Mating Call of the Plainfin Midshipman as an Indicator of Stress due to Anthropogenic Noise and Other Environmental Factors
Roger Bland, Newell Garfield, Matt Sanchez, Jemma Lorenat, Daniel Cuneo, and Ratna Lama
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Delta Sciences Conference, September 28, 2010
Aquarian Audio hydrophone
McCosker and the Midshipman

• In 1984 Sausalito house-boat residents were kept awake nights by a sound reminiscent of a motorcycle, coming through the hull. Was it an alien invasion, or secret government tests? Not so, said John McCosker of the California Academy of Sciences. It was . . .
McCosker and the Midshipman

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THE TOADFISH

Photo: Margaret A. Marchaterre, Cornell University
NIGHTTIME HUMMING

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rtc090712033712

800 Hz

600 Hz

400 Hz

200 Hz
POWER SPECTRUM FROM FFT
POWER SPECTRUM FROM FFT
MIDSHIPMAN BAND

power spectrum ($y^2$/Hz)

frequency

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MIDSHIPMAN BAND

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Humming Frequency, "better" fits

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Water temperature

frequency $\div 4$

temperature

2009
Frequency (red) and temperature (blue)
Good Hums, days 182 to 243, 2010

2010

f

t

hum frequency (Hz)
temperature (°C)
frequency = ( 19.4 + 5.06 T ) Hz
Frequency of Humming

• The toadfish is a thermometer with fins!
Frequency of Humming

• The toadfish is a thermometer with fins!

• What is the adaptive advantage?
Frequency of Humming

• The toadfish is a thermometer with fins!
• What is the adaptive advantage?
• Would this be the same in Tomales Bay, or Elkhorn Slough?
Power in Midshipman Band, all good hums

dB re 1 micro-Pascal

Jun Jul Aug Sep Oct Nov Dec

2009
Humming intensity, hour vs day, 2009

Romberg Tiburon Center, March 10, 2010
Delta Sciences Conference, September 28, 2010

Midshipman Humming Power, 2009

LUNAR SLOPE

6:00 AM
8:00 PM

hour, PDT

6
24
20

2009

Jul
Aug
Sep
Oct
Nov
Midshipman Hum Intensity, 2009, Months 1-12

8:00 PM

2009
Midshipman Hum Intensity, 2009, Months 1-12

8:00 PM

6:00 AM

2009

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Diel power distribution, all months, 2009
Diel power distribution, all months, 2010
ship noise

drowning out

humming
Suppression of Humming by Shipping Noise

- Need reliable ship-detection algorithm.
- Need comparison with estuary without shipping.
- Preliminary data is inconclusive.
- Further work is required!!!
The Unusual Event of October 12, 2009

Over two inches of rain fell in less than one day. And the Midshipmen stayed on for another two weeks.
Humming

2009, Pacific Standard time

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Humming, rainfall

2009, Pacific Standard time

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Humming, rainfall, Verona discharge

2009, Pacific Standard time

rainfall

discharge
Humming, rainfall, discharge, salinity

2009, Pacific Standard time

Delta Sciences Conference, September 28, 2010
Humming, rainfall, discharge, salinity, temperature

2009, Pacific Standard time
CONCLUSIONS

• Midshipmen rely on sound for successful reproduction.

• Midshipmen call mainly at night, while shipping traffic is lightest then; coincidence or causality?

• Humming frequency is accurately controlled by temperature.

• Humming responds to environmental (chemical?) trigger.