

# Listening to Fish - Passive Acoustic Applications to Fisheries

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Applications, Inc.

**Frances Juanes,**  
UMass Amherst

And

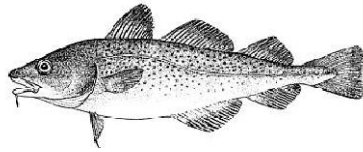
**Cliff Goudey,** Center  
for Fisheries Research  
Engineering, MIT



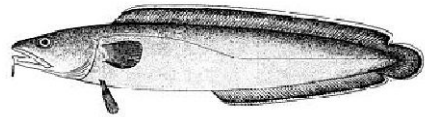
5 June 2006

**Rodney Rountree**

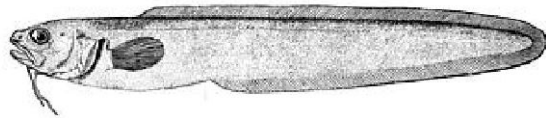
# Presentation Outline



**Introduction - Joe Blue**



**Six Projects**



**Technology Development**

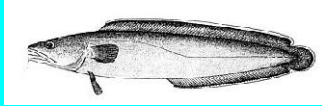
# Joe Blue (April 2001)



5 June 2006

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# Project 1: Stellwagen Bank National Marine Sanctuary



Francis Juanes, Rodney Rountree and Joe Blue pioneered the use of ROVs and the ISIS underwater camera system for the *in situ* study of soniferous gadids.

**First recording of cusk sounds**

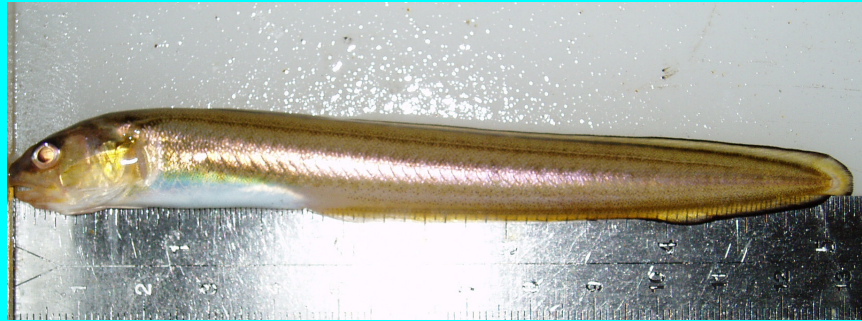


**Gadidae** Cusk (*Brosme brosme*)

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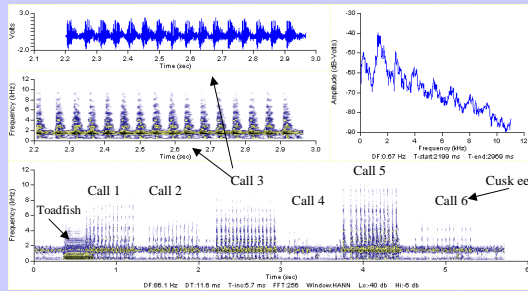
**Rodney Rountree**

# Project 2: Cusk-eels on Cape Cod

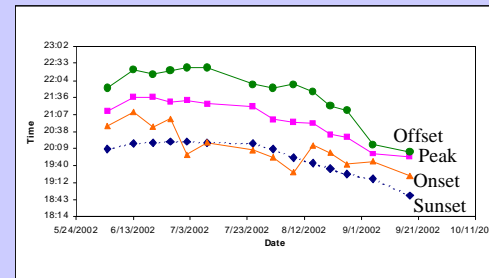


## Reproductive Ecology

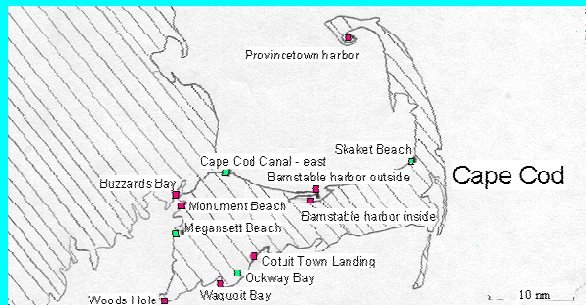
Cusk-eel calls



Seasonal pattern of chorus time

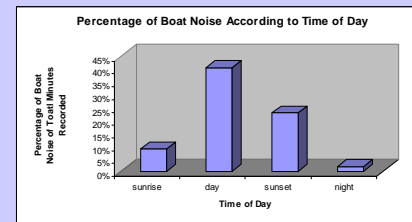


## Range extension



## Noise Pollution

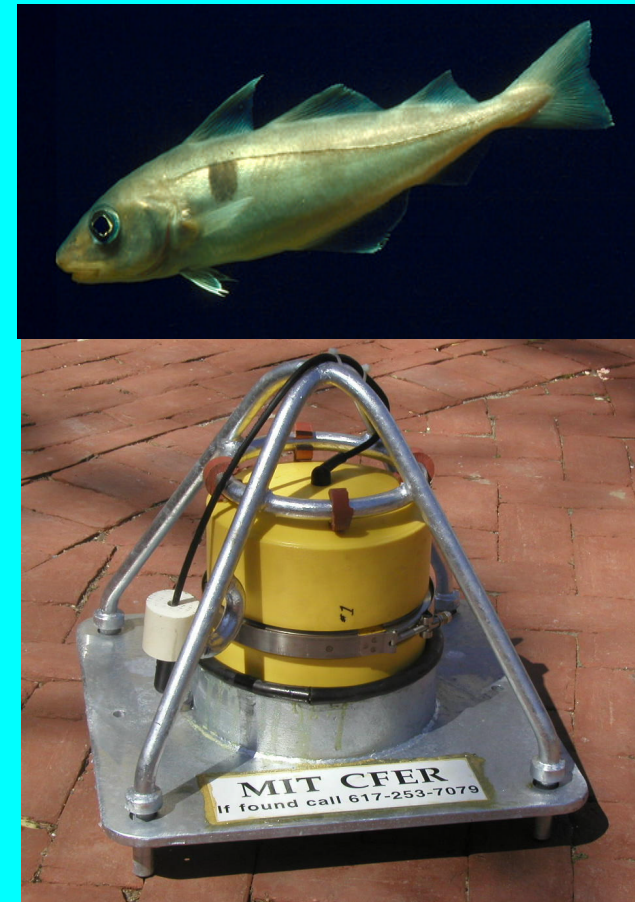
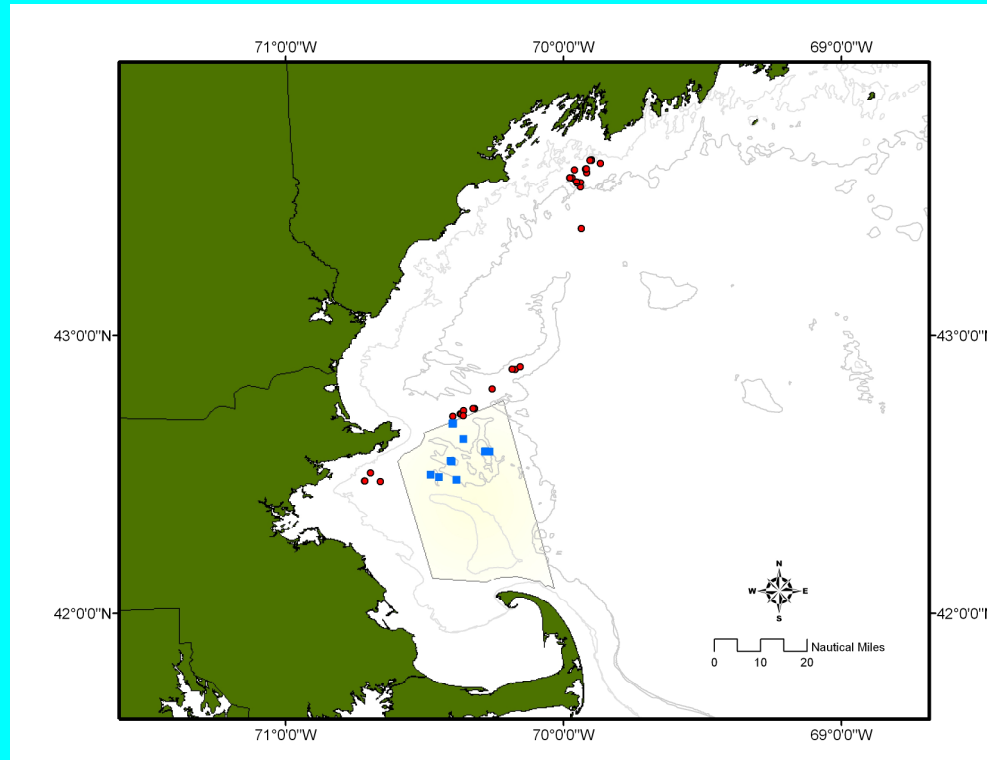
Prevalence of boat noise by time of day



# Project 3: Haddock Spawning Habitat



**Successfully developed inexpensive and robust AULS that fishermen deploy in GOM**



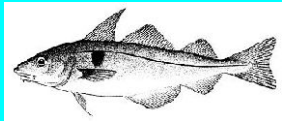
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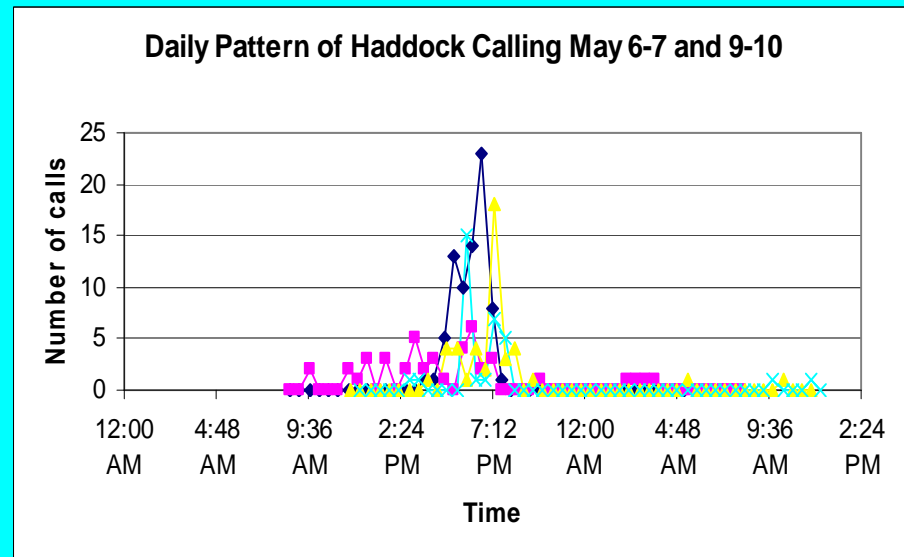
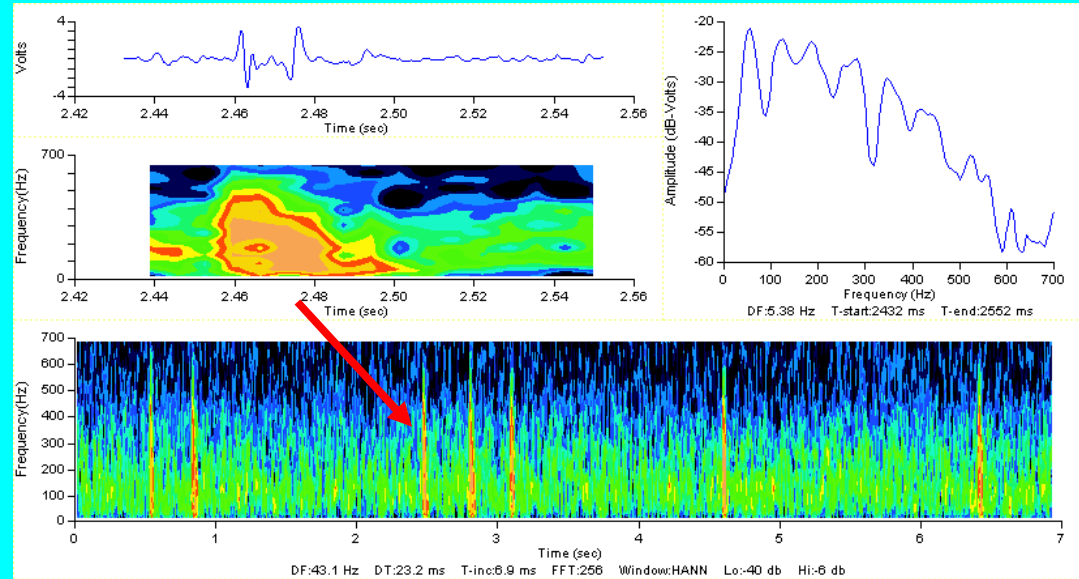
# Project 3 continued



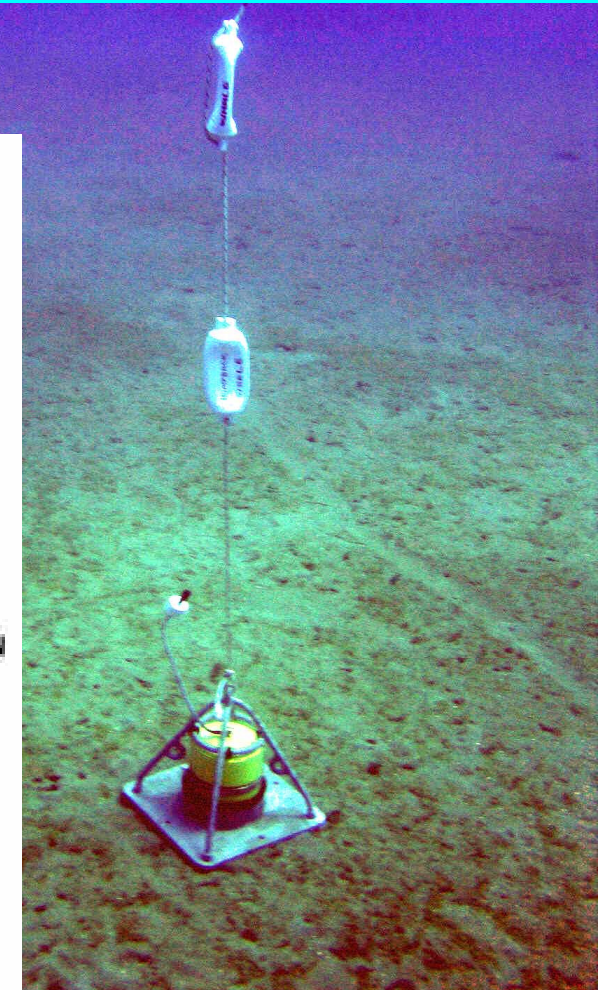
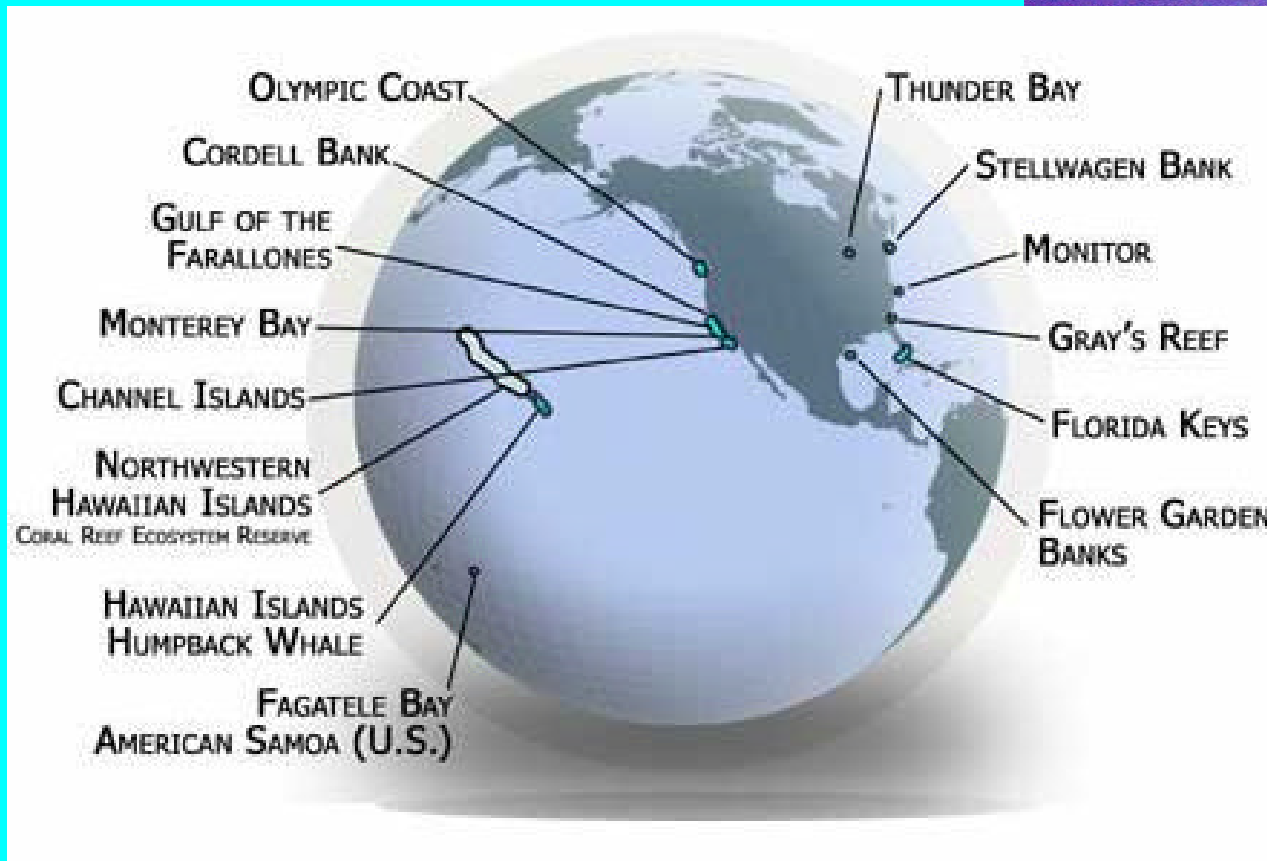
**First *in situ* recordings of haddock in North American waters**



**First *in situ* recording of daily vocal and presumed spawning activity**



# Project 4: Sanctuary Sounds Project (with Cathy Sakas, National Marine Sanctuaries Program)



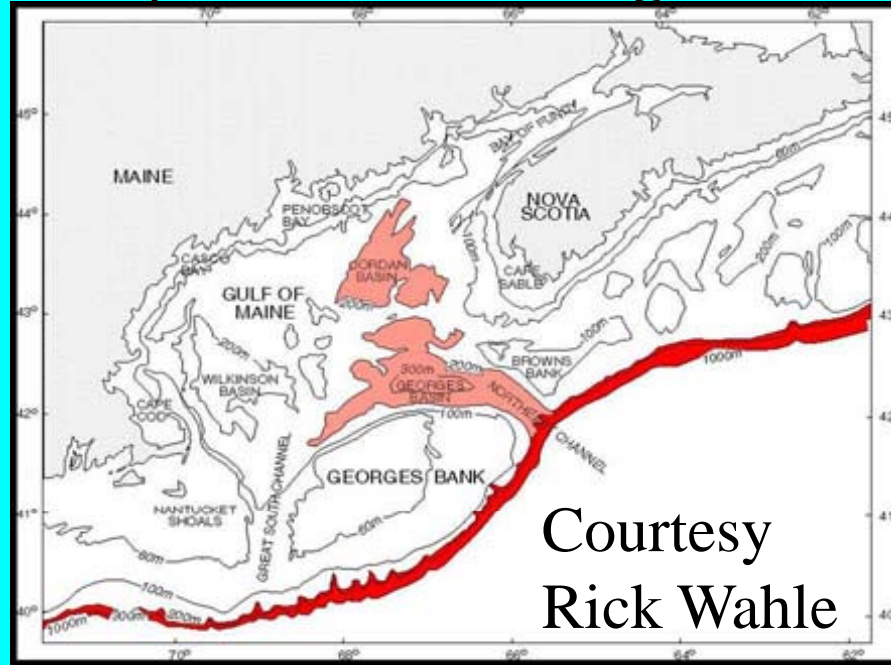
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# Project 4: Deep water exploration

Map of red crab fishing areas



Developed deep water AULS  
For use with cooperative  
Fishermen.  
Can be deployed to >1000 m

Courtesy  
Rick Wahle

Currently working with  
Red crab fishermen in a  
Pilot project funded by  
MIT Sea Grant



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# Recent deployment in 800 m in the northeast portion of Oceanographer Canyon



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# **Project 4: Soniferous fishes of Hudson River**

**(Katie Anderson, Undergraduate Study)**

**The River Project, New York City**



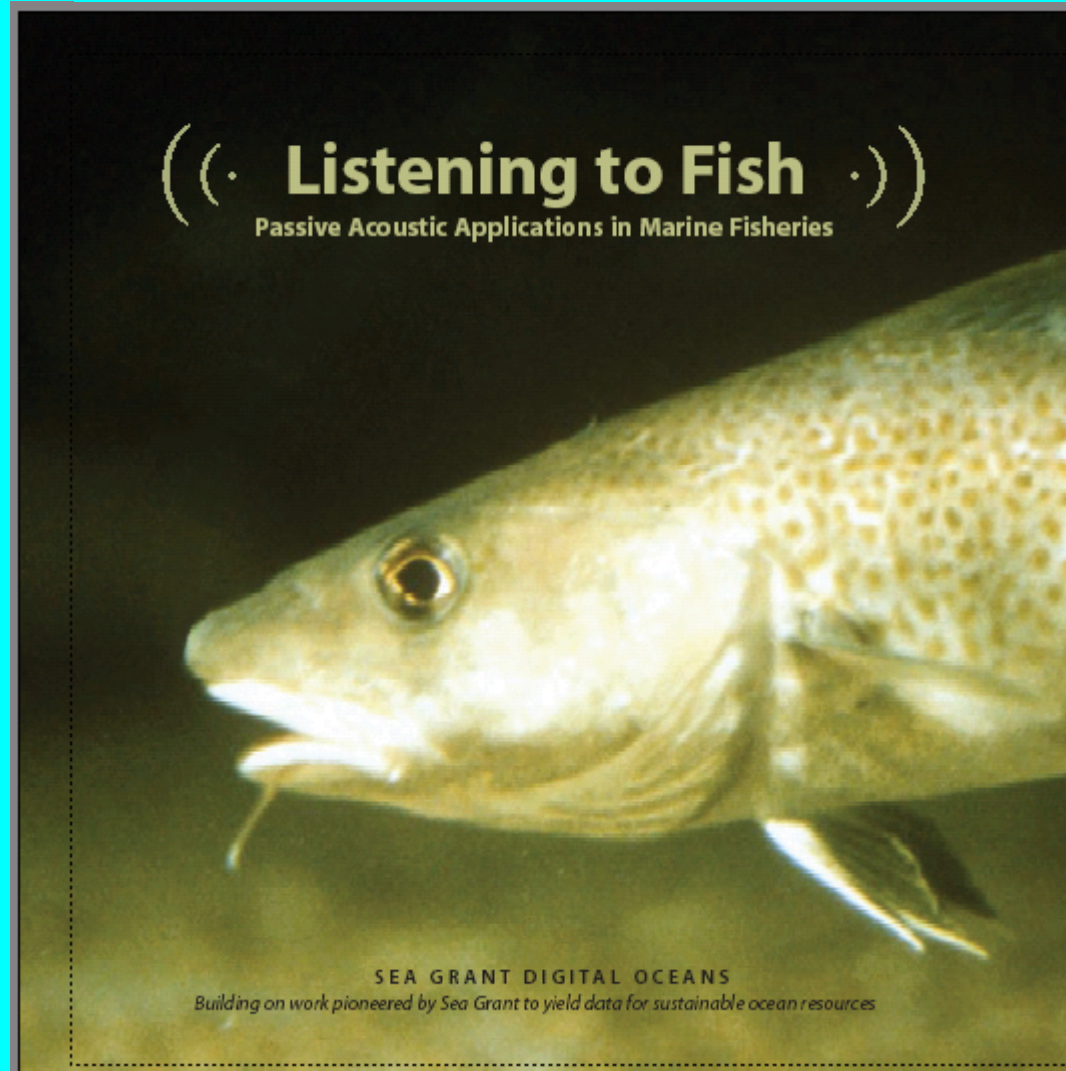
**Tivoli Bay NERR site, Annandale NY**



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# Technology Development: International Workshop



Organized by Rountree,  
Goudey, and Hawkins  
April 2002

Over 40 scientists from  
North America and  
Europe participated

## Major Sponsors

- MIT Sea Grant College Program
- Office of Naval Research
- NE-GL Center of the National Undersea Research Program

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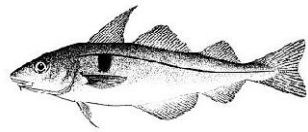
**Rodney Rountree**

# Technogenesis

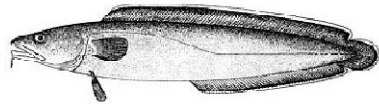
“The educational frontier where students, faculty and industry jointly nurture new technologies from concept to commercialization, and back to the classroom.”\*

\*from Stevens Institute of Technology web site

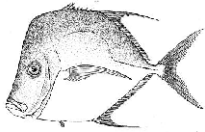
# Technogenesis for Passive acoustic tool development



Autodetection/analysis



Localizing source



Portable arrays



Acoustic/optic systems

# Automatic sound detection AND analysis

Measure: Duration

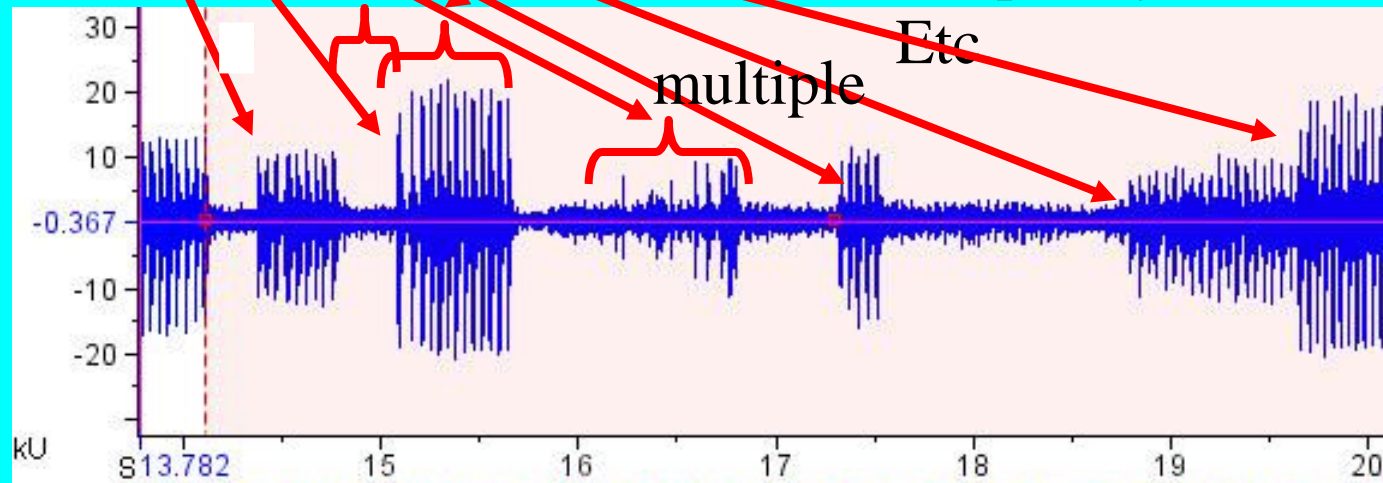
No. pulses

Rep. Rate

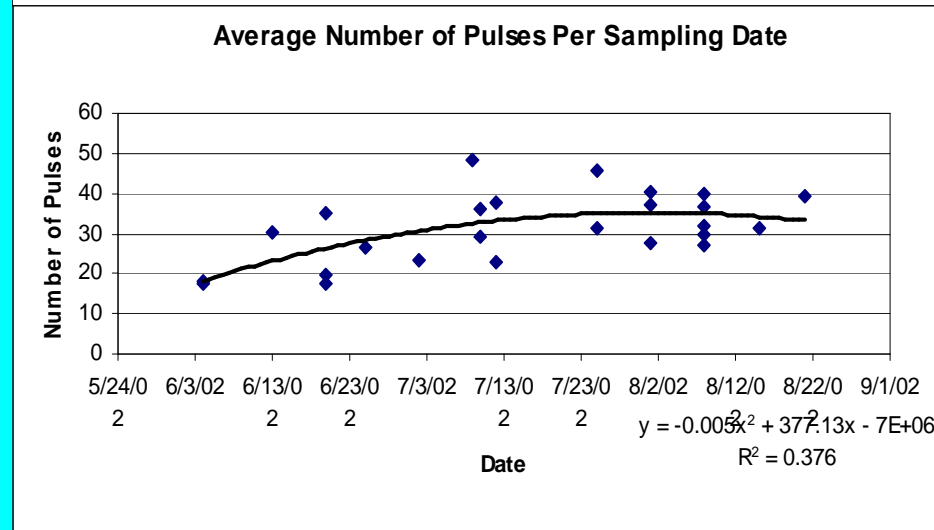
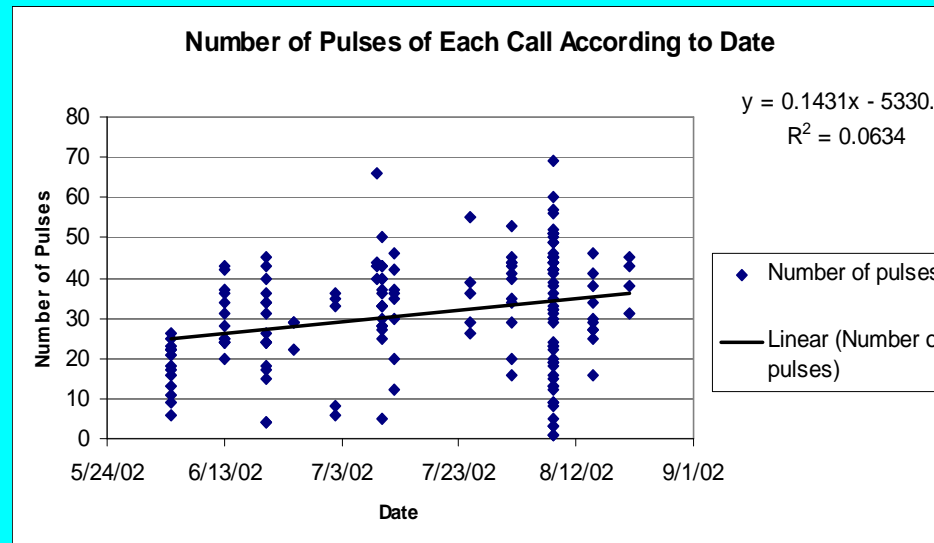
Call interval, time, etc. Pulse width

Frequency

Etc



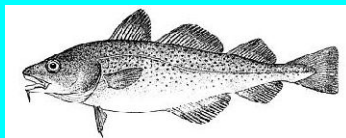
# Create Summary Statistics



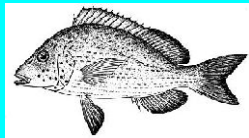


# Portable arrays

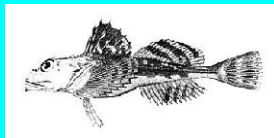
Useful to determine:



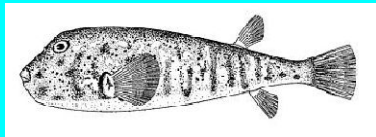
Source location



If single or multiple sources

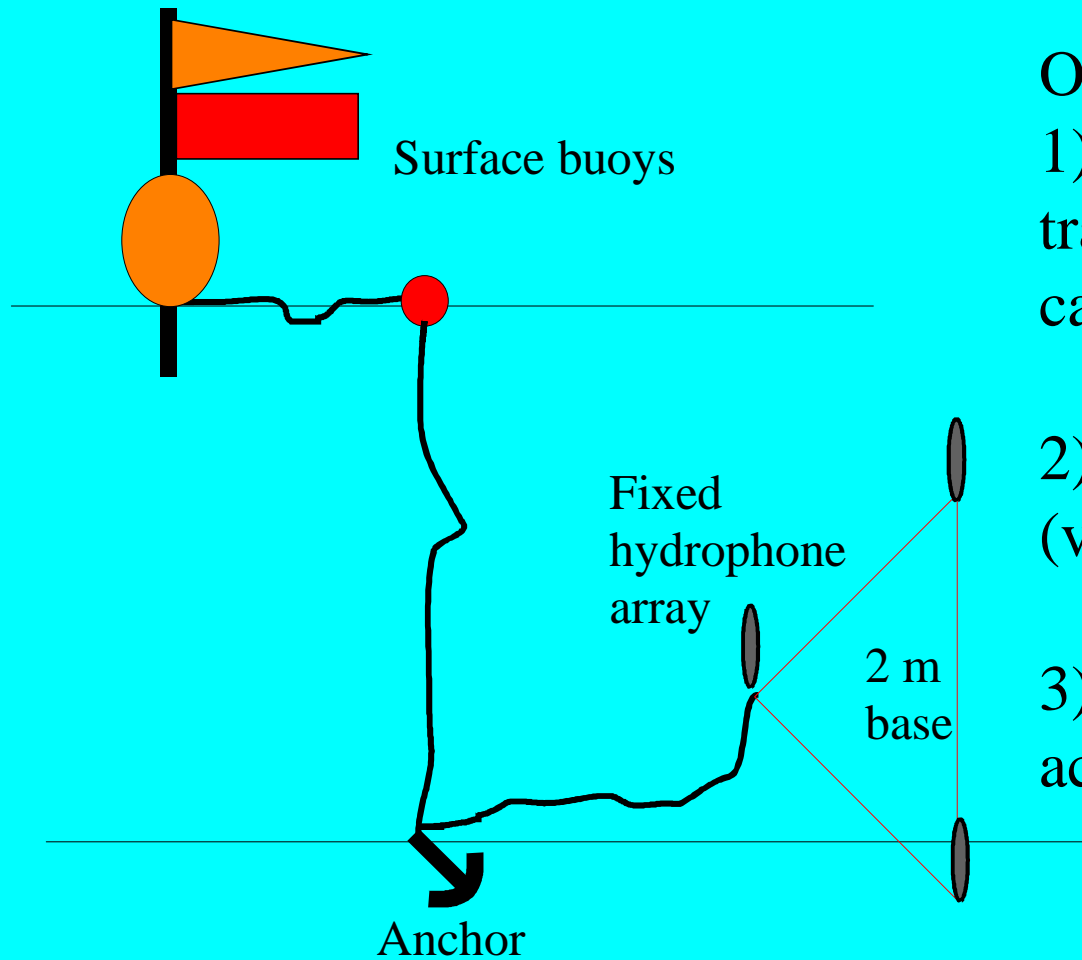


Detection range



Source level

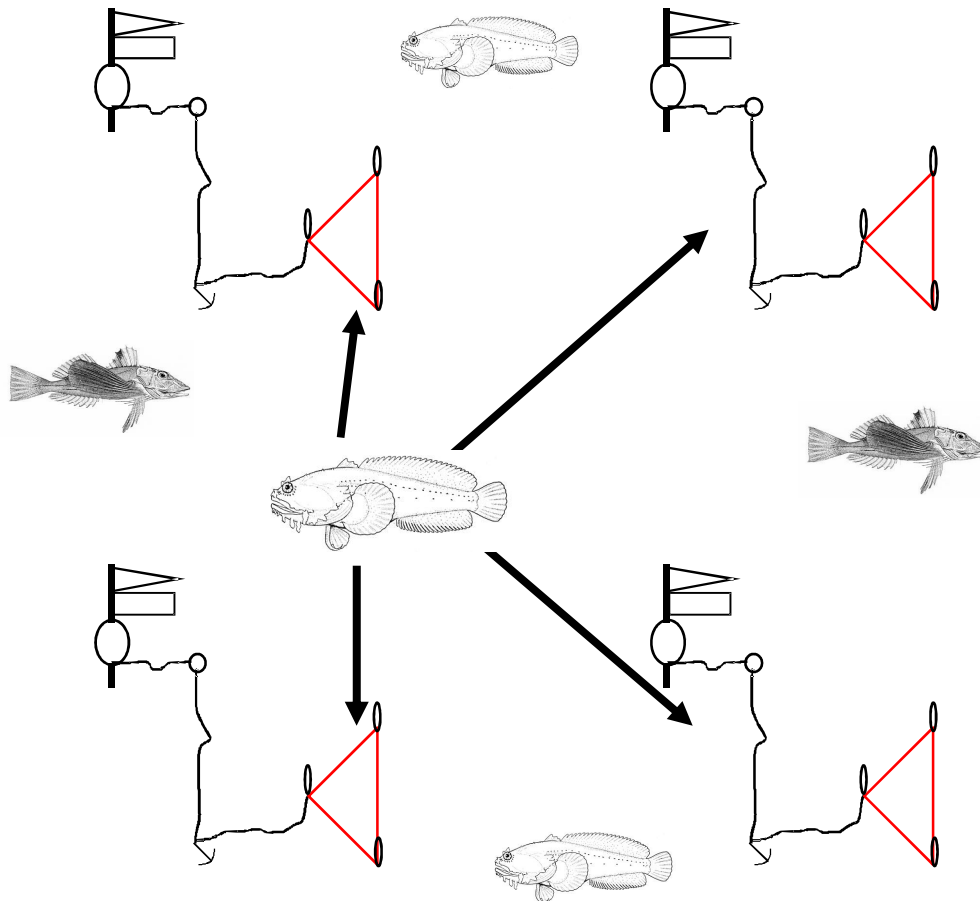
# Portable array



Options:

- 1) Data archived or transferred via cable or telemetry
- 2) Coupled optic data (video)
- 3) Coupled active acoustic data

# Large composite array



Portable “brain”

Near real-time processing

PC based or stand-alone “fishfinder”

GPS/relative positioning

GIS interface

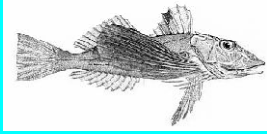
# Acoustic/optic systems



Synchronized video and audio data (uncompressed  
wav files – manual gain control!)



Software for simultaneous analysis of audio and video  
data to enable correlations between sounds and images



Variable lighting options – very big problem for  
studying fish behavior at night and at depth



Portable, programmable



Oh yeah, and inexpensive too...

# Conclusions

Passive acoustics promises to become one of the most exciting fields of marine research in the coming decade from both an ecological and engineering perspective. Important discoveries are just waiting right outside the door...

# Funded by:

- Northeast and Great Lakes National Undersea Research Center, which also provided extensive logistical support
- Woods Hole Sea Grant Program
- The Sounds Conservancy, Quebec-Labrador Foundation/Atlantic Center for the Environment
- Northeast Consortium
- MIT Sea Grant

**[www.fishecolology.org](http://www.fishecolology.org)**