REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION / AVAILABILITY OF REPORT Approved for public release; distribution is unlimited.
2b. DECLASSIFICATION / DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) NUSC TD 7979	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION Naval Underwater Systems Center 6b. OFFICE SYMBOL (If applicable) 10	7a. NAME OF MONITORING ORGANIZATION
6c. ADDRESS (City, State, and ZIP Code) New London Laboratory New London, CT 06320	7b. ADDRESS (City, State, and ZIP Code)
8a. NAME OF FUNDING / SPONSORING ORGANIZATION Naval Underwater Systems Center 8b. OFFICE SYMBOL (If applicable) 10	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State, and ZIP Code) New London Laboratory New London, CT 06320	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. / PROJECT NO. 710Y11 / TASK NO. / WORK UNIT ACCESSION NO.

11. TITLE (Include Security Classification)
LOW-FREQUENCY AMBIENT NOISE NEAR BERMUDA: FILLING IN THE NOTCH

12. PERSONAL AUTHOR(S)
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13a. TYPE OF REPORT	13b. TIME COVERED FROM ____ TO ____	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
		1987 May 27	12

16. SUPPLEMENTARY NOTATION
A paper presented at the 113th meeting of the Acoustical Society of America, 11-15 May 1987, Indianapolis, Indiana

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	Ambient Noise Noise Models Wind-Generated Noise

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

Ambient noise models which assume no significant wind-generated noise mechanism in the 5- to 100-Hz frequency range predict a notch in noise levels, between shipping and microseismic noise, at approximately 10 Hz. Data are presented for the frequency range 3-200 Hz that show that this notch fills in at increasing wind speeds and is entirely eliminated above 35 knots for a North Atlantic Ocean location near Bermuda. These results are consistent with the low-frequency wind-generated noise mechanism proposed by Isakovish and Kur'yanov (Sov. Phys. Acous., 16, 49 (1970).

20. DISTRIBUTION / AVAILABILITY OF ABSTRACT ☐ UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT. ☐ OTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED
22a. NAME OF RESPONSIBLE INDIVIDUAL David G. Browning	22b. TELEPHONE (Include Area Code) (203)440-4173 22c. OFFICE SYMBOL 3331

DD FORM 1473, 84 MAR 83 APR edition may be used until exhausted. All other editions are obsolete.

NUSC Technical Document 7979
27 May 1987

Low Frequency Ambient Noise Near Bermuda: Filling in the Notch

A Paper Presented at the 113th Meeting of the Acoustical Society of America, 11-15 May 1987, Indianapolis, Indiana

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PREFACE

This document was prepared under NUSC Project No. 710Y11.

REVIEWED AND APPROVED: 27 May 1987

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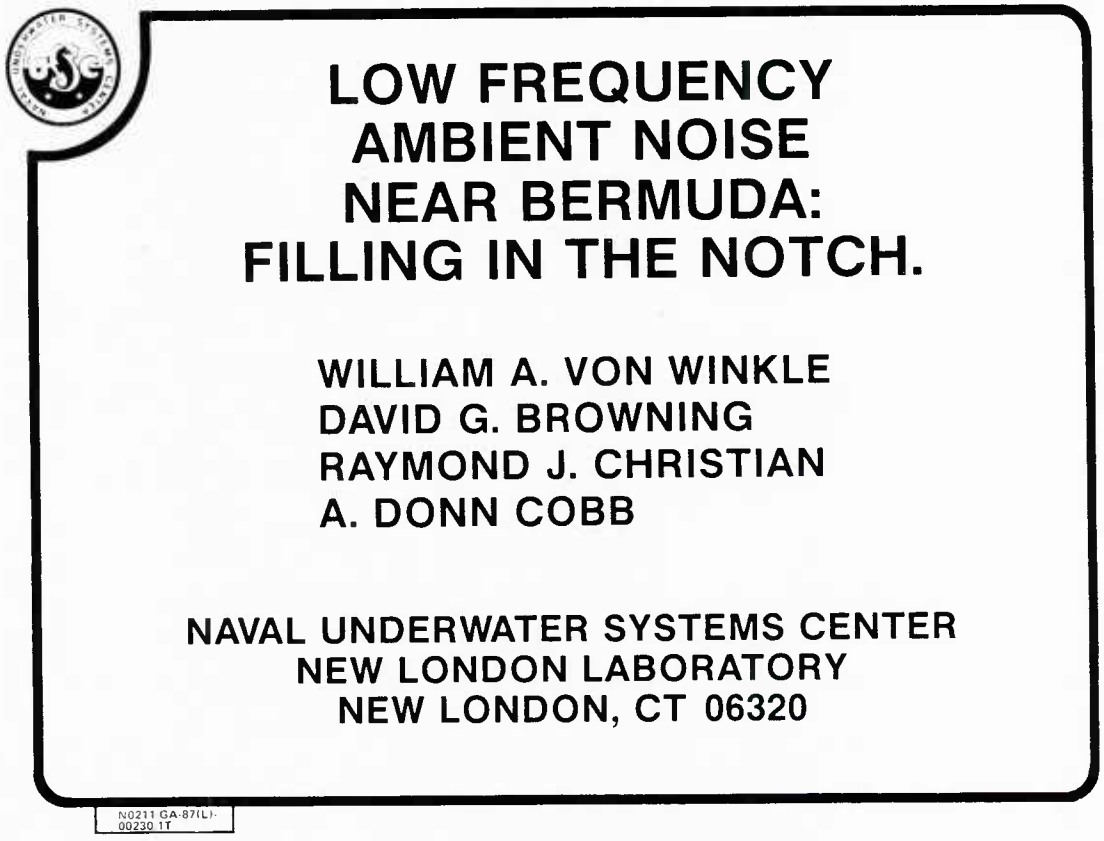
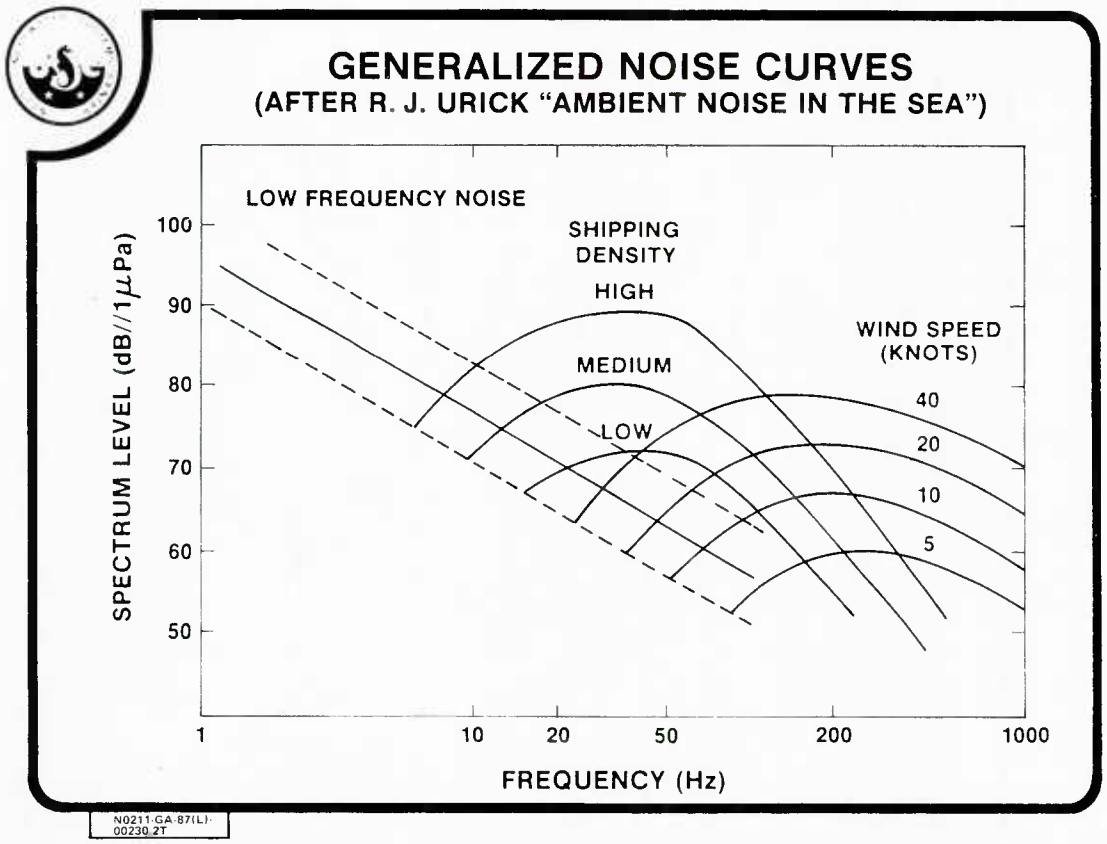


VIEWGRAPH 1

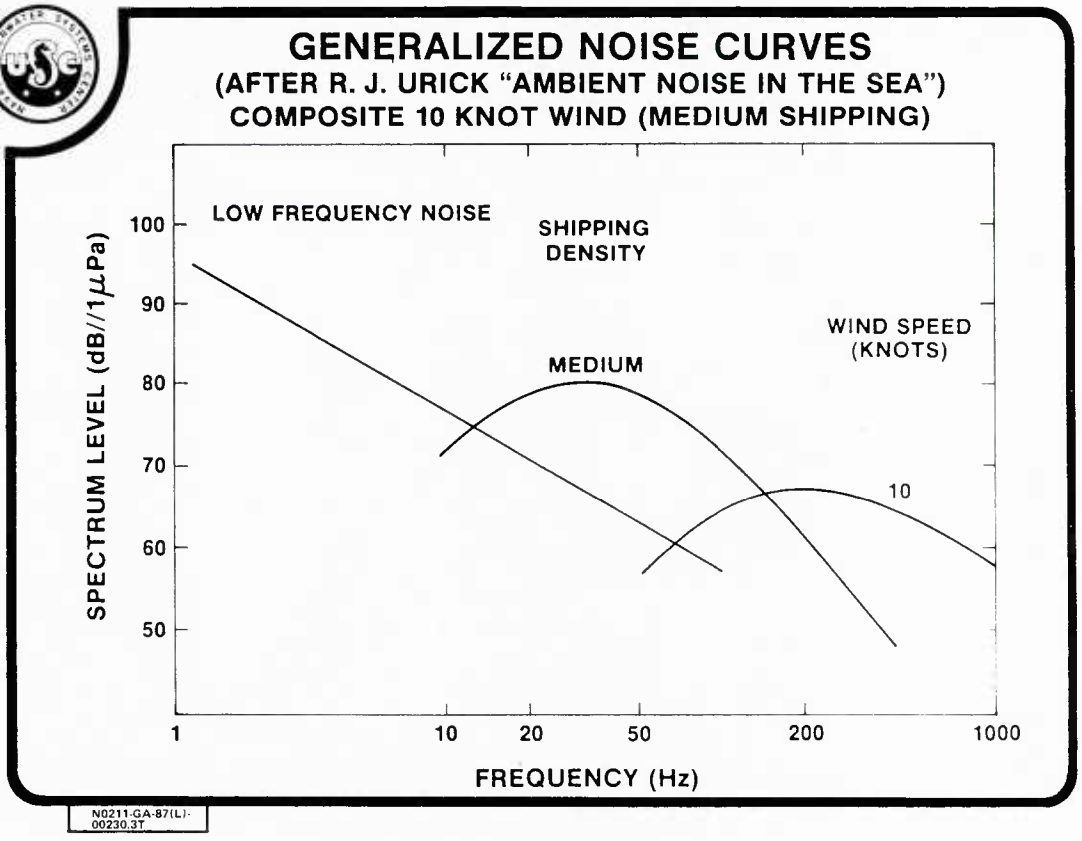
The majority of published ambient noise data has been from relatively heavily trafficked areas of the northern hemisphere taken at low to moderate wind speeds. Based on these data, it has been suggested that significant notches exist over the frequency range. It is the purpose of this paper to show that this may not be the case, at least not to the extent that has been predicted.



VIEWGRAPH 2

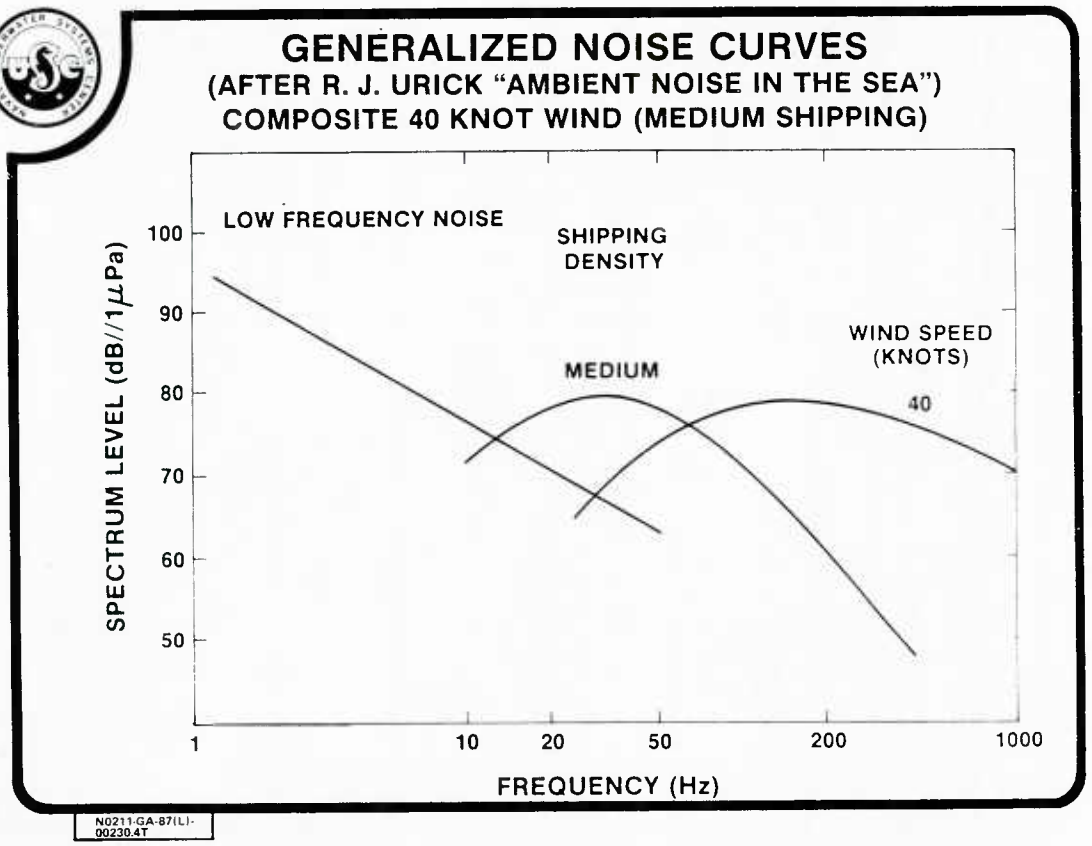
Urick (in his recent book Ambient Noise in the Sea*) has, as always, presented an excellent summary of existing data and has suggested generalized noise curves based on three mechanisms: wind driven bubbles and spray, shipping noise, and low frequency (microseism) noise.

*R. J. Urick, Ambient Noise in the Sea, Undersea Warfare Technology Office, Department of the Navy, Washington, DC, 1984.



VIEWGRAPH 3

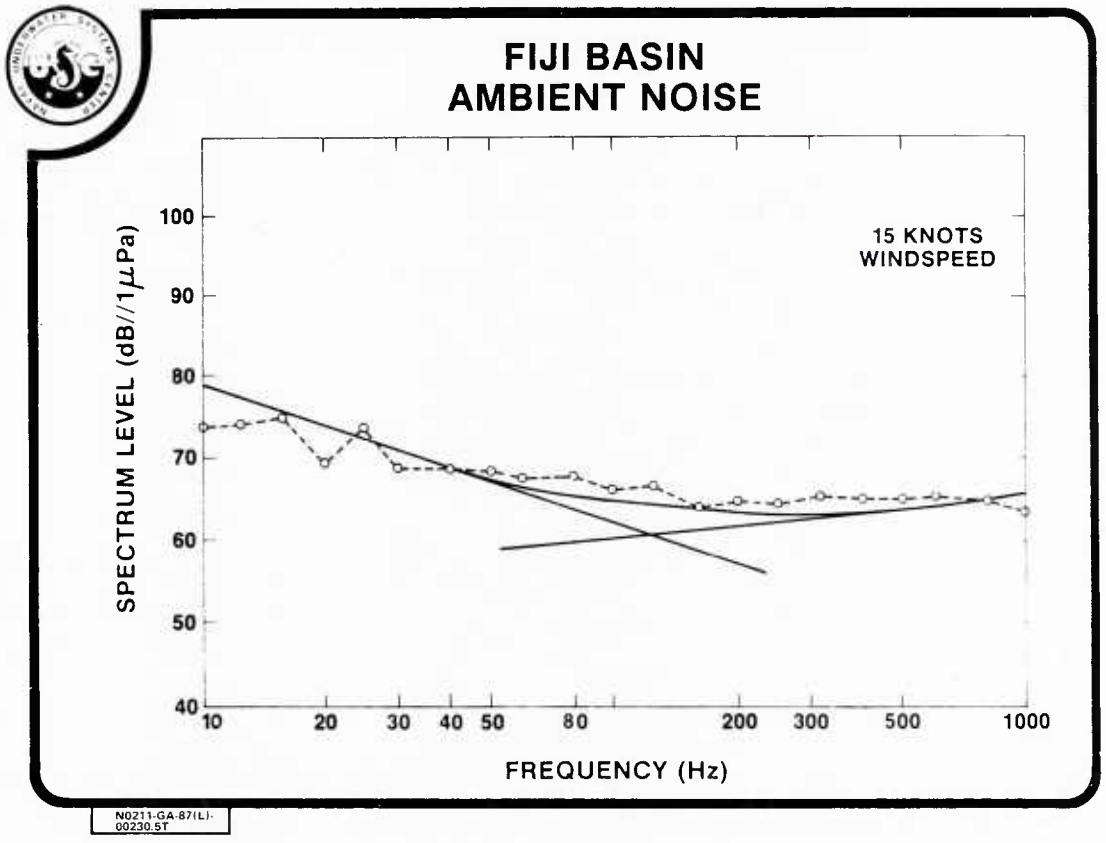
Consider two typical cases: first, wind speed of 20 knots and a medium shipping density. In this case a notch occurs at about 10 Hz. With the shipping removed from the viewgraph there would be a significant notch at approximately 60 Hz.



VIEWGRAPH 4

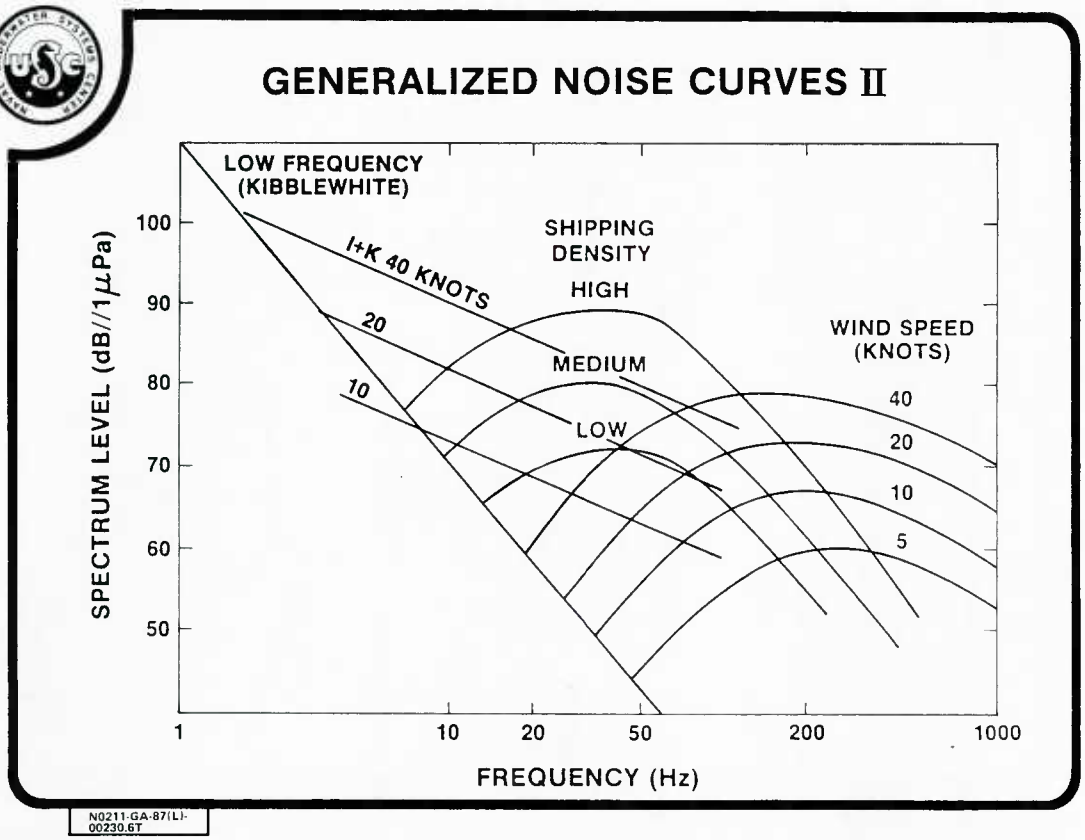
Secondly, consider a wind speed of 40 knots and the same medium shipping density. Since the wind–generated noise rolls off below 200 Hz, it still does not impact the notch that persists at about 10 Hz. Without the shipping, the notch shifts down to around 20 Hz.

So from these curves we get the picture of a persistent wind–independent notch at about 10 Hz with shipping present and a notch that shifts downward in frequency with increasing wind speed without shipping.



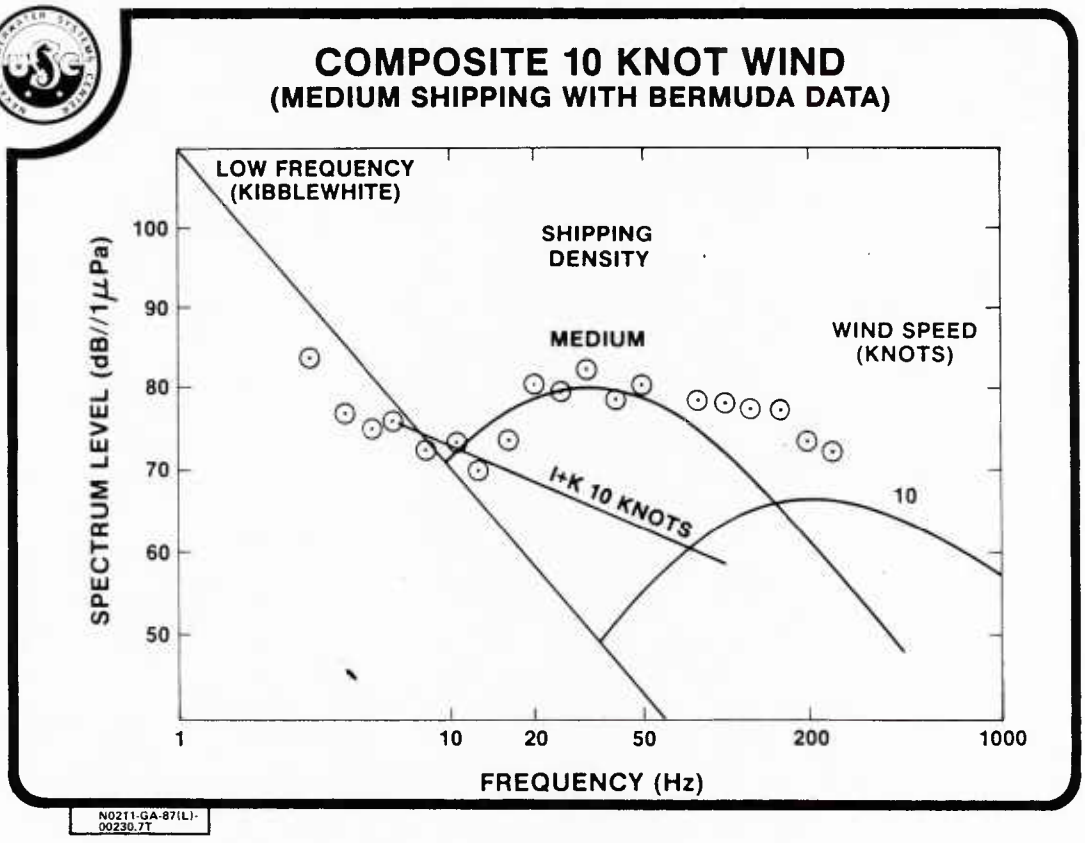
VIEWGRAPH 5

The rub is this: All the data (albeit limited) collected in the low shipping density southern hemisphere shows that wind-generated noise does not roll off below 200 Hz. It is suggested by Isokovich and Kur'yanov, Burgess and Kewley, Wilson, and others that a second mechanism exists below 200 Hz. As you may have noted in the April JASA the theories are still hotly contested.



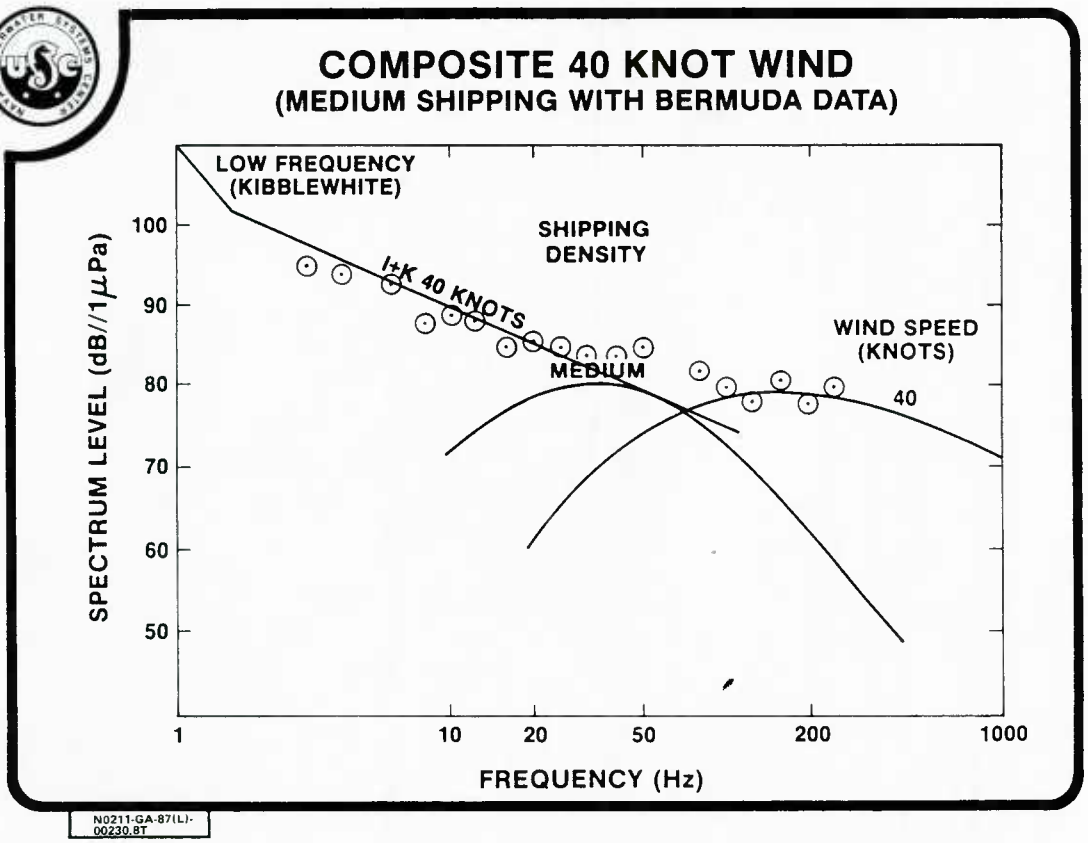
VIEWGRAPH 6

We have taken the original curves, updated the low frequency mechanism based on the latest data of Kibblewhite, and added a second wind-generated noise mechanism after Isokovich and Kur'yanov. The key point is that you need a second wind-generated noise mechanism; these curves may not be the exact answer but they should be close to it.



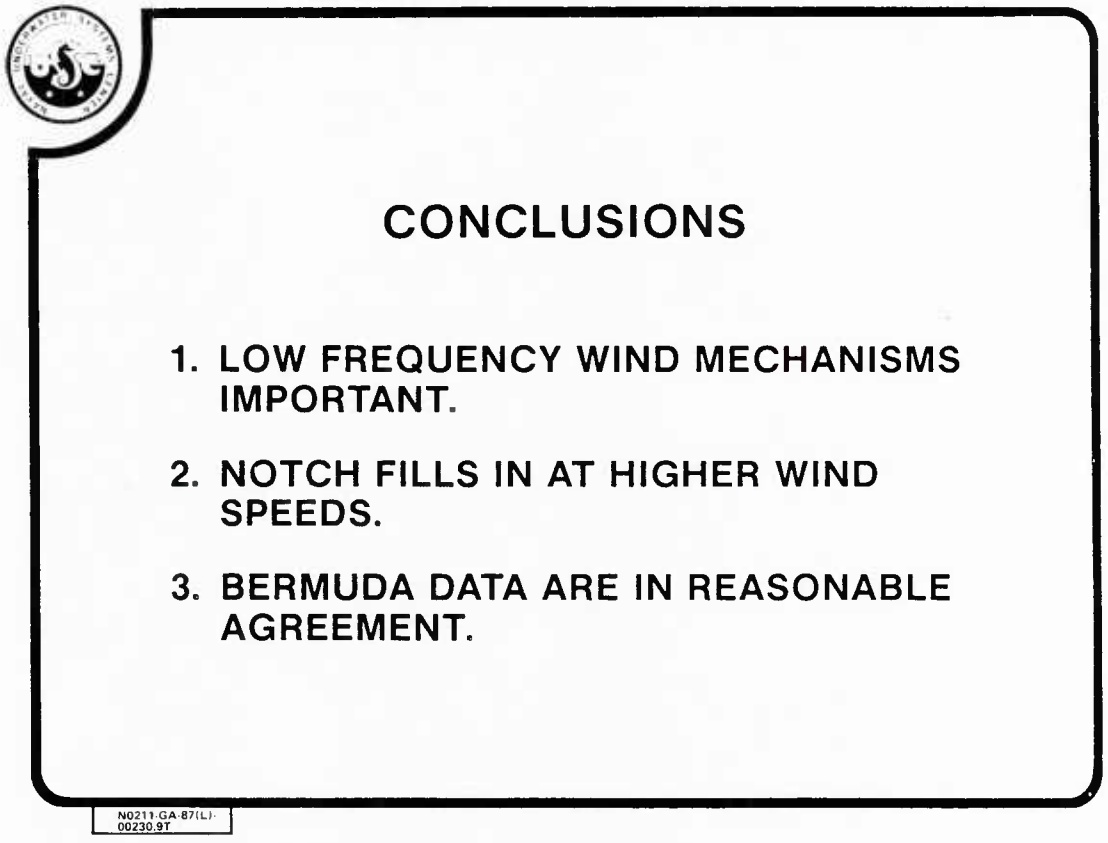
VIEWGRAPH 7

Let's revisit the two examples we had before and make a comparison with ambient noise data taken near Bermuda: first, a wind speed of 10 knots and a medium shipping density. The second wind-generated mechanism really isn't significant and it is easy to see it wasn't considered. However, with the shipping removed things have changed from Urick's curves, this notch has been significantly filled in.



VIEWGRAPH 8

Look at the impact on the 40 knot wind speed case. The 10 Hz notch is totally filled in. When the shipping is removed that notch is essentially filled in too. The ambient noise data from Bermuda is in good agreement.



VIEWGRAPH 9

We can summarize as follows:

- Low frequency wind-generated noise mechanisms are important especially at higher wind speeds. A second mechanism in the range 10-200 Hz as proposed by Isokovich and others is required. Also, the original low frequency mechanism (latest results from Kibblewhite) needs to be fine tuned.
- The impact is that any notch will fill in with increasing wind speeds.
- Finally, we have found that the limited high wind speed data we have from Bermuda supports this conclusion.

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