



SHARK SENSORY CAPABILITIES



Sensory Systems

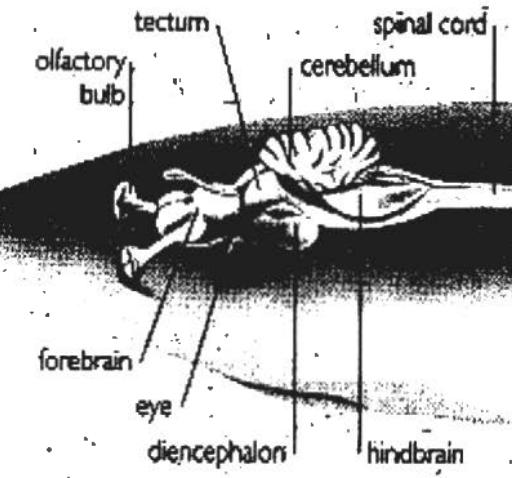
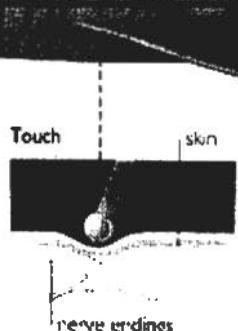
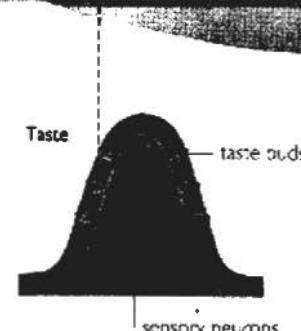
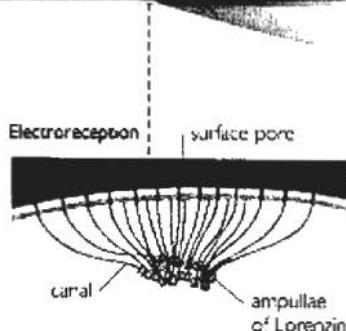
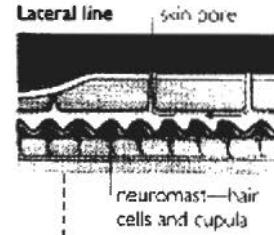
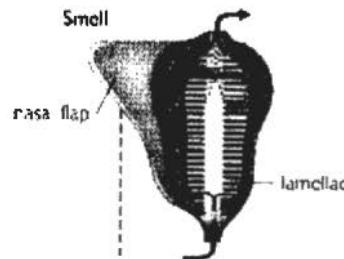
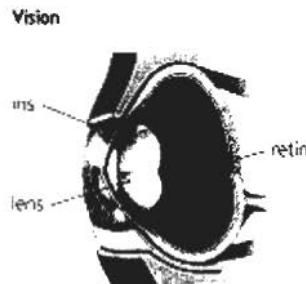


Six senses of humans

Hearing, Balance, Vision, Smell, Taste & Touch

AND

Mechanosensory lateral line and Electroreceptors

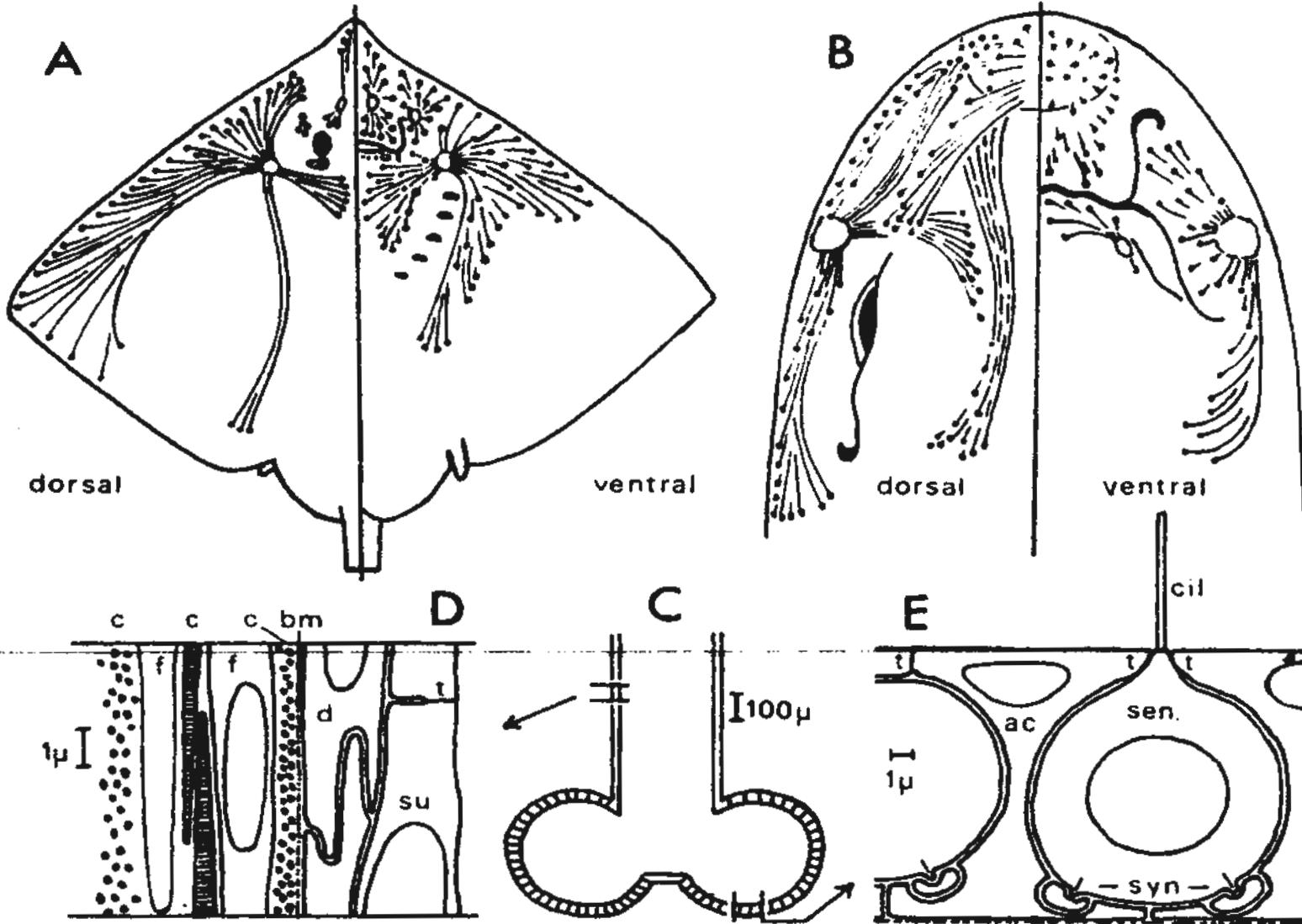


Many species have a brain that is larger in size than that of some birds and mammals.

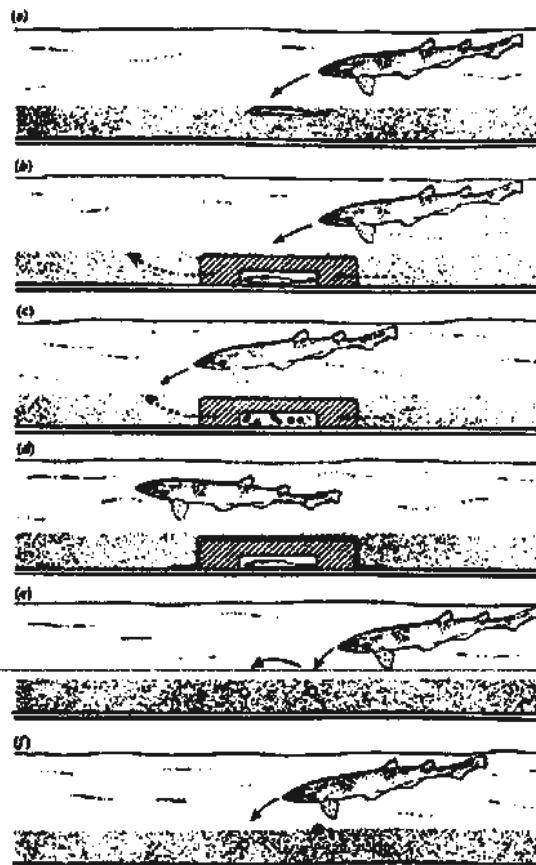
Sharks and rays have exquisite sensory systems and a large brain for processing biologically relevant information.



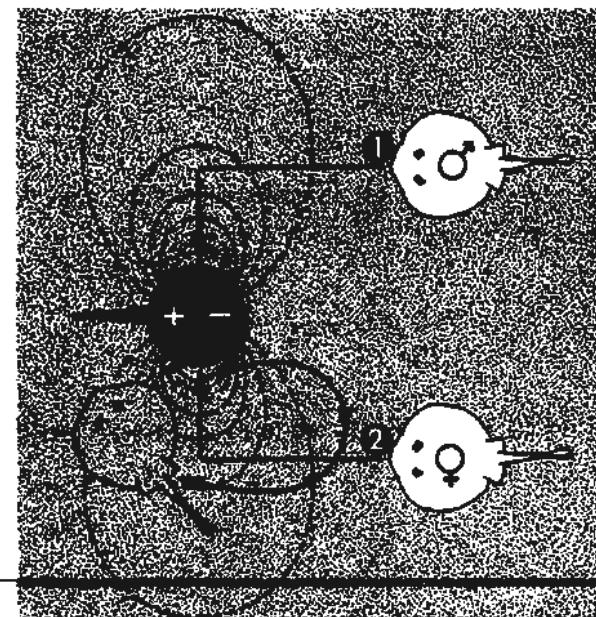
AD



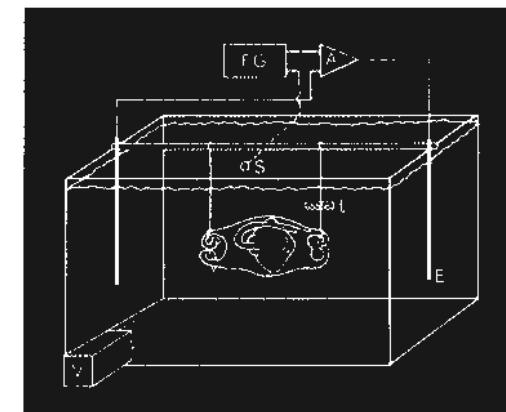
Prey



Mates



Predators



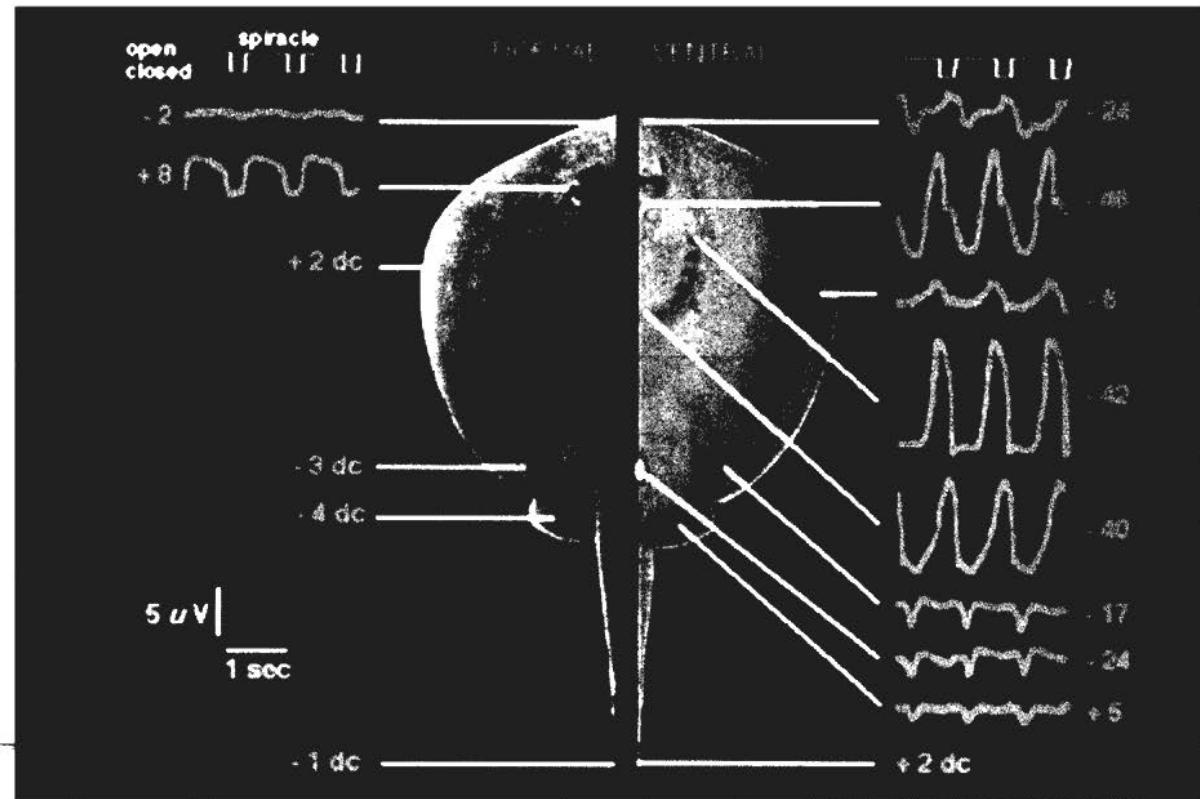
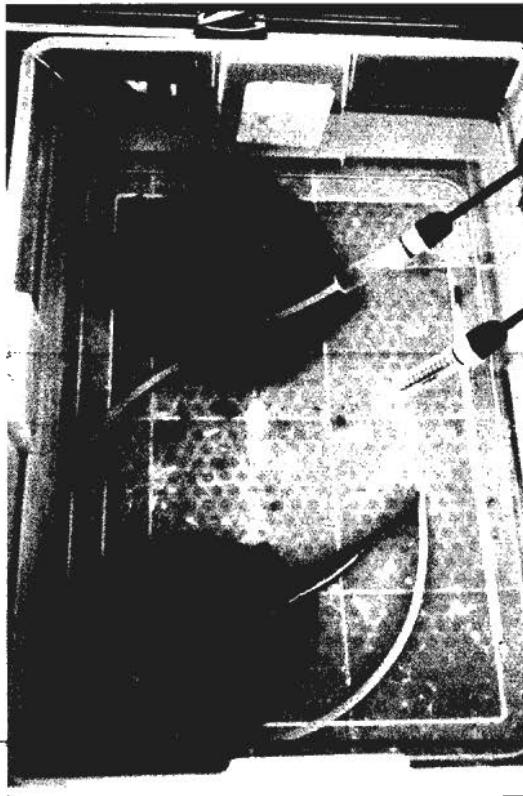
Kalmijn 1972

Tricas et al. 1995

Sisneros et al. 1998



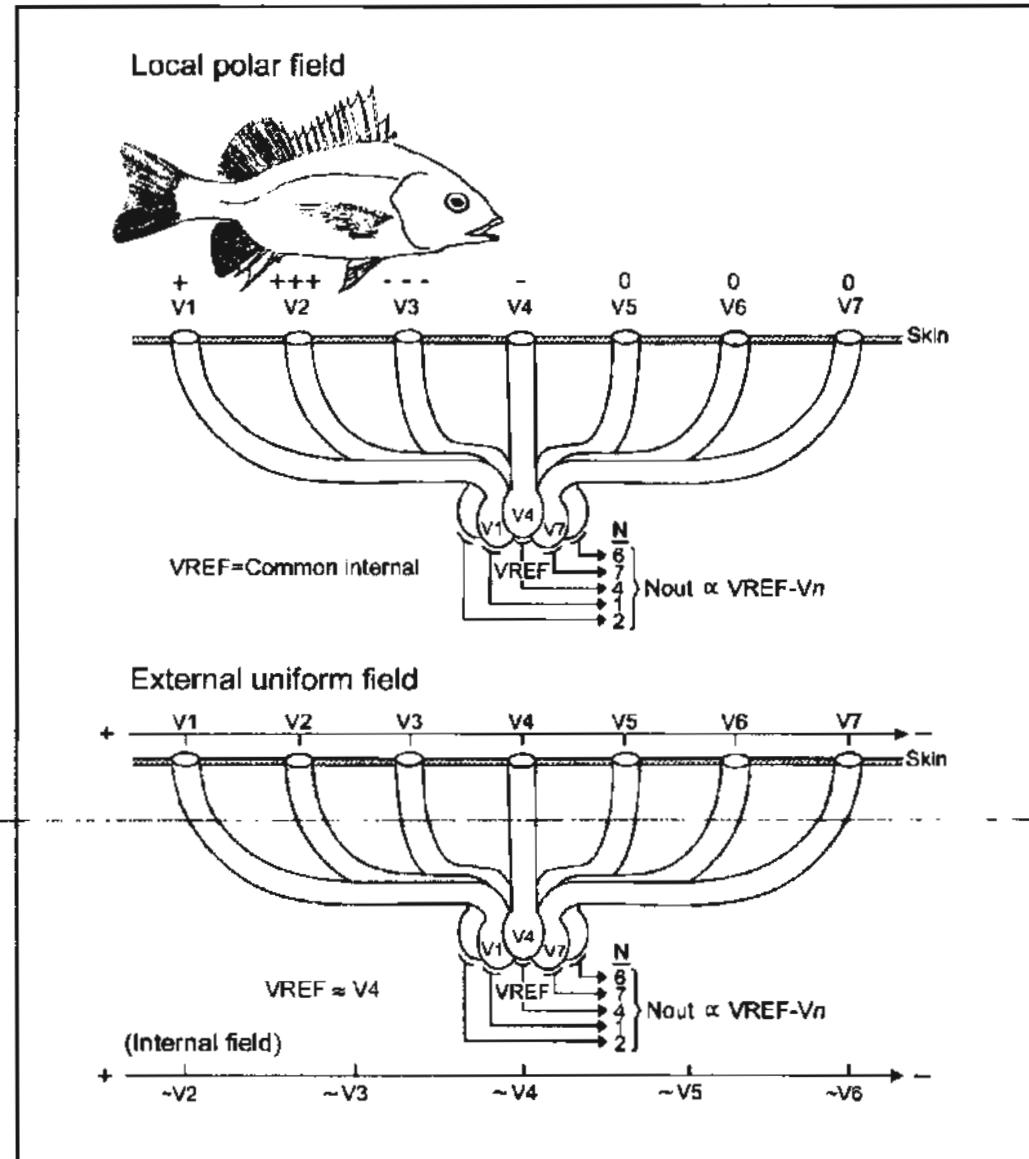
Bio Electric Sensing Present and Can be Exploited for all Elastobranch Marine Species (Sharks/Rays/Skates)



Bioelectric fields have been measured in related elastobranch species (Rays & Skates) and have been shown to have been used for sensory cueing and localization.

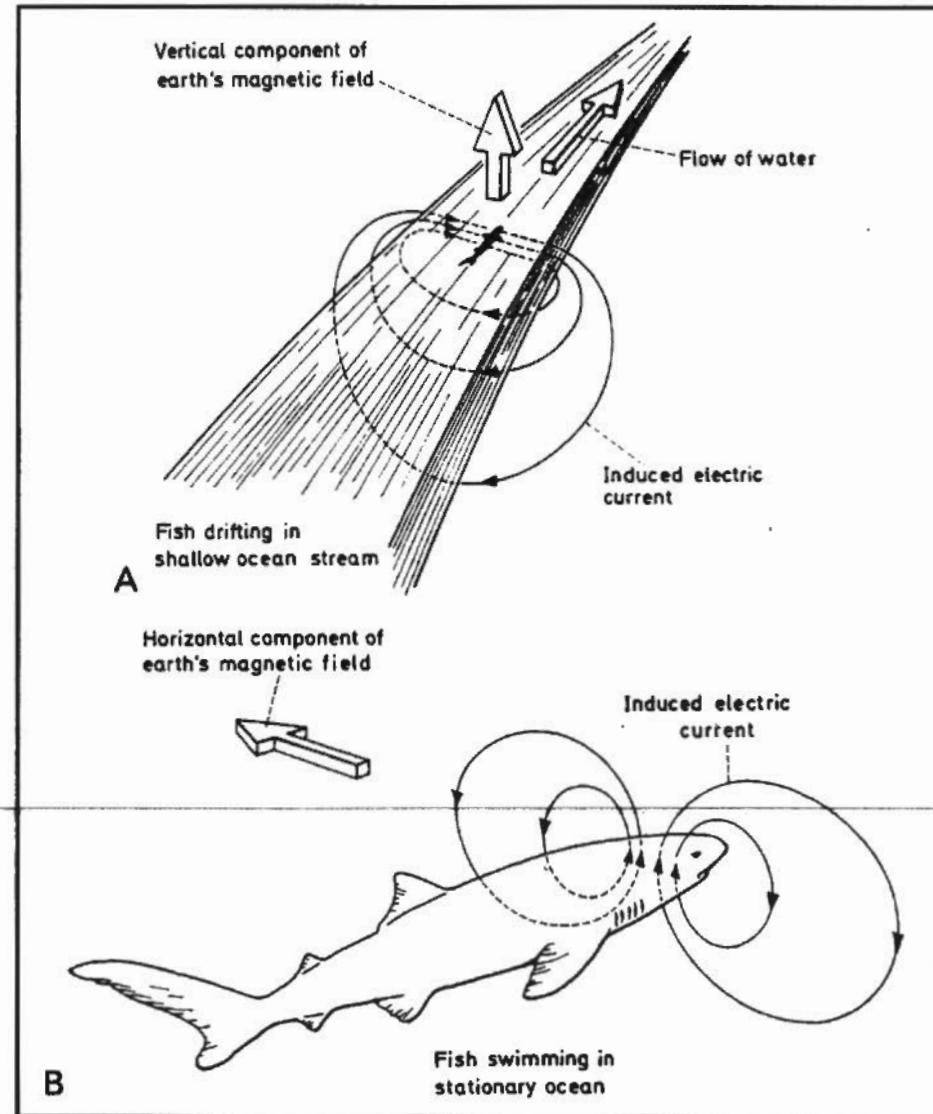
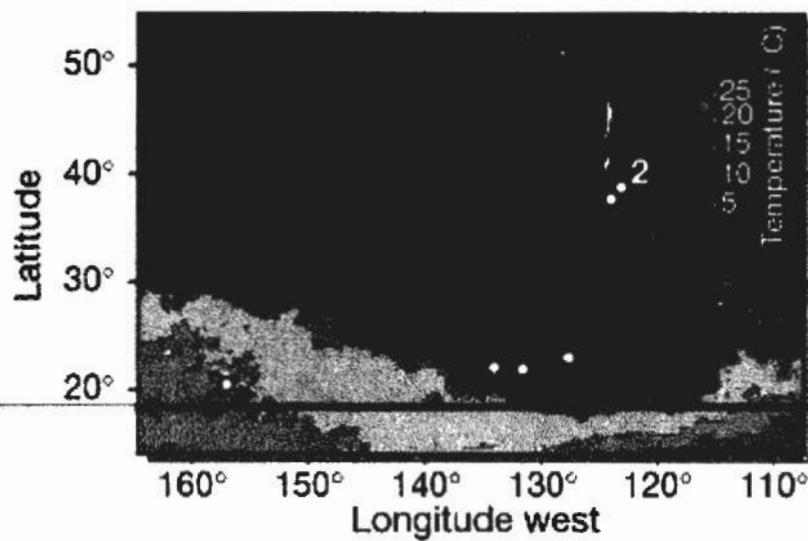


- Detect weak external fields
 - Sharks < 1 to 5 nV/cm
 - Catfish 10 nV/cm
- Dipole or uniform fields
- Sensitivity \propto canal length
- Somatotopically mapped



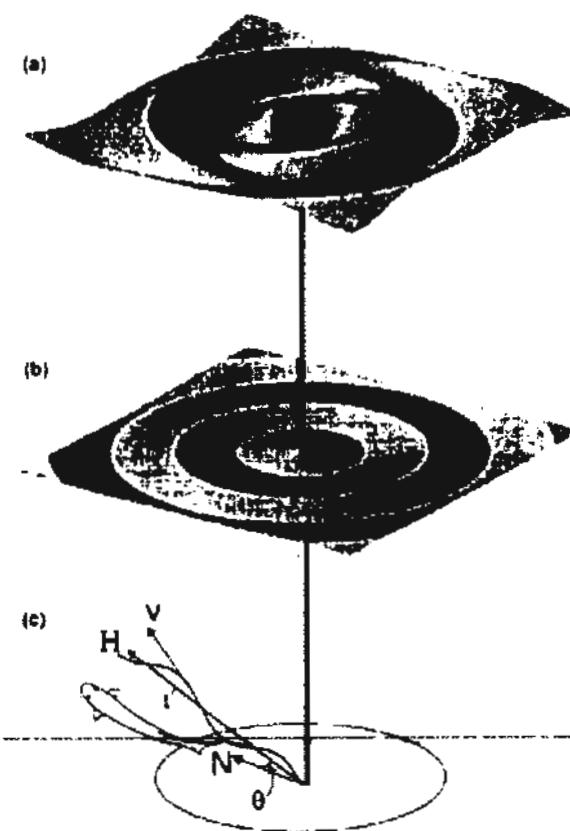
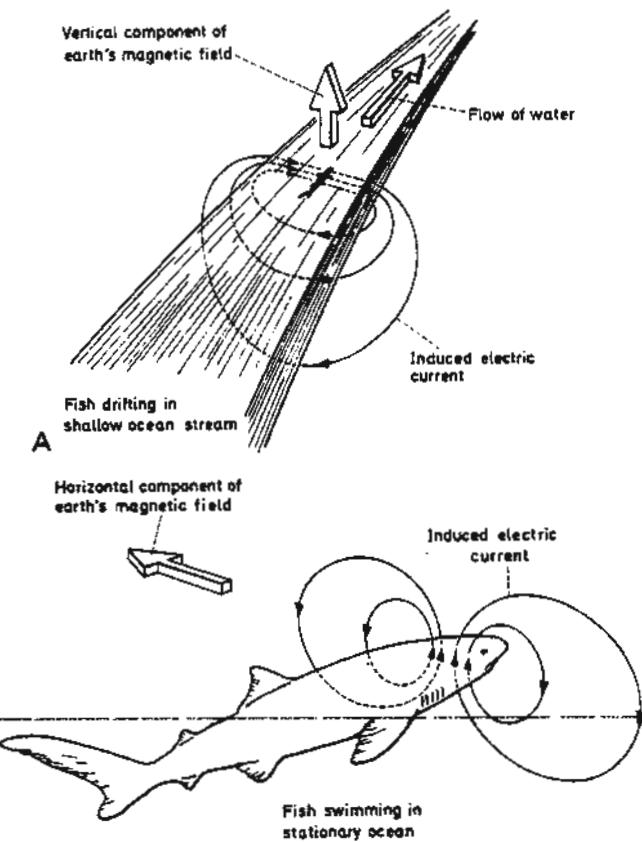


Theories of geomagnetic orientation



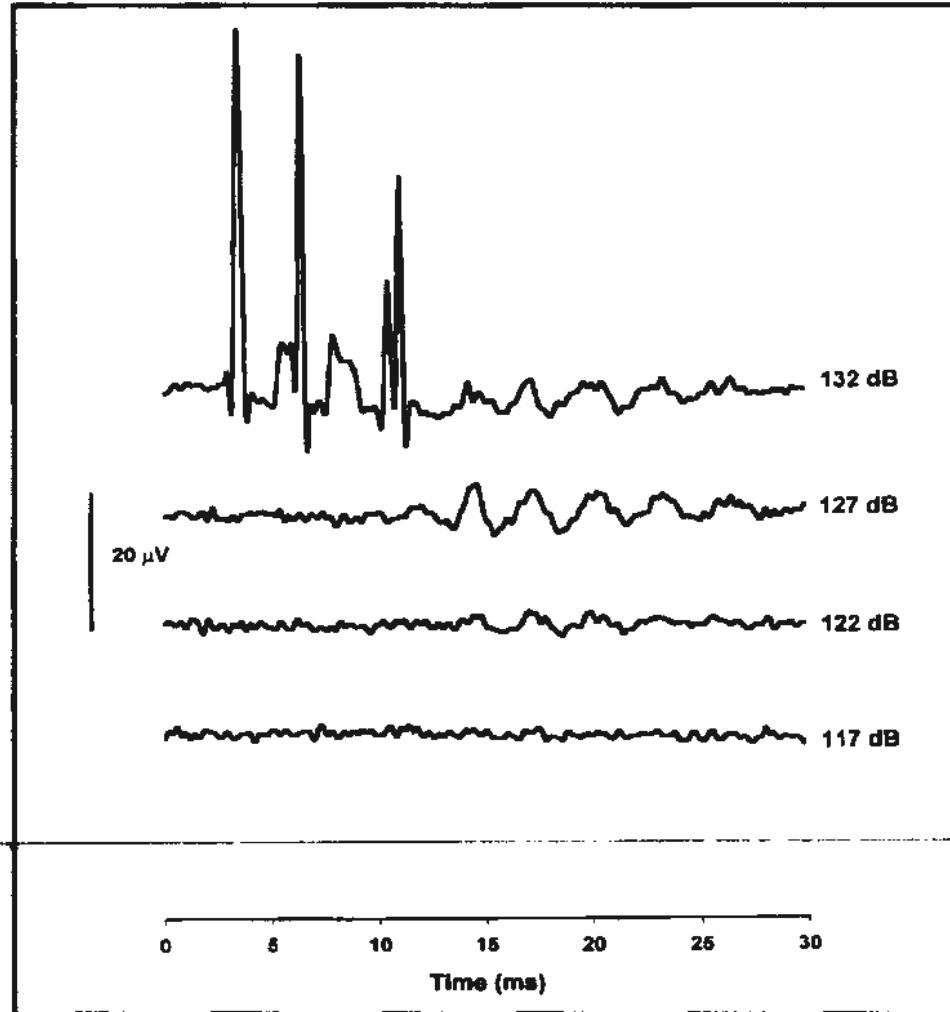
Kalmijn 1974

AD



Kalmijn 1974

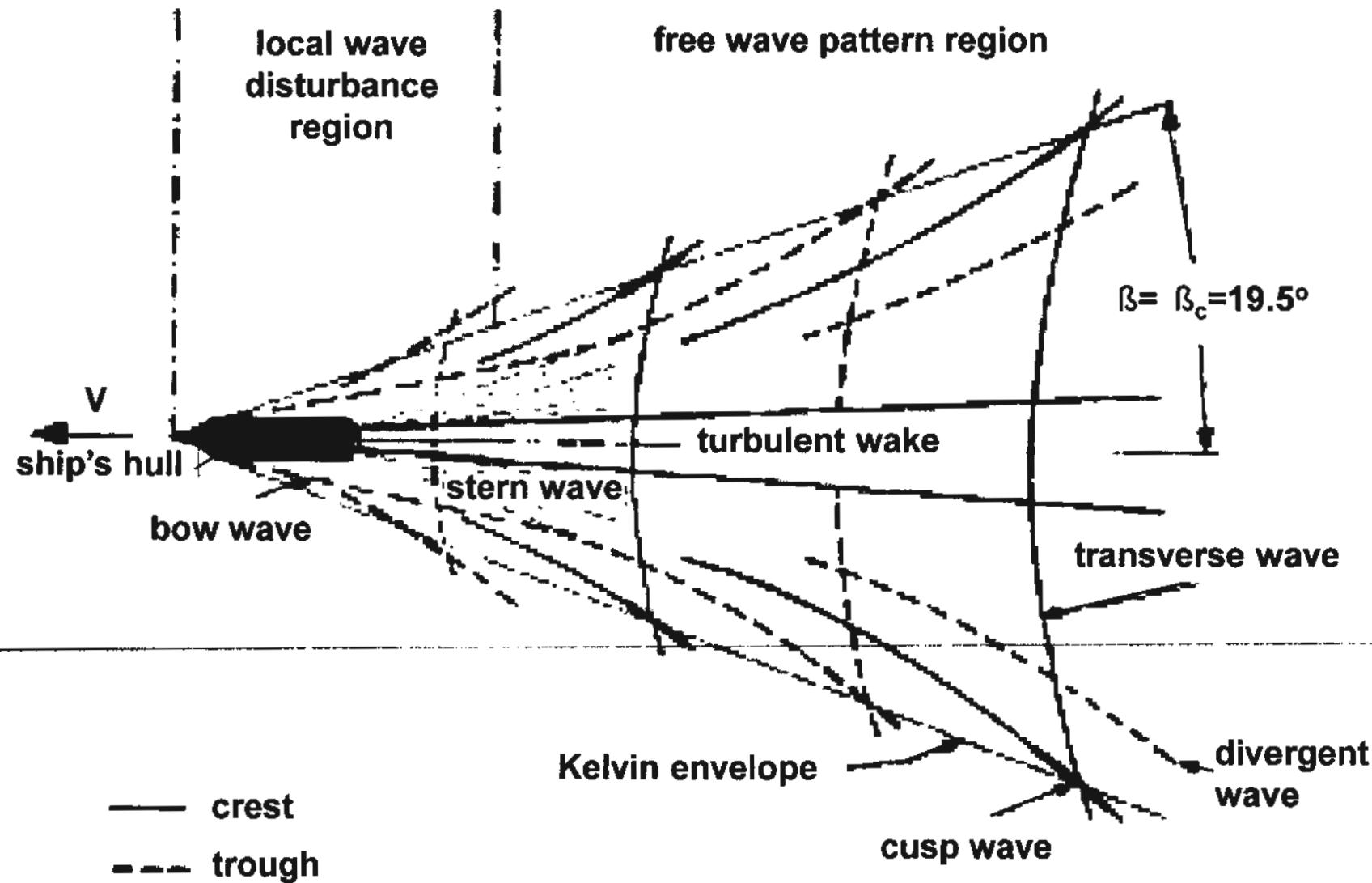
Paulin 1995



ABR is an electrophysiological method that records evoked potentials generated along the auditory pathways in the brainstem of a fish in response to sound stimuli.

Kenyon et al. (1998) established the use of the auditory brainstem response (ABR) method for testing hearing sensitivity in fishes and it has been used to obtain audiograms for a variety of species (Ladich & Yan 1998, Yan 1998, Ladich 1999, Yan & Curtsinger 2000, Yan et al. 2000, Mann et al. 2001, Scholik & Yan 2001).

Example of ABR waveforms obtained from the skate, *R. erinacea* at 200 Hz. As the intensity of the sound stimulus decreases, the voltage output obtained from the auditory nerve decreases until 117 dB re 1 μ Pa where a repeatable ABR signal cannot be obtained. Therefore, 122 dB re 1 μ Pa is the lower hearing threshold. The sharp peaks from 0-13 ms at 132 dB are artifacts due to the suprathreshold intensity of the sound stimulus being played. *from Brandon, Lobel & Yan in press*



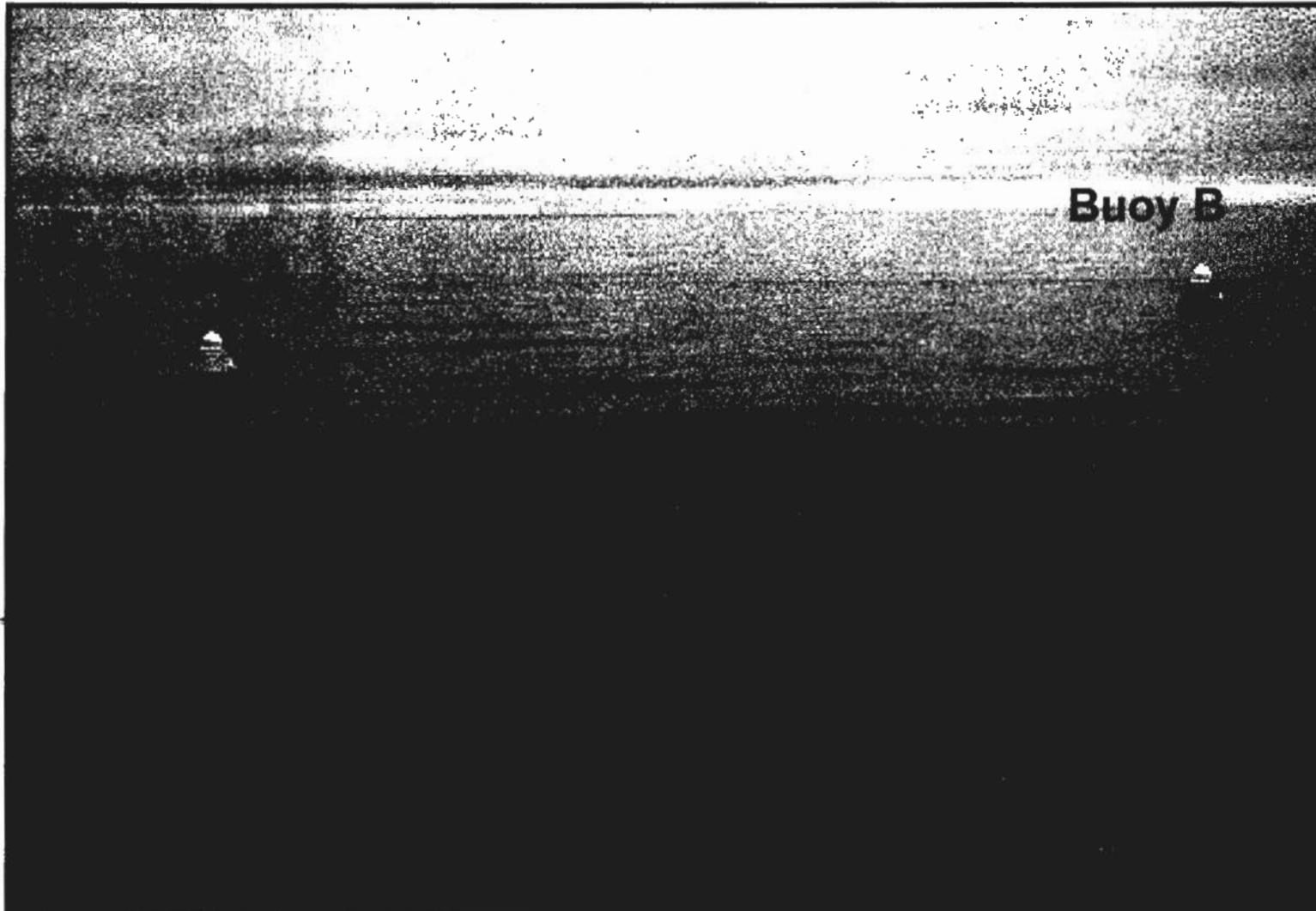




RAFOS Tags



Sharks provide: TOA_A, TOA_B, Temp, Depth, & Light.





Acoustic Communications (ACM) 1000



High Data Rate Acoustic Communications Download

Micropower acoustic transmitter
may allow 1 Mbit data transfer @
1 Joule IFF a fish can be coaxed
to within 10 m of deployed
reader.

Littoral/small scale example: Johnston Atoll lagoon

