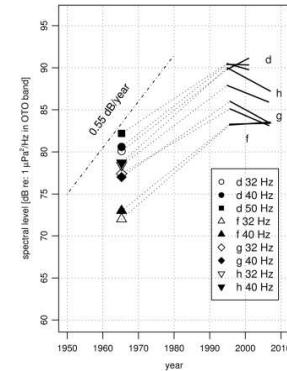


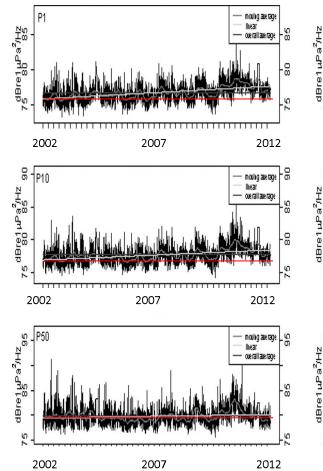
運輸・交通・漁業・鉱物探査・エネルギー開発



徐々に増加する海中の背景音レベル



650 J. Acoust. Soc. Am., Vol. 129, No. 2, February 2011
Andrew et al. 2011
North American West Coast



1. 海の騒音問題

水中音はなぜ問題か？

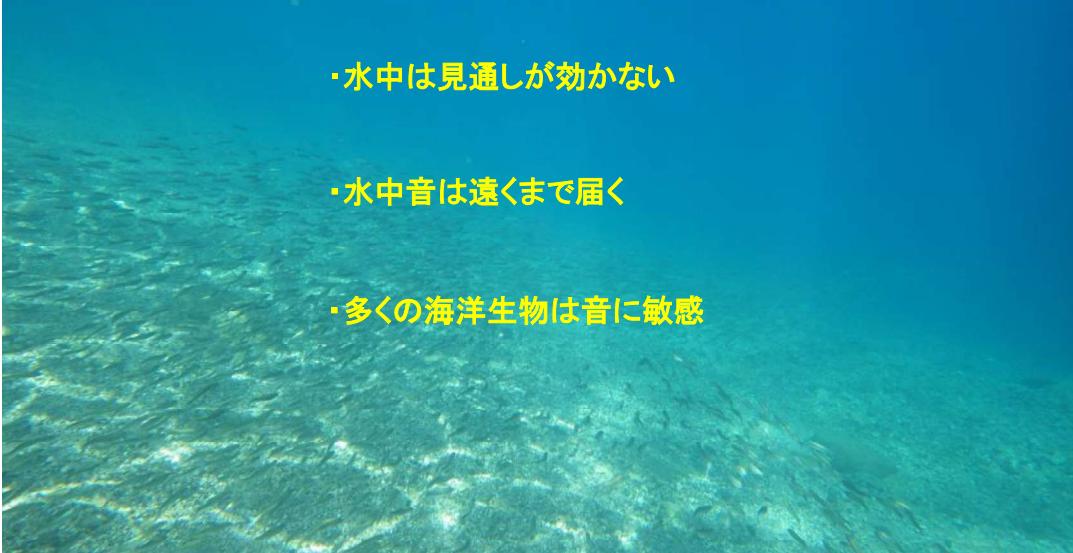


箱根山から富士山は見えますが、、、

1. 海の騒音問題

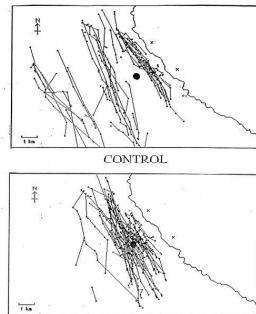
水中音はなぜ問題か？

- ・水中は見通しが効かない
- ・水中音は遠くまで届く
- ・多くの海洋生物は音に敏感



1. 海の騒音問題

水中音の影響：行動、聴覚感度

(Quick Look report LFA phase II playbacks to migrating gray whales)
PLAYBACK

(Nachtigall et al. 2003)

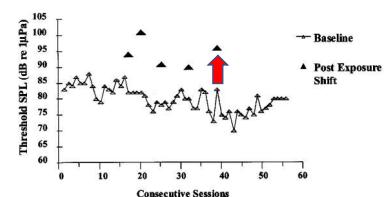


FIG. 5. Baseline threshold measures and postexposure temporary threshold shifts.

コククジラ

ハンドウイルカ

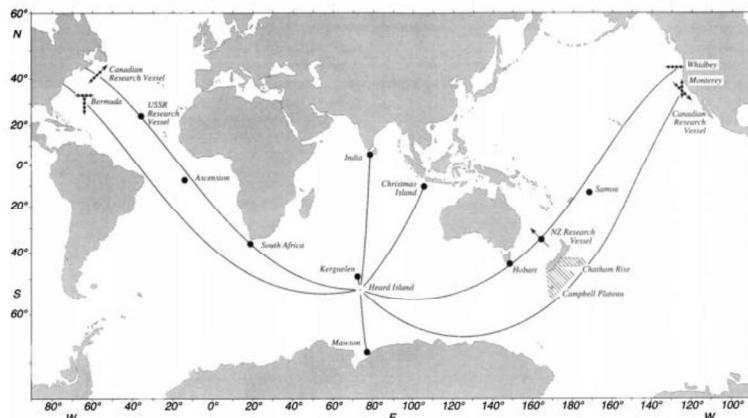
1. 海の騒音問題

水中音は遠くまで届く

The Heard Island Feasibility Test

Walter H. Munk
Scripps Institution of Oceanography, University of California San Diego La Jolla, California 92093Robert C. Spindel
Applied Physics Laboratory, University of WashingtonArthur Baggerer
Departments of Ocean and Electrical Engineering,
Massachusetts 02139Theodore G. Birdsell
Communications and Signal Processing Laboratory,
Michigan 48109-2122

“In January 1991
to establish the limits
of usable, long range
acoustic transmission.”



J. Acoust. Soc. Am. 96 (4), October 1994

1. 海の騒音問題

水中音の影響：聴覚器官への影響

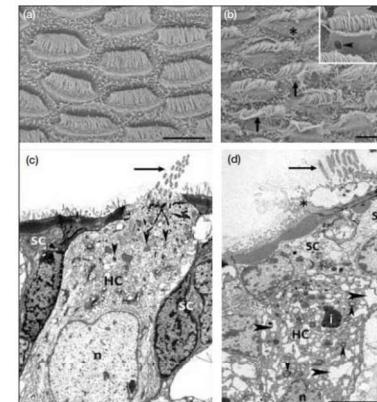


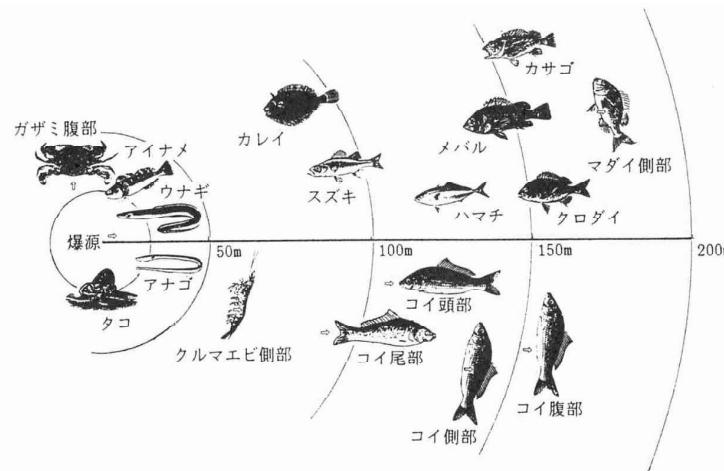
Figure 3. (a, b) Scanning electron microscope and (c, d) transmission electron microscope images of *Sepia officinalis* macula acusticae pores. (a) and (c) Control specimens, not exposed to sound; (b) and (d) sound-exposed individuals. (a) Normal sensory epithelium. At the apical surface of the hair cells, all kinocilia are erect and well-organized into bundles. (b) Immediately after sound exposure, hair cells show bending and disorganized kinocilia. (c) After 48 hours of recovery, hair cells appear partially polarized. Note the normally extruded hair cell, 48 hours after exposure. Note the injured lateral plasma membrane (arrowhead). (d) Apex of a normal hair cell (HC) is between two supporting cells (SC). The HC shows well-formed kinocilia and healthy cytoskeletal organelles. Arrowheads indicate damaged hair cells. (d) Apex of a severely damaged hair cell 48 hours after sound exposure. The top of the hair-cell body, including kinocilia (arrows) and cytoplasmic material (asterisk), is protruding into the stereocilium cavity. Note the numerous vacuoles (arrowheads), damaged mitochondria (small vertical arrowheads), and a dark inclusion (i) in the portion of hair cells that remains in the epithelium. (n) indicates the cell nucleus. Scale bars: (a, b) 10 μ m; (c, d) 0.5 μ m.

André, Michel, et al. "Low - frequency sounds induce acoustic trauma in cephalopods." *Frontiers in Ecology and the Environment* 9.9 (2011): 489-493.

コウイカ

Sepia officinalis (photo: Wikipedia)

水中音の影響：衝撃による死亡



海中騒音問題は、国際的に注目



国連海洋法決議で水中音に言及



2014年に船舶騒音の非強制ガイドラインを探査、2020年にMEPC 75(延期)への新規議題提案見込み

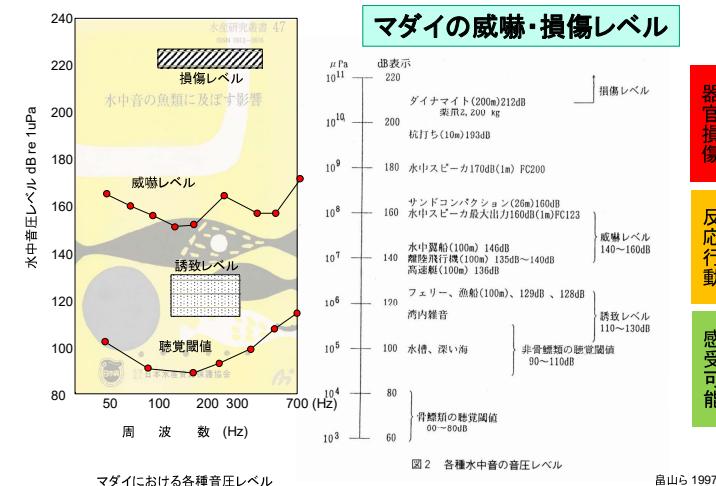


水中騒音の評価やガイドライン要求を盛り込んだ決議探査

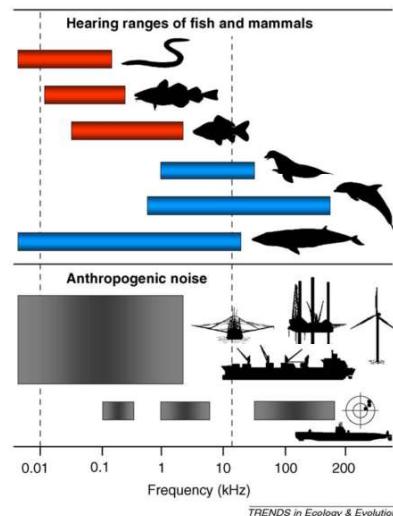
船舶騒音の把握(AQUO)
水中騒音低減方策(SONIC)

2. 生物への影響評価

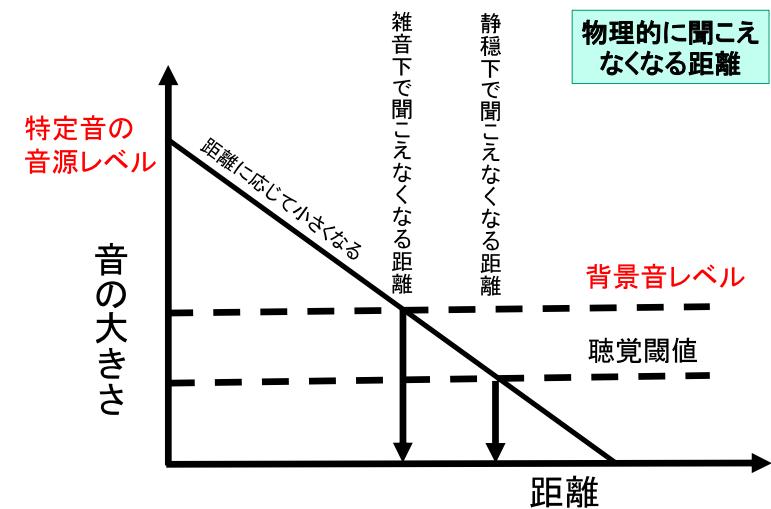
水中音の影響：マダイの例



聞こえる周波数はさまざま

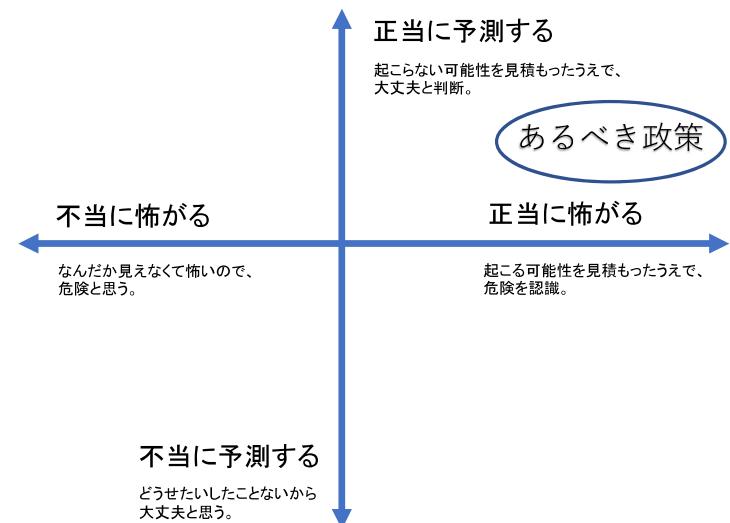


安全距離



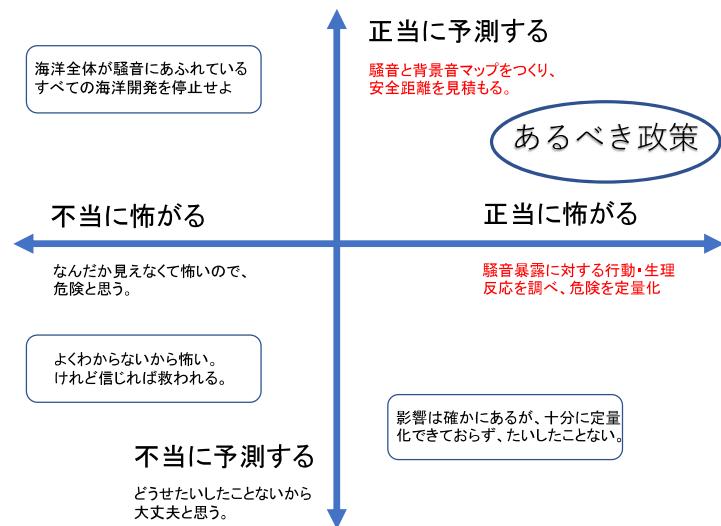
3. 政策提言の道筋

データを基にして妥協点を探る



データを基にして妥協点を探る

海中騒音対策に必要な作業



1. 騒音暴露レベルに対する、行動、生理反応の定量化。とくに水産有用種について。
2. 現状の騒音マップと騒音源の可視化※
3. 騒音影響による生態系サービスの増減量見積もる
4. 騒音対策による社会的コストとベネフィットを見積もる
5. 効果を最大化する社会変革の許容レベルを提言

※海洋音響学会の研究部会で計測法のガイドを検討中です。