ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR- UND MEERESFORSCHUNG

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LOCAL TO BASIN SCALE ARRAYS FOR PASSIVE ACOUSTIC MONITORING IN THE ATLANTIC SECTOR OF THE SOUTHERN OCEAN

AIM / Context

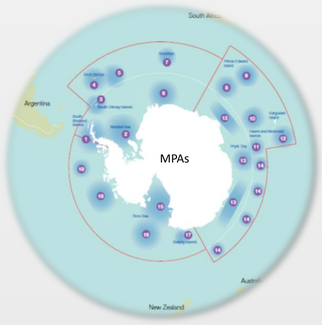
Platforms

Data analysis

Motivation

- Effective conservation of marine mammals (e.g., designation MPAs) requires fundamental understanding of species-specific distribution and habitat preferences

Minke whale (*Balaenoptera bonaearensis*)



Proposed marine protected areas (MPAs) in the Southern Ocean
(source: Antarctic Ocean Alliance)

Distribution of several species in Southern Ocean unknown
(source: IUCN Red list)

- Currently relatively little is known on abundance and spatio-temporal patterns in distribution for most marine mammal species in the Southern Ocean

→ Use networks of time-synchronized recorders to explore marine mammal occurrence over several spatial scales

Advantages of PAM over visual data

- Broadband (multi-species)
- Year-round, multi-year
- Omni-directional
- Suitable for marine mammal monitoring
- Monitor in seasonally inaccessible areas (polar oceans)
- Cost-effective
- Not limited by bad weather, sea state or ice coverage

Glare, waves, ice and fog limit visual surveys

Requirements for PAM arrays in polar oceans

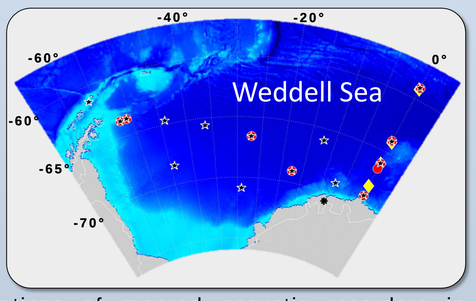
- Sufficient data storage and power for multi-year operation
- Tolerant against low temperatures
- Precise time-base for localization of acoustic sources and event correlation
- Deployment depth >200 m to minimize chance of entrapment by passing icebergs
- Deployment platform suitable for recovery in ice-covered areas

Left: bright and colorful floatation enhances detectability of moored recorders upon retrieval in ice covered areas; Right: flags mark on-ice recorder positions, light-colored recorder casing limits melt-in

HAFOS (Hybrid Antarctic Float Observation System)

Location:

Greenwich Meridian south of 60°S, Weddell Sea, Antarctica



Locations of moored acoustic recorders in the Southern Ocean. ♦ 2008-2010 ; ● 2010-2012; ★ from 2012; * Neumayer Station III/Atka Bay

Basin scale investigation:

- Focal species: Baleen whales
- Explore large scale spatio-temporal patterns in marine mammal vocal behaviour
- Investigate habitat suitability by linking acoustic presence information to local environmental parameters

Array set-up:

16 oceanographic moorings provide the platform for 24 acoustic recorders in the Weddell Sea

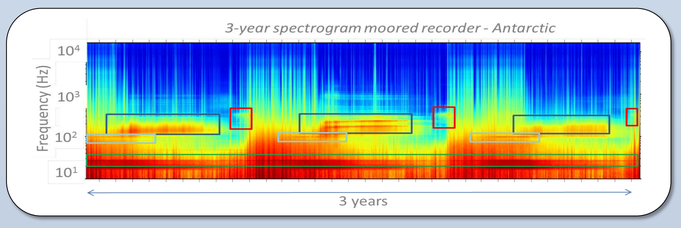
AURAL-M2

SonoVault

Recorder Type	AURAL-M2 (Multi-Electronique Inc., Canada)	SonoVault (Develogic GmbH, Germany)
Number of units depl.	3	21
Gain setting	22 dB	48 dB
Sampling frequency	32 kHz	5.3 kHz; 96 kHz
Recording interval	5 minutes/hour	Continuously; 5 minutes/2 hours
Storage capacity	640 GB	1.1 TB
Power supply	64 LR20 Lithium cells (~ 3 years)	77 LR20 Lithium cells (up to 3 years)
Deployment depth	ca. 200-300 m	Up to 2500 m
Deployment period	Depl: Dec 2012/Jan 2013 – Retr: 2015	

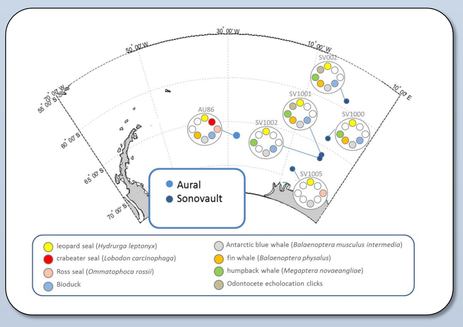
Preliminary results:

Deployment period	Recovered recorders	Data	Recordings / hrs
2008 – 2010	3	~ 340 GB	~ 1 849
2010 – 2012	7	~ 3.1 TB	~ 53 822
2012 – Scheduled for 2015	25	Up to 24,45 TB	~ 416 692



Above: 3-year LTSA: Grey box = fin whales (*Balaenoptera physalus*), Blue box = unknown sound source 'bioduck', Green box = Antarctic blue whales *(B. musculus intermedia*), Red box = leopard (*Hydrurga leptonyx*) and Ross seals (*Ommatophoca rossii*)

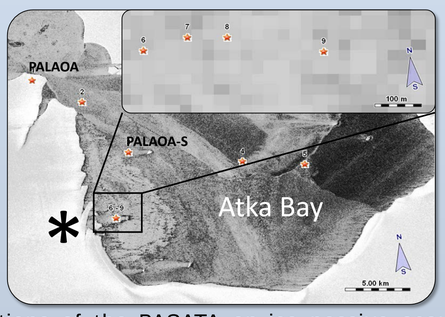
Below: Preliminary marine mammal acoustic biodiversity maps showing the species composition for the 6 recorders that were recovered in the Southern Ocean in 2012



PASATA (PASsive Acoustic Tracking of Antarctic marine mammals)

Location:

Antarctic coastal region, Atka Bay, near German research station Neumayer III



Locations of the PASATA on-ice passive acoustic recorders in Atka Bay. * Neumayer Station III

Local scale investigation:

- Focal species: Ice-breeding pinnipeds
- Localize calling individuals
- Investigate small scale spatial distribution in relation to ice conditions
- Gauge detection ranges of calls

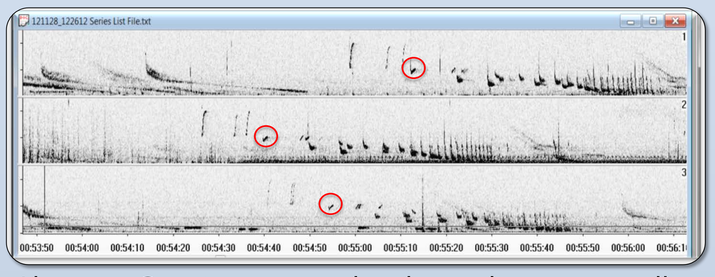
Array set-up:

- 7 acoustic recorders were fitted into insulated aluminum boxes
- Mounted GPS antenna for time-synchronization
- Hydrophone cable in 2m aluminimum tube with heating cable to allow recovery

Recorder Type	SM2+ (Wildlife Acoustics)
Number of units depl.	7 (+PALAOA+PALAOA-S)
Gain setting	12 dB
Sampling frequency	96 kHz
Recording interval	continuously
Storage capacity	4x128 GB
Power supply	33 Ah Pb Battery
Time base	GPS corrected
Deployment period	Nov 2012 – Dec 2012

(photos I. Van Opzeeland, Karolin Thomisch)

Preliminary results:



Above: Spectrogram showing three recording channels. Weddell seal call type W2 exhibits sufficiently distinctive features that allow triangulation of individual calls.

Deployment period	Nov 2012 – Dec 2012
Data	~ 4 TB
Total recording time	> 496 hrs

Species recorded:

- Weddell seals (*Leptonychotes weddellii*)
- Leopard seals (*Hydrurga leptonyx*)
- Ross seals (*Ommatophoca rossii*)

Juvenile leopard seal (photo S.Menze)

Weddell seals (photo I. Van Opzeeland)

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