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# Prediction of the cochlear frequency map of harbour porpoise

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Cochlea (inner ear)

Apex: low frequencies

Base: high frequencies

Girdlestone et al., 2018

MacDonald, 2010

Organ of Corti

Tectorial membrane

Stereoc...

Basilar membrane

Inner hair cells

Outer hair cells

www.flipper.diff.org
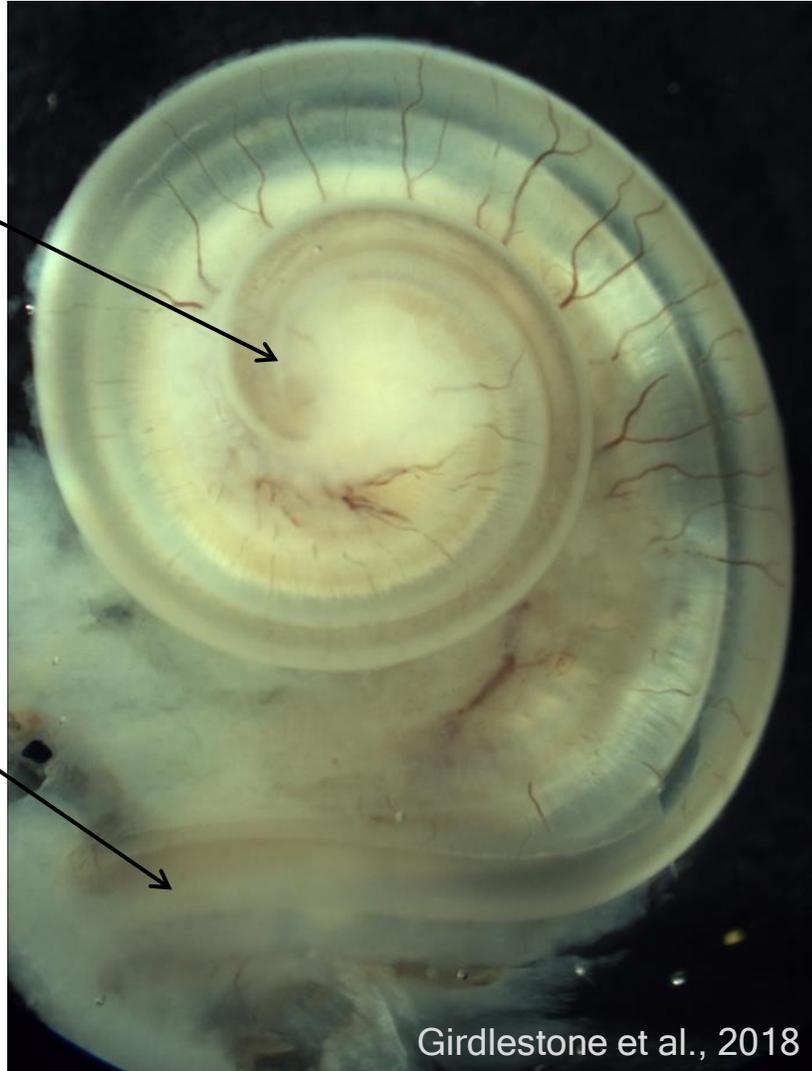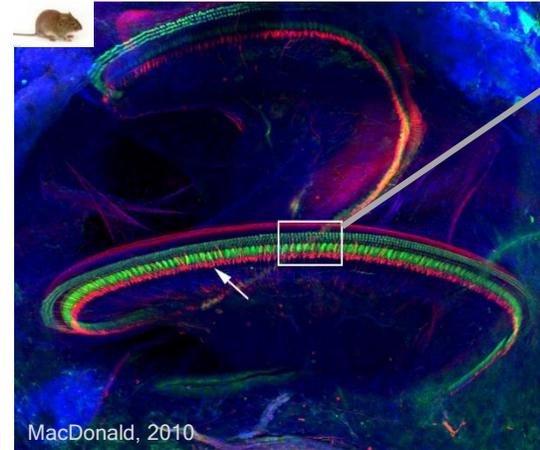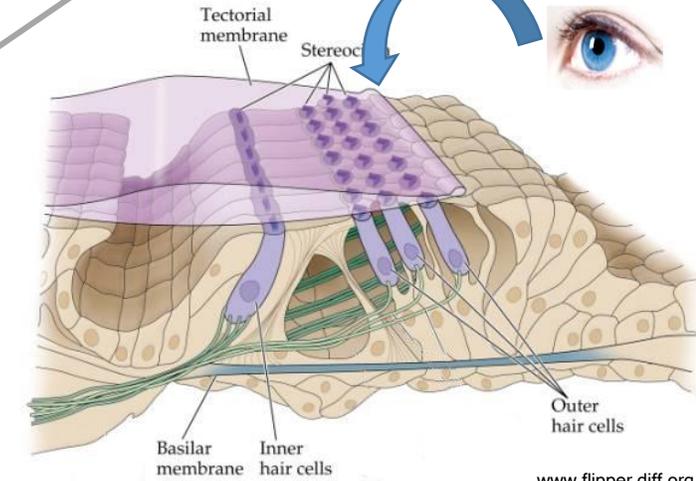
Inner Hair Cell →

Outer Hair Cell 1 →

Outer Hair Cell 2 →

Outer Hair Cell 3 →

20 μm

Girdlestone et al., 2018
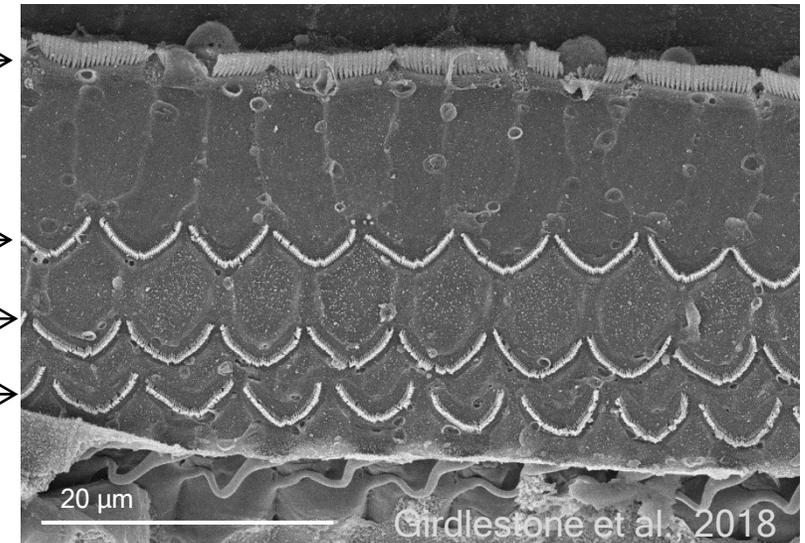
WHY?

- If a lesion is found $\longrightarrow$ frequency range that is impaired $\longrightarrow$ source

LFA

pinger

mid-frequency sonar

shipping

seismic survey
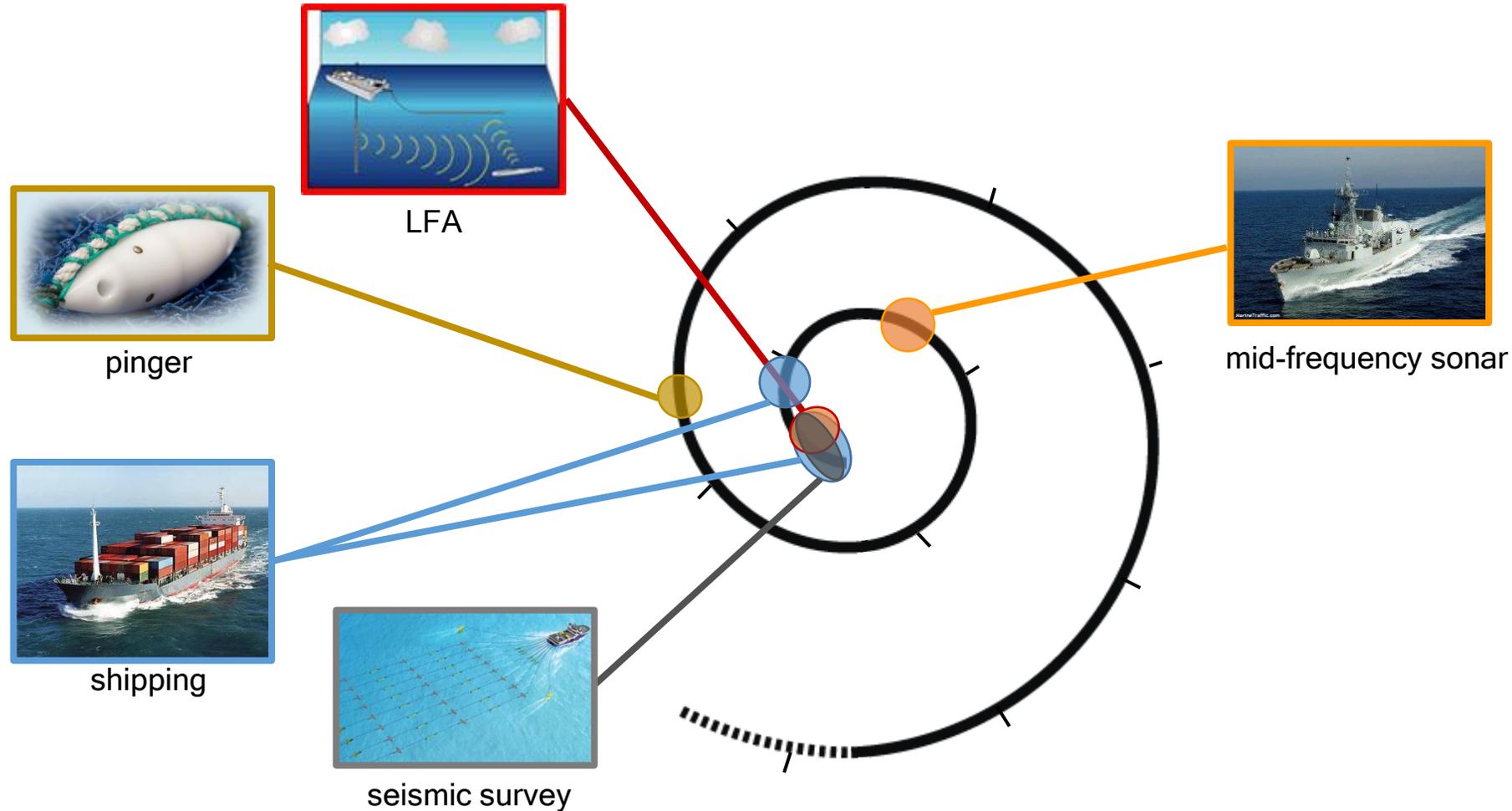
1) Relationship Shape (cells organ of Corti) and Frequency? **YES**

2) Is this relationship comparable among species? **YES with similar hearing range**

(25-111 kHz)
n=7

(0.5-54 kHz)
n=4

+
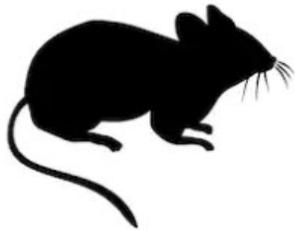
(5-68 kHz)
n=5

(0.25-30 kHz)
n=7

(0.15-55 kHz)
n=7

Using Machine Learning Techniques to build a Predictive Model

Rel. Morphometrics - Frequency

Use this predictive model with
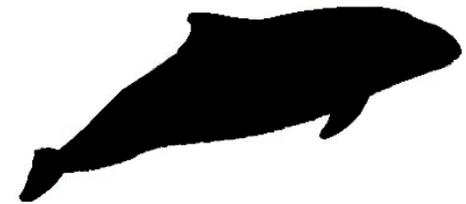
(0.25 - 180 kHz)   n=5 + 6

Objective: **predict the cochlear frequency map for harbour porpoise** based on morphometric characteristics of the organ of Corti.

1) **Include more inner ears of terrestrial mammals** to make the predictive model stronger.

2) **More detailed information from the most apical region of the cochlea of harbour porpoise**

3) **Validate the predictions with individuals whose audiograms have been measured**

possible to extrapolate the same predictive model to establish cochlear frequency maps (and hearing ranges) for species whose hearing capabilities been not yet been measured

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Geometric Morphometrics: Landmarks

10 locations of the cochlea
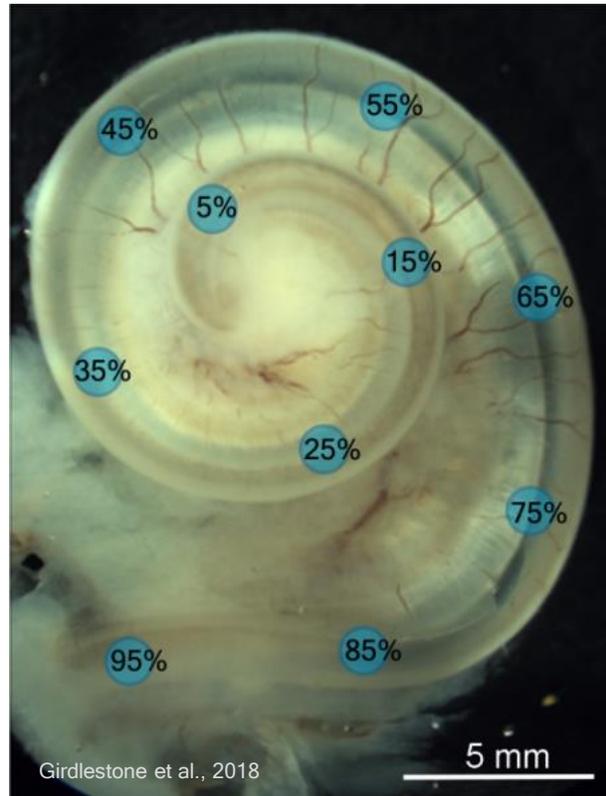
Apex

Middle

Base



At least 3 replicates per location
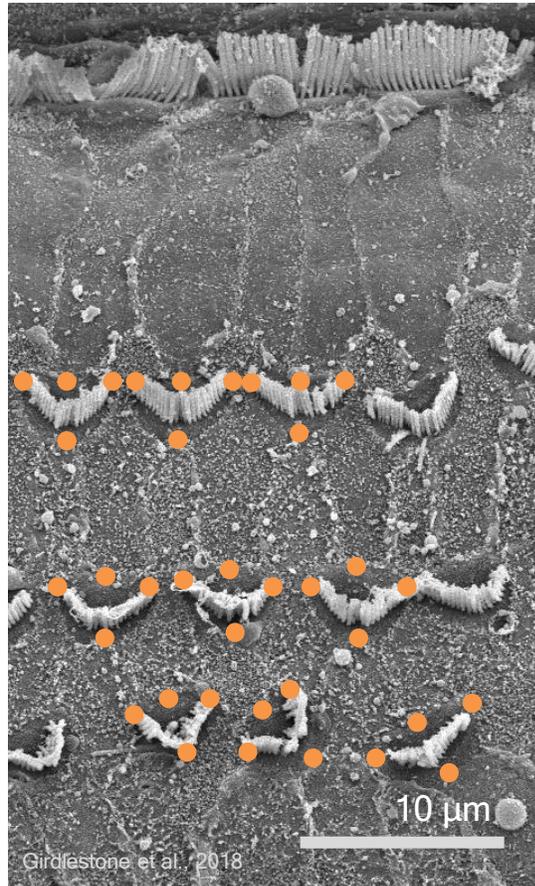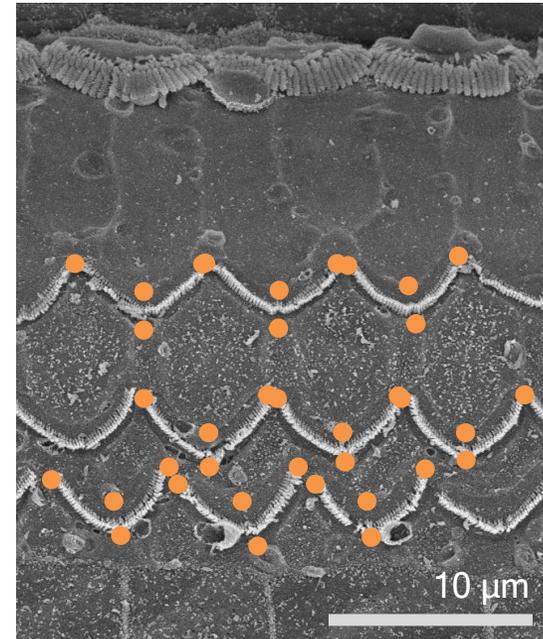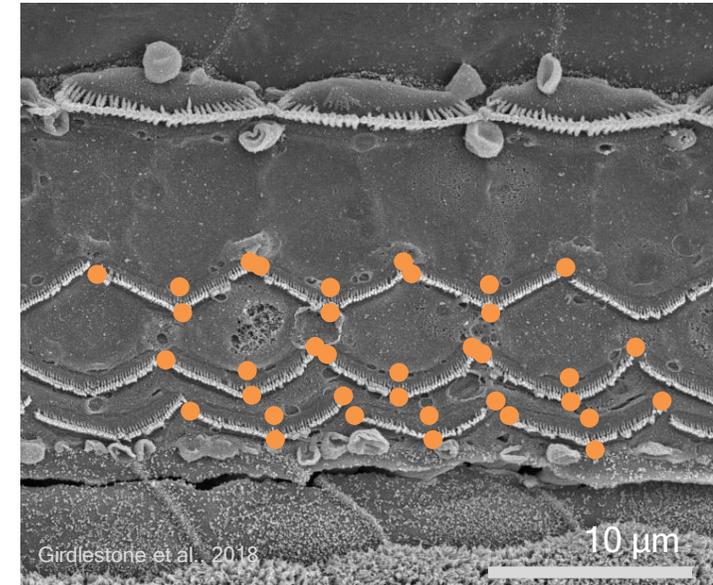
1) Include more inner ears of terrestrial mammals

✓ 7 guinea pigs (currently integrating the data into the predictive model)

2) Have more detailed information from the apex of the cochlea of harbour porpoise

✓ 11 harbour porpoises (already integrated in the prediction)

3) Validate the predictions with individuals whose audiograms have been measured

Currently working on that

Audiogram from Pp02
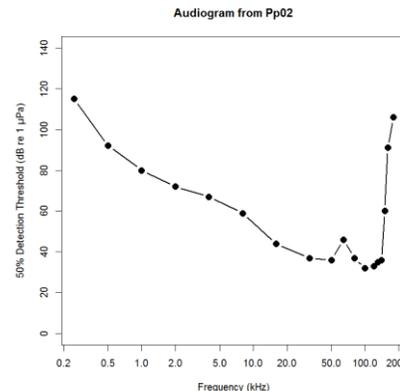
Kastelein *et al.*, 2010

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