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8/14/09 Conf. Call Notes
: Lori, Doug, Sandy Frank Torin'a, +

CAHA
1720

National Park Service
U.S. Department of the Interior

Natural Resource Program Center
Natural Sounds Program

Cape Hatteras National Seashore
Acoustical Monitoring Snapshot
April 2009

Comment [dw1]: This is a summary report. Full report will follow. Sandy thought September but Frank will confirm. Need to have it in first draft before editing, so will need it in next month or so. Frank to discuss with techs about getting this done in a month.

Background Information

Comment [dw2]: Might want to add that they sat on the beach and described the ambient sounds.

The Natural Sounds Program received a technical assistance request from Cape Hatteras National Seashore (CAHA) for acoustical monitoring. The purpose of this monitoring was to capture the Seashore's natural ambient and estimate noise impacts from ORV use. To capture the natural ambient, two sites were monitored for 31 days. This briefing serves as a preliminary snapshot of the acoustical conditions at the long-term monitoring sites. This briefing also addresses potential impacts from ORV noise. Additional information, including the calculated natural ambient, will be provided in a full acoustic monitoring report that will follow, pending further analysis. Table 1 describes the location and characteristics of the long-term monitoring site.

Table 1. Study area

Comment [dw3]: Two sites used. Not on beach because equipment is kept away from traffic and needs to be secure. Bodie Island site was north of the fishing center. Cape point – just off the road on the ocean side.

Site	Site Name	Dates Deployed	Vegetation	Elevation (m)	Latitude	Longitud
CH1	Bodie Island Bone Yard	05/06/2008 – 06/02/2009	Woody Wetlands/Mixed Forest	1	35.82550	75.5696
CH2	Cape Point	05/06/2008 – 06/02/2009	Woody Wetlands/Shrubland	1	35.23439	75.54999

Metrics

In order to understand the implications of the acoustic data fully, it is important to describe the distribution of sound levels in relation to potential functional effects. Table 2 presents park sound sources and common sound sources with their corresponding A-weighted decibel levels (dBA). The dBA is a logarithmic measure of sound energy that approximates human hearing sensitivity (Harris, 1998, p. 1.16).

Table 2. Interpreting sound levels

Comment [dw4]: How about a comparison with Atlantic coast beach surf? Yes, this can be put into the table.

Park Sound Sources	Common Sound Sources	dBA
Volcano crater (HALE)	Human breathing at 3m	10
Leaves rustling (CANY)	Whispering	20
Crickets at 5m (ZION)	Residential area at night	40
Conversation at 5m (WHMI)	Busy restaurant	60
Snowcoach at 30m (YELL)	Curbside of busy street	80
Thunder (ARCH)	Jackhammer at 2m	100
Military jet at 100m AGL(YUCH)	Train horn at 1m	120

Note: An increase of 10dBA represents a tenfold multiplication of energy

Comment [dw5]: Good baseline, standard.

Table 3 summarizes sound level values that relate to human health and speech, as documented in the scientific literature. Human responses can serve as a proxy for potential impacts to other vertebrates because humans have more sensitive hearing at low frequencies than most species (Dooling and Popper, 2007, p. 5).

Table 3. Explanation of sound level values

Sound Levels (dBA)	Relevance
35	Blood pressure and heart rate increase in sleeping humans (Haralabidis et al., 2008)
45	World Health Organization's recommendation for maximum noise levels inside bedrooms (Berglund, Lindvall, and Schwela, 1999)
52	Speech interference for interpretive programs (U.S. Environmental Protection Agency, 1974)
60	Speech interruption for normal conversation (U.S. Environmental Protection Agency, 1974)

Table 4 reports the percent of time that measured levels were above the values in Table 3. The top value in each cell focuses on frequencies affected by transportation noise whereas the lower values use the conventional full frequency range.

Table 4. Percent time above metrics

Site	% Time above sound level: 0700 to 1900				% Time above sound level: 1900 to 0700			
	35 dBA	45 dBA	52 dBA	60 dBA	35 dBA	45 dBA	52 dBA	60 dBA
CH1	56.84	2.51	0.55	0.08	58.96	0.50	0.05	0.01
	85.24	10.50	1.40	0.12	98.46	22.23	2.01	0.12
CH2	48.18	2.45	0.49	0.09	92.09	16.30	0.08	0.01
	82.75	9.13	1.06	0.14	99.96	46.06	16.20	0.03

Comment [dw6]: 56% of the time, the sound levels were above 35dB.

Comment [dw7]: Ignore bottom row

Exceedence levels (L_x) are metrics used to describe acoustical data. They represent the dBA exceeded x percent of the time during the given measurement period (e.g. L_{90} is the dBA that has been exceeded 90% of the time). Table 5 reports the L_{90}, L_{50}, and L_{10} values for the sites measured in CAHA. The top value in each cell focuses on frequencies affected by transportation noise whereas the lower values use the conventional full frequency range. The L_{90} can be used to approximate natural ambient conditions.

Comment [dw8]: NPS uses natural ambient as the baseline. L90 is natural ambient, until human-caused sounds are removed.

Table 5. Exceedence levels for existing conditions

Site	Exceedence levels (dBA): 0700 to 1900			Exceedence levels (dBA): 1900 to 0700		
	L_{90}	L_{50}	L_{10}	L_{90}	L_{50}	L_{10}
CH1	33.6	36.0	39.9	33.8	35.6	38.4
	36.8	39.3	43.9	40.0	42.3	44.8
CH2	33.4	35.9	39.5	41.0	43.0	44.6
	35.9	38.0	43.0	46.1	47.2	48.8

Comment [dw9]: Db level is exceeded 90% of the time. Could use the L90 as the ambient until human-caused sounds are removed.

Comment [dw10]: Median sound level. Equipment records every second. 50% of measurements were above 36.0. L50 is called "existing ambient". Half time sound levels above, half time below that level. 10% of time at 33.6 dBA.

Comment [dw11]: Db level exceeded 10% of the time.

Figures 1 and 2 plot the dB levels for 33 one-third octave band frequencies over the day and night periods at CH1 and CH2, respectively. The grayed area represents sound levels outside of the typical range of human hearing. The typical frequency levels for transportation, conversation and songbirds are presented on the figure as examples for interpretation of the data. These ranges are estimates and are not vehicle-, species-, or habitat- specific.

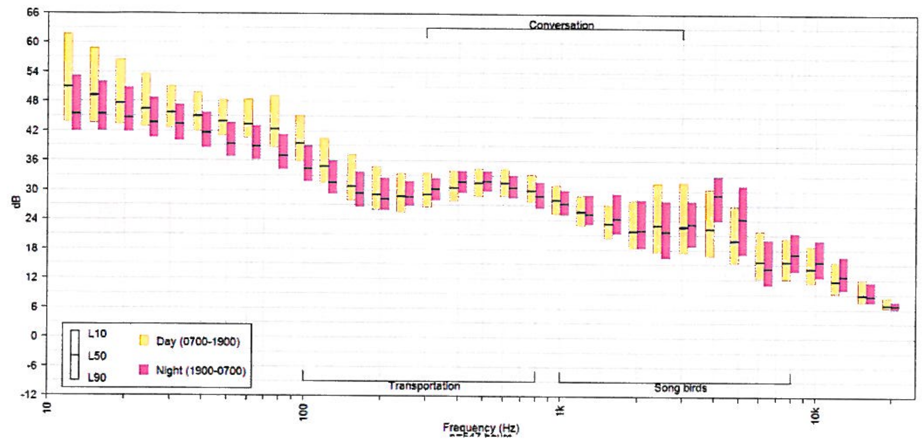

Figure 1. Day and night dB levels for 33 one-third octave bands at CH1

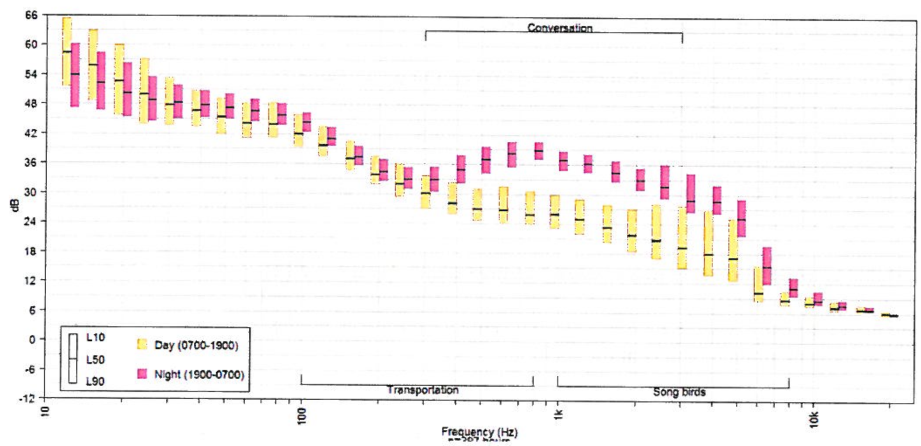

Figure 2. Day and night dB levels for 33 one-third octave bands at CH2

Noise Impacts from ORVs

Comment [dw12]: Sandy and Frank to talk through the impact thresholds and determine level of effect.

OHV noise levels were calculated at various distances using standard air absorption based on the annual average atmospheric conditions at CAHA. OHV noise is calculated according to operating conditions, such as speed and throttle, for various OHV types such as ATV, cars/trucks, and motorcycles. The noise levels for cars can also be applied to standard light trucks.

To understand increases due to groups of vehicles, 3 dB should be added for each doubling of vehicles. For example, a group of two ATVs will be 3 dB higher than the calculation for one, and a group of four ATVs will be 6 dB higher than the calculation for one. Similarly, a group of eight ATVs will be 9 dB higher than one. The levels were calculated in order to give planners information to determine impacts for OHV usage according to speed and operating conditions.

Results of the analysis are provided in Table 6. The table indicates sound levels from various vehicle types and speeds at specific distances from the source (4m, 15m, 50m, etc.)

Vehicle	Reference Measures		Other Distance (meters)					
	Src LpA @	*Distance*	*4*	*15*	*50*	*150*	*250*	*500*
ATV cruising at 30 mph (based on MC 1/2 load spectrum and 79 dBA at 4m)	79	4	79.0	67.4	56.7	46.6	41.6	34.6
ATV cruising at 15 mph (based on MC 1/2 load spectrum and 74 dBA at 4m)	74	4	74.0	62.4	51.7	41.6	36.6	29.6
Auto at 15 mph (FHWA)	52	15.24	64.0	52.5	41.7	31.5	26.4	19.0
Auto at 25 mph (FHWA)	59	15.24	71.0	59.4	48.7	38.5	33.4	26.0
Motorcycle at 15 mph (FHWA)	59	15.24	71.2	59.6	48.9	38.6	33.6	26.3
Motorcycle at 25 mph (FHWA)	66	15.24	77.7	66.1	55.3	45.1	40.0	32.6

Comment [dw13]: From literature and other public sources

Comment [dw14]: meters

Comment [dw15]: near natural ambient

Table 6 Noise levels from vehicles at various distances from the source.

The natural ambient at CAHA is estimated to be 33dB (based on the L90 condition in Table 5). As indicated in Table 6, noise levels from an auto travelling at 25 mph or 15 mph would attenuate to natural ambient levels at approximately 250 meters from the source. Noise levels for ATVs would diminish to natural ambient levels at approximately 500 m. Noise levels at 15 meters would exceed or approach EPA levels for speech interference (60 dB) for all vehicles except autos at 15 mph.

Lori – did analysis take wind into consideration (monitors weren't at the beach)? Frank – NPS must protect natural sounds. Just b/c it's windy, it's not windy all the time. NPS sounds will help us write this section and why measurements were done there. Bodie island monitor was on the sound side. However, just wanted to get ambient levels at the park.

Potential Wildlife Impacts

Several bird species could be adversely affected by noise from ORVs. The primary frequencies in transportation noise are typically in the range of 100HZ to 1 KHz. Species with calls close to those frequencies are most at risk of compromised communication. Even species with higher frequency calls have been shown to shift their calls towards higher frequencies in the presence of transportation noise (Slabbekoorn & den Boer-Visser, 2006). Table 7 indicates potential impacts to bird species at CAHA.

Comment [dw16]: birds in urban environments

Species	Potential effect
piping plover	1-3 kHz call with most energy around 2 kHz-- acoustic communication could be compromised. Could be impacted by

Comment [dw17]: What about oystercatchers? Are they "noise sensitive"? If that's the case, we need to state that they're not in this document.

	shifting the frequency of the calls away from the transportation noise (see Slabbekoorn and Boer-Visser 2006)
black skimmer	Fundamental frequency of call is at and below 2 kHz-- acoustic communication could be compromised. Could be impacted by shifting the frequency of the calls away from the transportation noise (see Slabbekoorn and Boer-Visser 2006)
wilson's plover	Most acoustic energy in the call occurs below 3 kHz-- acoustic communication could be compromised. Could be impacted by shifting the frequency of the calls away from the transportation noise (see Slabbekoorn and Boer-Visser 2006)
least tern	Could be impacted by shifting the frequency of the calls away from the transportation noise (see Slabbekoorn and Boer-Visser 2006)
common tern	Could be impacted by shifting the frequency of the calls away from the transportation noise (see Slabbekoorn and Boer-Visser 2006)
gull-billed tern	Could be impacted by shifting the frequency of the calls away from the transportation noise (see Slabbekoorn and Boer-Visser 2006)

In addition, studies of the effects of underwater levels of anthropogenic noise on sea turtles have suggested that turtles may be adversely affected by noise. Samuel et al. (2005) conclude that "continued exposure to existing high levels of pervasive anthropogenic noise in vital sea turtle habitats and any increase in noise could affect sea turtle behavior and ecology." The results of the study suggest that terrestrial noise may affect turtle behavior in a similar fashion.

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http://www.nature.nps.gov/naturalsounds/

Literature Cited

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Dooling, R., & Popper, A. (2007). *The effects of highway noise on birds*. Rockville, MD: Environmental BioAcoustics LLC.

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Samuel, Y., Morreale, S.J., Clark, C.W., Greene, C.H., and Richmond, M.E.. (2005) Underwater, low-frequency noise in a coastal sea turtle habitat. *J. Acoust. Soc. Am.* 117, 1465, DOI:10.1121/1.1847993

Slabbekoorn, H. & den Boer-Visser, A. (2006) Cities Change the Songs of Birds. *Current Biology.* 16, 2326–2331

U.S. Environmental Protection Agency (EPA). 1974. Information on levels of environmental noise requisite to protect public health and welfare with an adequate margin of safety. EPA, Washington, D.C.

Comment [dw18]: Frank to send copies of these to Sandy.

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#172

Wetmore, Doug

From: Sandra_Hamilton@nps.gov
Sent: Friday, August 14, 2009 10:27 AM
To: Frank_Turina@nps.gov; Fox, Lori; Wetmore, Doug
Cc: Niosi, Dan; Randy_Stanley@nps.gov
Subject: call this afternoon
Attachments: CAHA Acoustical Snapshot.doc

Hello All,

I've reserved our conference line for our call on the CAHA soundscapes report this afternoon at 3:30.

phone number 866-541-6611
passcode 3661304

Attached again is the report.
(See attached file: CAHA Acoustical Snapshot.doc)

Thanks.

Sandy

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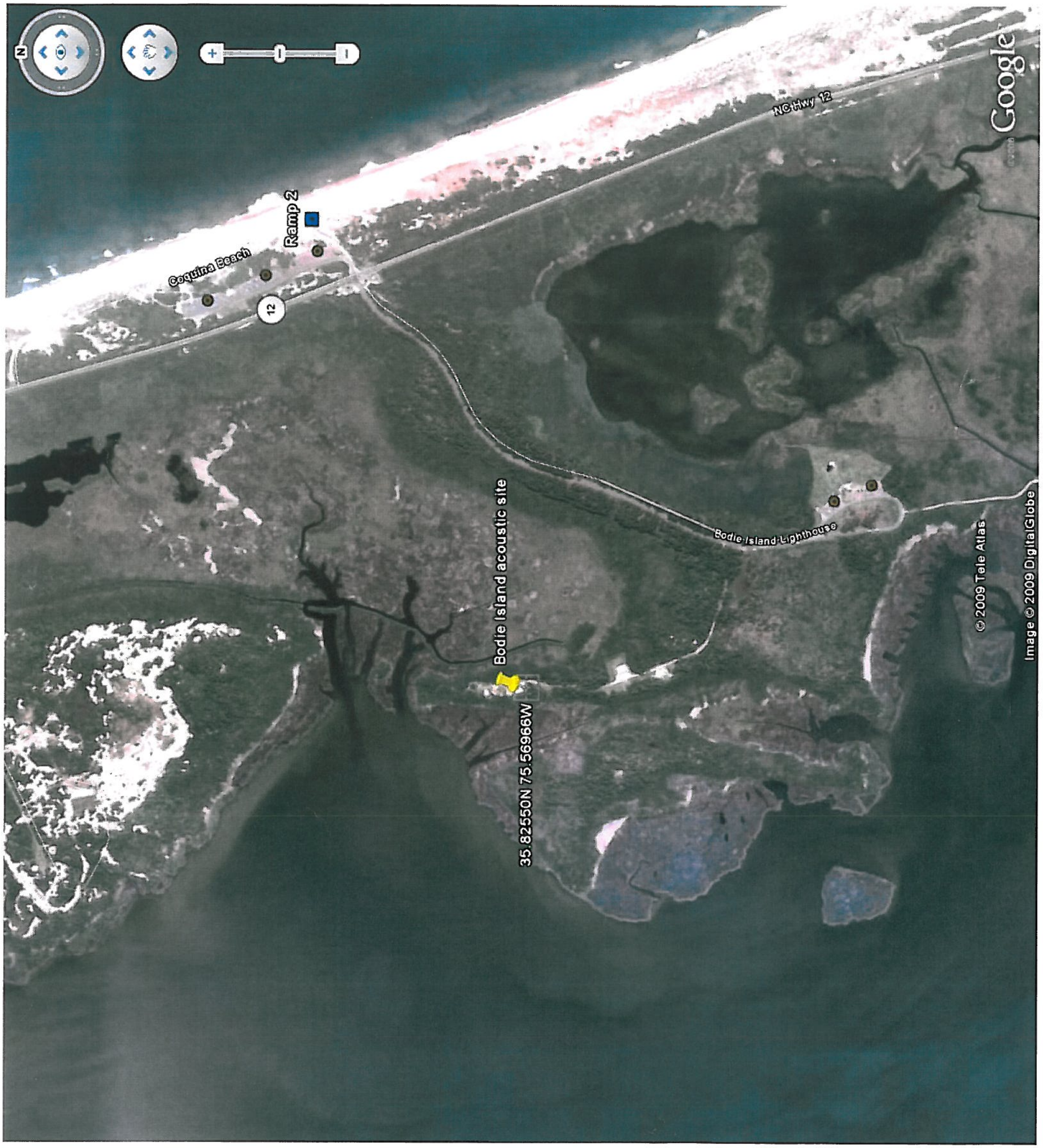

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