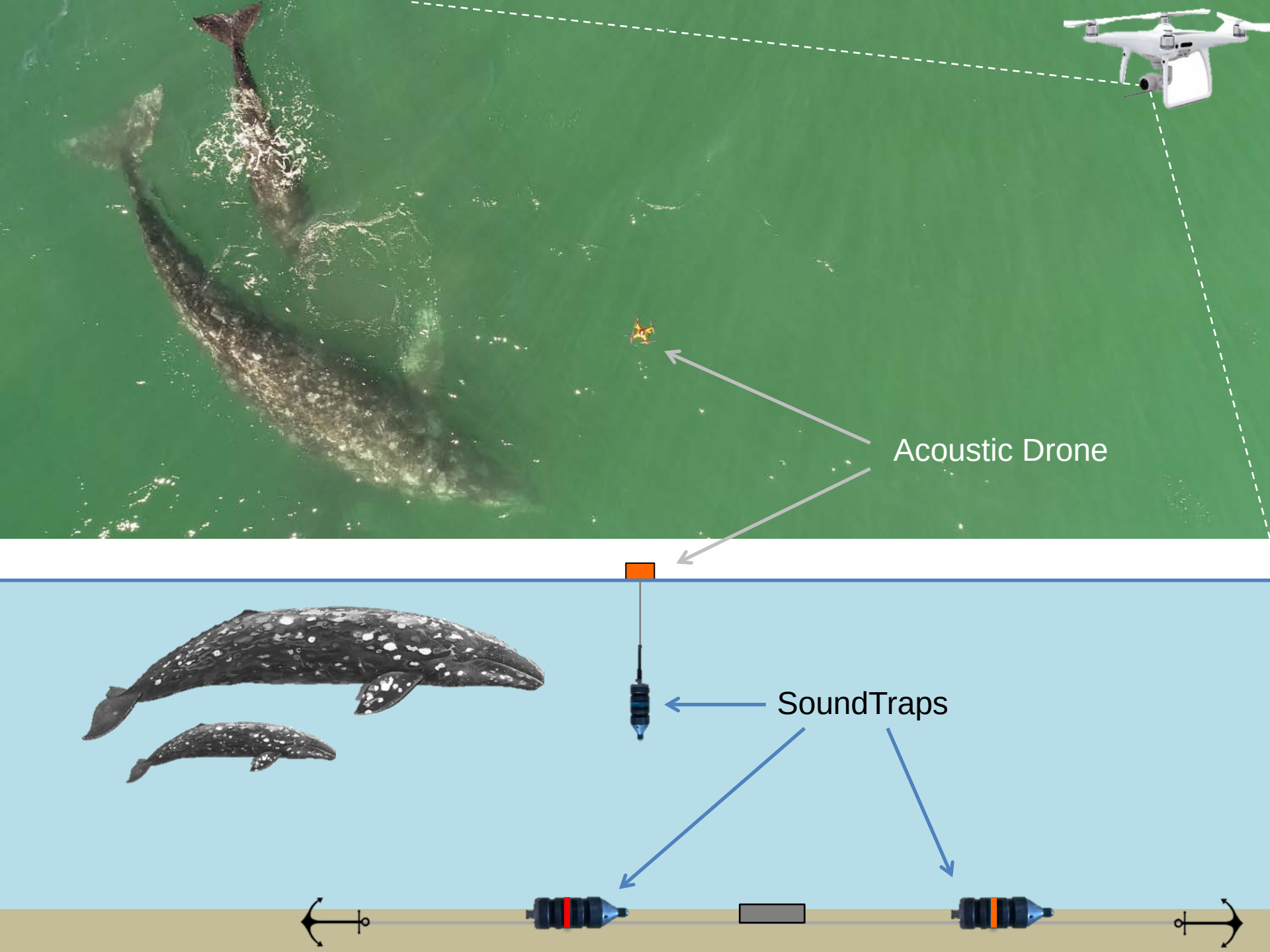
DJI Phantom 4

GPS track

4k resolution

03/01/2019: 15:26-15:50 (UTC-6)

“Acoustic” drone


Acoustic Drone
SoundTraps

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Short Communication

Using two drones to simultaneously monitor visual and acoustic behaviour of gray whales (*Eschrichtius robustus*) in Baja California, Mexico

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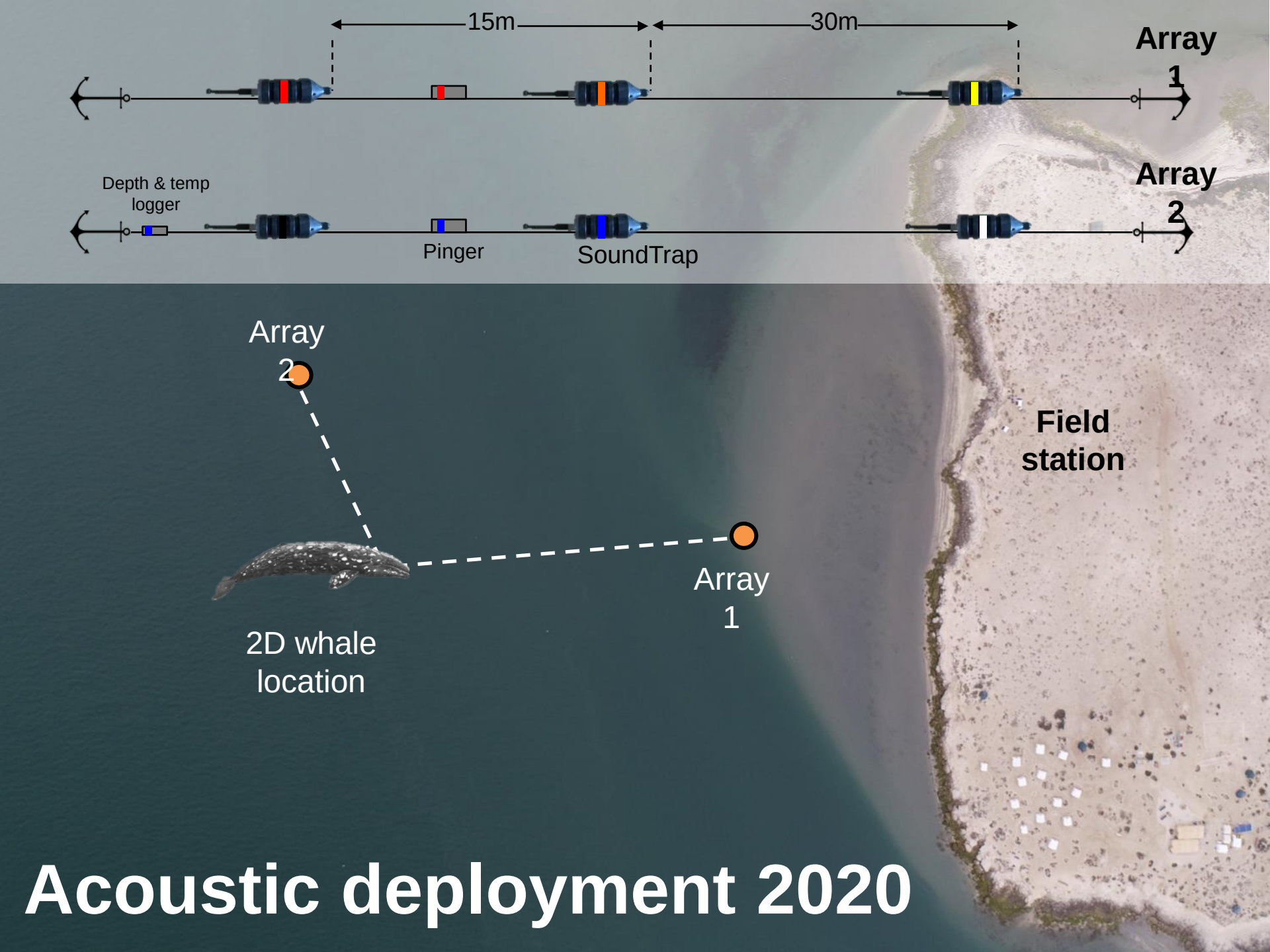
ABSTRACT

This study provides an initial demonstration of a combined two-UAV (Unmanned Aerial Vehicle) system for measuring the underwater source levels and behavioural context of vocal and non-vocal marine mammal signals, information that is highly ecologically-relevant in terms of understanding how a species interacts and copes with conspecifics and its acoustic environment. Although the calls of a few species are well known, major gaps exist in our knowledge about the relationship between vocal output and behavioural context, gender and age for most species. Accurate parameter estimates (e.g., typical source levels, frequency ranges, and temporal characteristics of animal sounds) relevant to their behaviour (activities such as foraging, migrating, mating, or parental care) are needed to establish use of critical habitats (when monitored by acoustics) or to assess potential effects of anthropogenic sound exposure (including reduction of the detection space of sounds used for communication). The emergence of UAVs provides new perspectives and data collection capabilities for marine mammal research. Although UAVs have been frequently exploited for visual observations of whales, most approaches for monitoring and recording sounds from individual whales are still performed using overside hydrophones from a boat or using acoustic tags attached to the animals. Laguna San Ignacio (LSI), Mexico, is one of the breeding and calving grounds of the Eastern North Pacific gray whale (*Eschrichtius robustus*) population. LSI area's restricted geography, combined with the short dive times of the whales, provided an excellent field laboratory to test a dual drone approach. We used two UAVs: one to obtain acoustic measurements close to the whales and another one to obtain overhead visual observations. For the acoustic drone, a hydrophone (SoundTrap) was suspended via a 2-m line to a waterproof UAV quadcopter (Swellpro), which has the ability to take off and land from the surface of water. Simultaneously, the visual drone (DJI) monitored the whales in the area. Between 27 February and 17 March 2019, we simultaneously recorded underwater gray whale sounds and visual behavioural observations. During 92 min of underwater acoustic recordings, the acoustic drone recorded 11 call types. By time-synching underwater audio with the behavioural video, we obtained new insights into the source levels and functions of various quiet underwater sound that are difficult to impossible to obtain with standard methods. To our knowledge, no studies combining overhead visual observations and underwater acoustic recordings to describe acoustic behaviour and sound parameters of calls have been previously published.



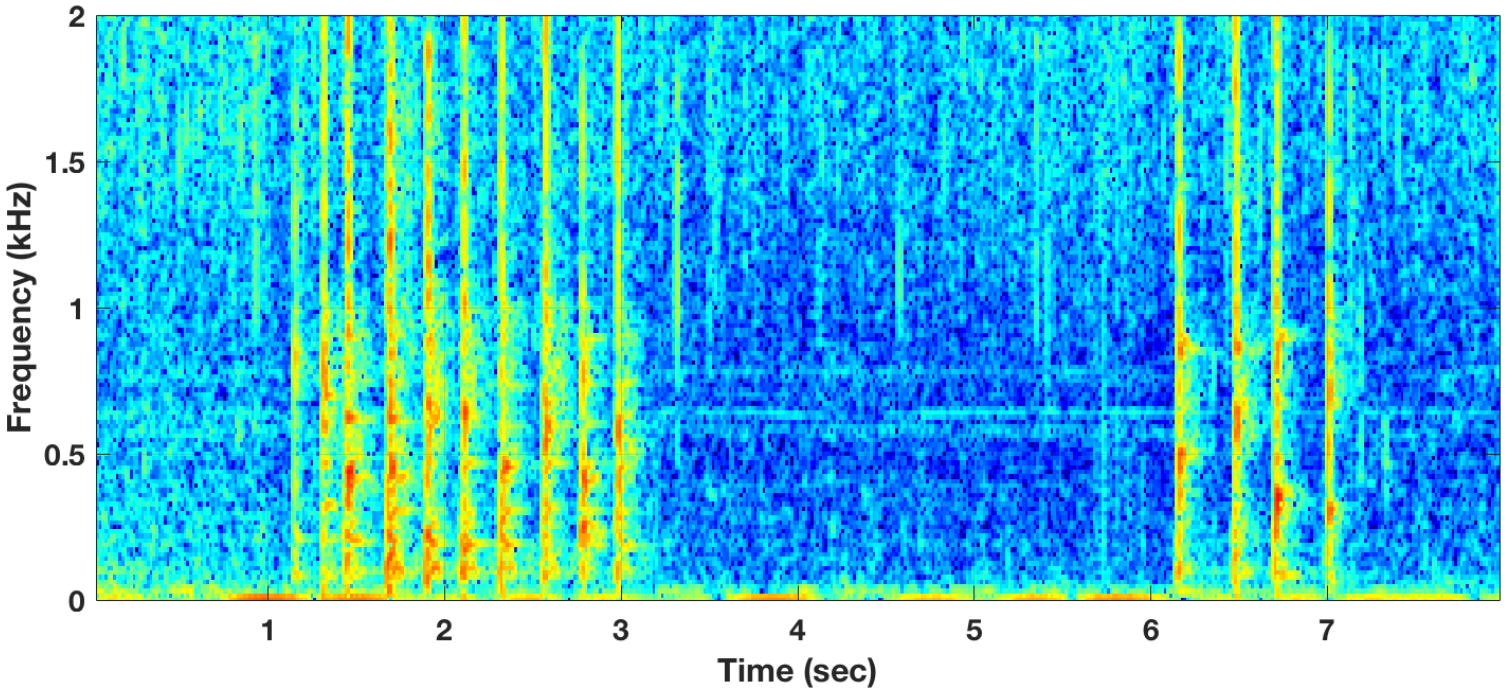
Acoustic deployment 2020

Snapping/Pistol shrimp

Laguna San Ignacio: *Crangon dentipes* or *Synalpheus lockingtoni* (Dahlheim, 1987)

Gray whale calls

S1 call – Series of pulses/knocks (“conga call”)

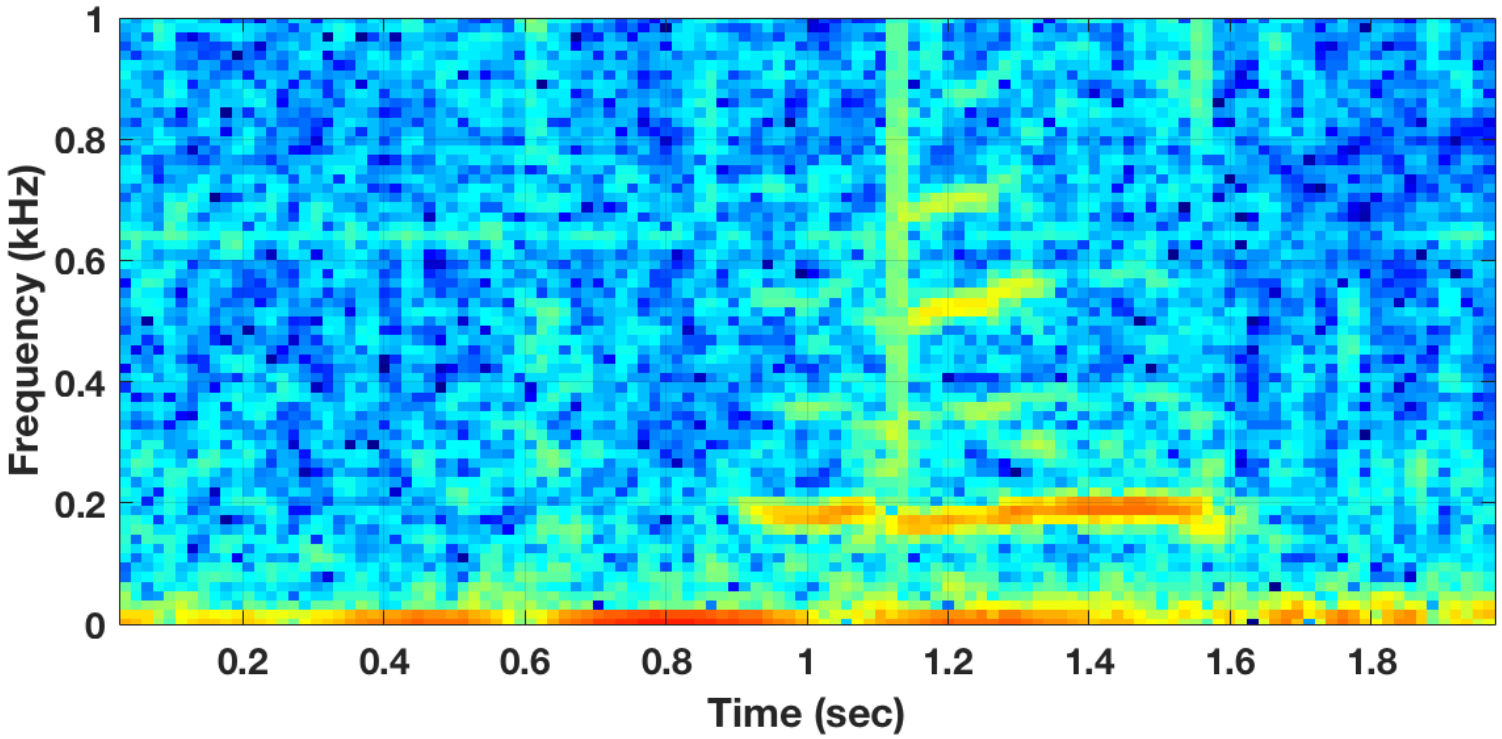


Acoustic drone SoundTrap data

File: 1208012833.190227171414.wav

Gray whale calls

S3 call – Moan (like a cow moo)



Acoustic drone SoundTrap data

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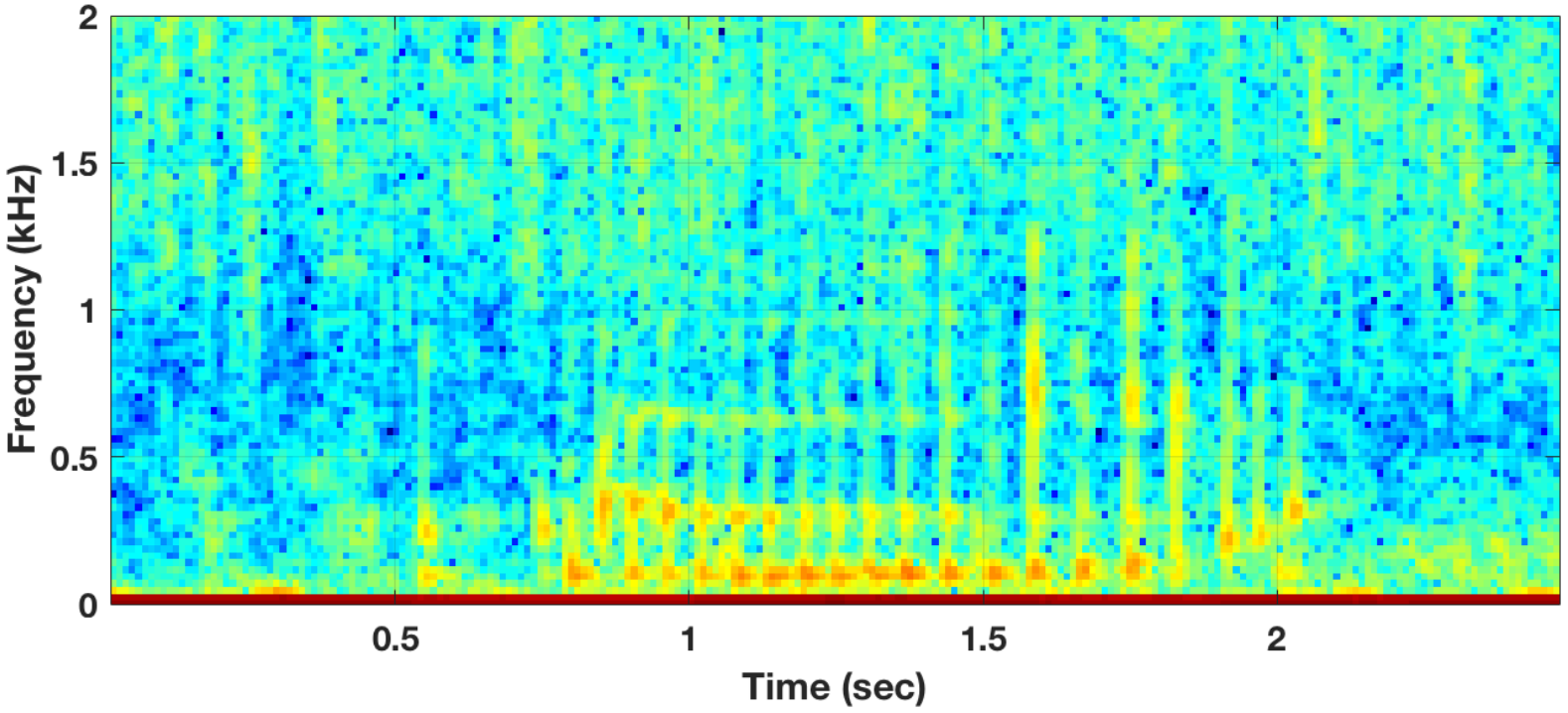
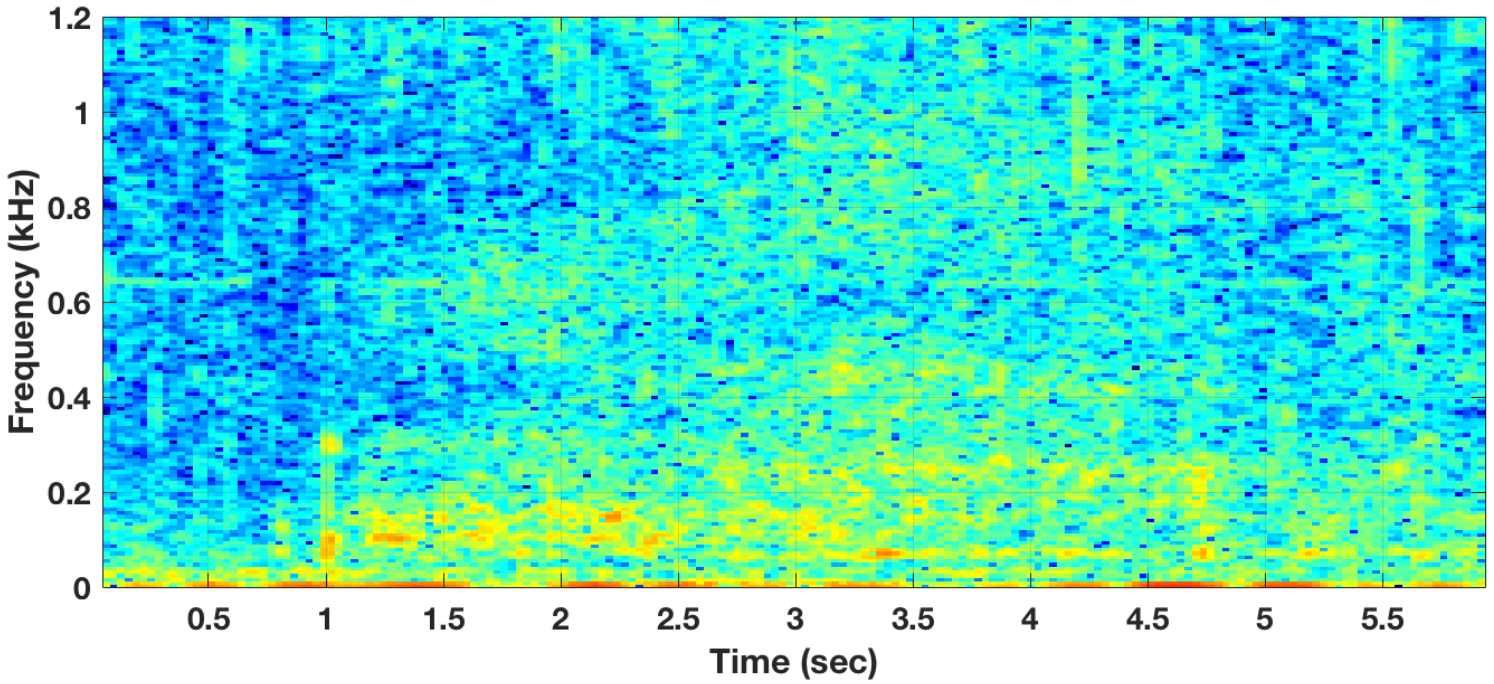
Gray whale calls

S4 call – Purr/grunt



Gray whale calls

S5/S6 sounds – Bubble blast/trains



Acoustic drone SoundTrap data

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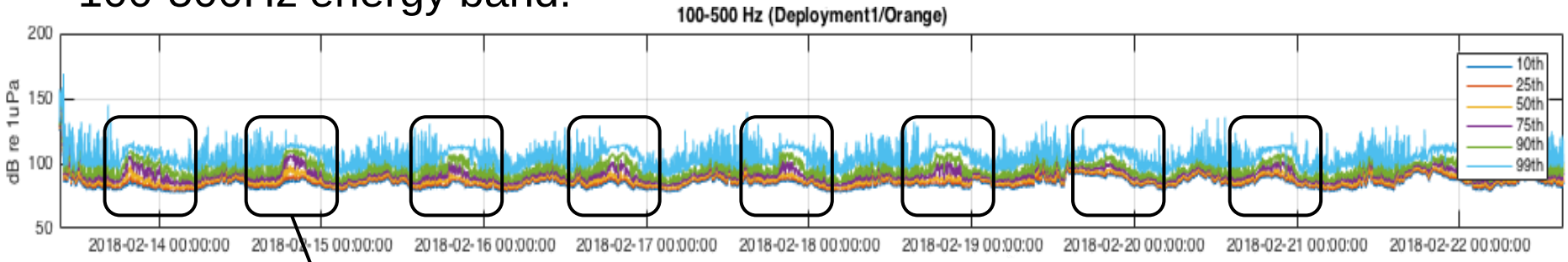
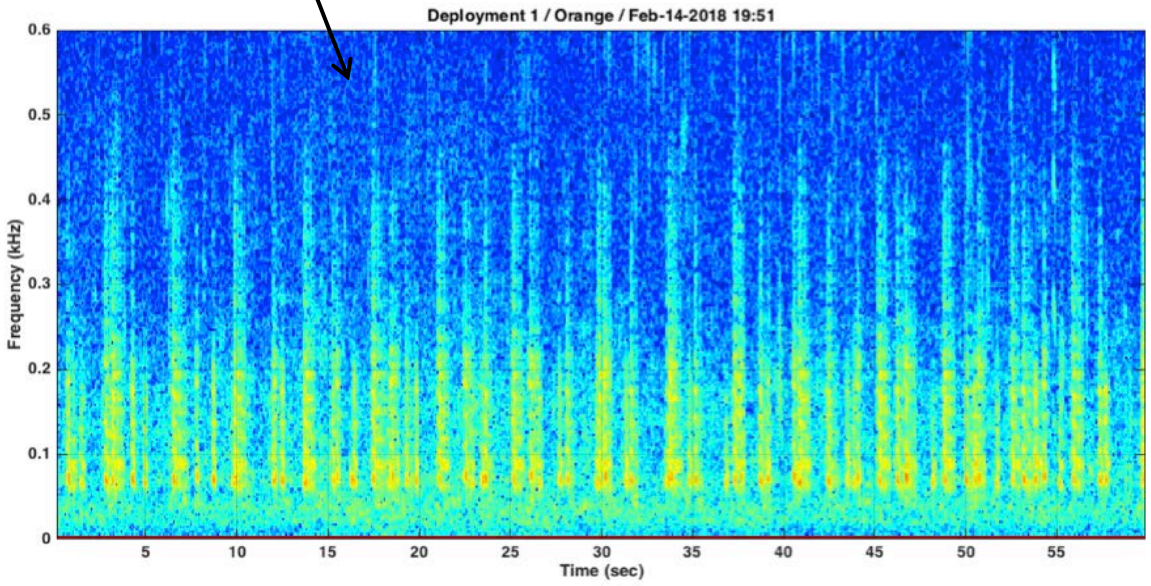
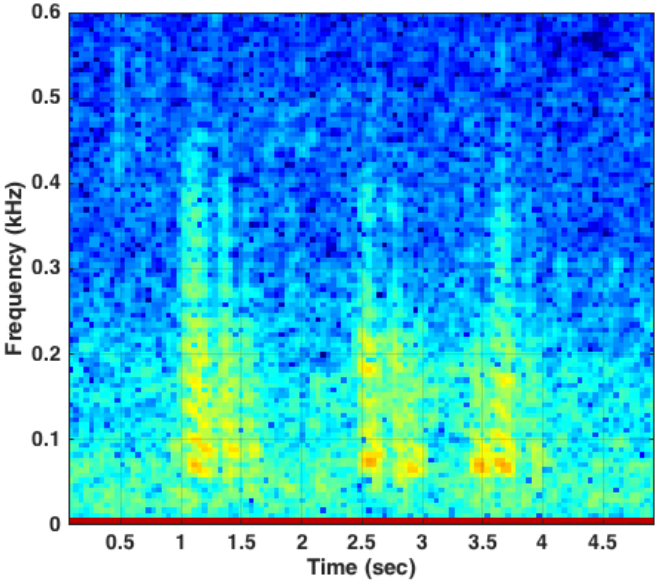
Croaker fish (*Sciaenidae* family): **“Evening chorus”**

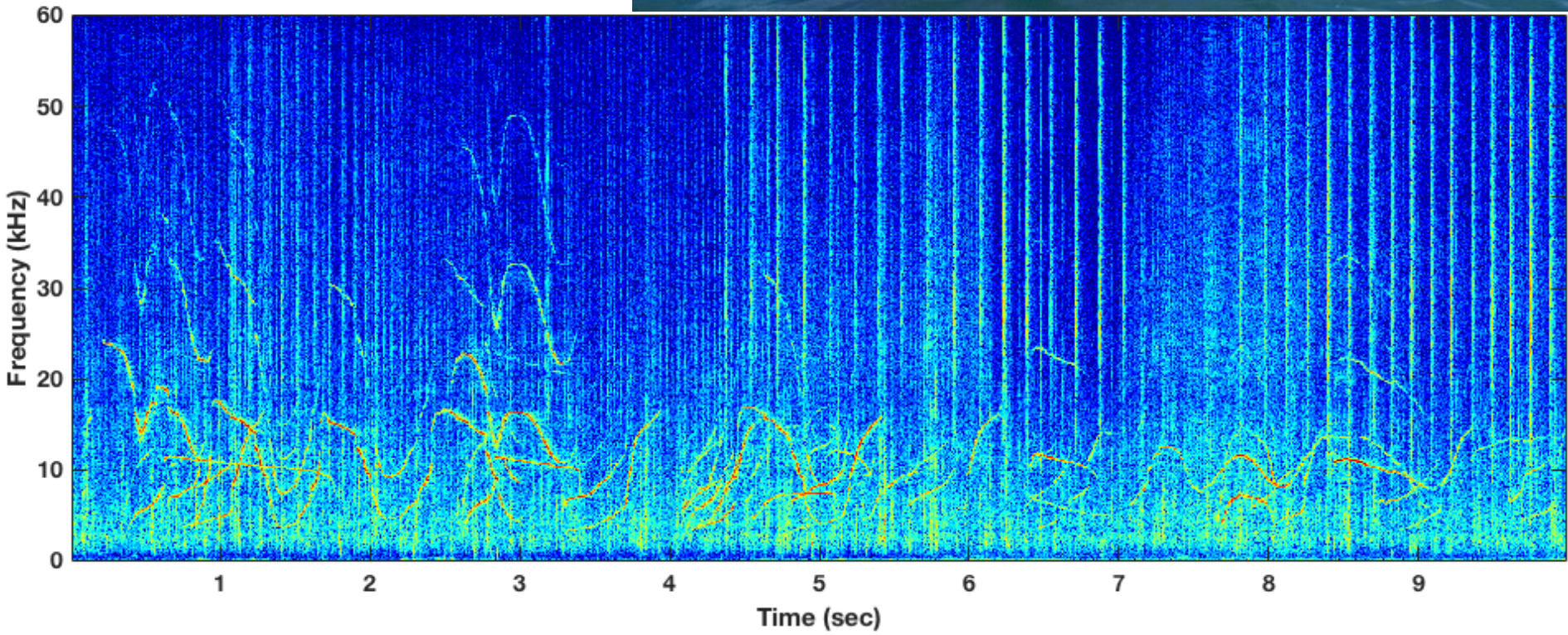
100-500Hz energy band:







Bottlenose dolphins
(*Tursiops truncatus*)



2019 Red SoundTrap data

File: 336338975.190301175255.wav

GRACIAS

Laguna San Ignacio Ecosystem Science Program

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THE OCEAN FOUNDATION

baja discovery

ECOTURISMO KUYIMA