Supplemental file 3: Statistics Report for Signal Quality Analysis

Stats outputs for JMP analysis (see JMP reports in https://github.com/jmkendallbar/Eavesdropping-on-the-Brain-at-Sea/tree/main/scripts). See S4_Statistics Report.xlsx for full data outputs.

"In a mixed-effects model of signal quality over time (individual as a random effect), we found a significant interaction between signal quality over time and version (p=0.0366*)."

Signal Quality vs. Day and Version

Dataset: 05_SignalData_binned.csv - Signal quality data binned by day for each animal
Model: Mixed-effects
Random Effect: Seal ID
Response variable (y): Mean Standardized (SWS δ/REM δ) Signal Quality per day
Fixed Effects: Day, Version, Version*Day

Source	Nparm	DFNum	DFDen	F Ratio	Prob > F
Day	1	1	31.1	8.441232	0.0067
Version	2	2	7.4	0.204556	0.8195
Version*Day	2	2	31.6	3.679011	0.0366

"V2 displayed a significant negative trend over time (V2: slope= -3.538±1.016 p=0.032*), V1 and V3 did not significantly degrade over time (V1: slope= -1.807±1.682 p=0.3951; V3: slope= -0.7695±0.5053 p=0.1486)."

Signal Quality vs. Day by Version

Dataset: 05_SignalData_binned.csv - Signal quality data binned by day for each animal
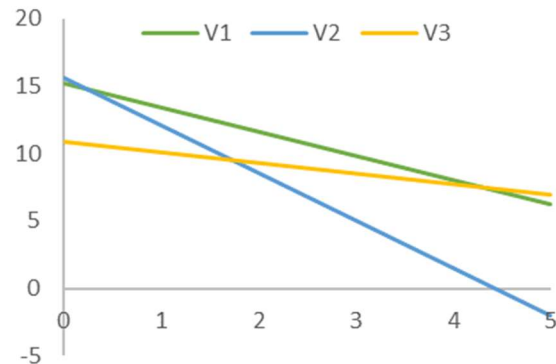**Model:** Mixed-effects
Random Effect: Seal ID
Response variable (y): Mean Standardized (SWS δ/REM δ) Signal Quality per day
By: Version
Fixed Effects: Day, Version, Version*Day

By	Fixed Effect	Estimate	Std Error	Prob>|t|	Random Effect
V1	Day	-1.80736	1.682471	0.3951	Seal.ID
V2	Day	-3.53795	1.016372	0.0032	Seal.ID
V3	Day	-0.76949	0.505302	0.1486	Seal.ID

"Therefore, there was an interaction between location and version (p=0.0026*)."

Signal Quality vs. Location and Version

Dataset: *05_SignalData_paired.csv - Signal quality data per each sleep cycle for each animal*
Model: *Mixed-effects*
Random Effect: *Seal ID*
Response variable (y): *Standardized (SWS δ/REM δ) Signal Quality per sleep cycle*
Fixed Effects: *Day, Version, Version*Day*

Source	Nparm	DFNum	DFDen	F Ratio	Prob > F
Location	1	1	690.8	37.20367	<.0001
Version	2	2	8.2	0.171145	0.8456
Location*Version	2	2	682.6	5.985103	0.0026

"Signal quality was significantly lower in water than on land for V1 (p=0.0012*) and V2 (p<.0001*), but we were able to minimize the impact of water intrusion on signal quality by V3 (p=0.9753) (Figure 12C-D)."

Signal Quality vs. Location and Version

Dataset: *05_SignalData_paired.csv - Signal quality data per each sleep cycle for each animal*
Model: *Tukey HSD All Pairwise Comparisons*
Random Effect: *Seal ID*
Response variable (y): *Standardized (SWS δ/REM δ) Signal Quality per sleep cycle*
Fixed Effects: *Version*Location*

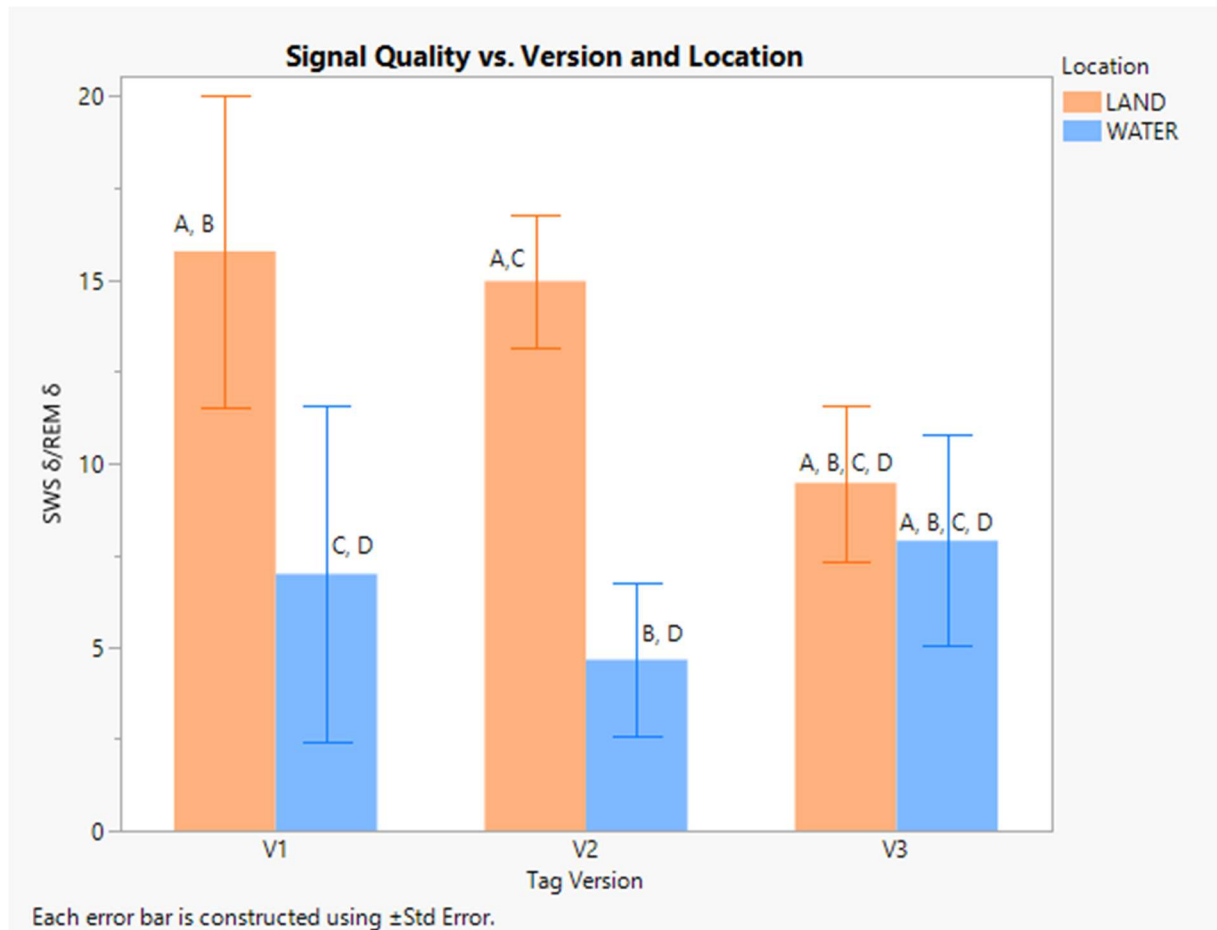| Location	Version	-Location	-Version	Difference	Std Error	Prob>|t|
LAND	V1	LAND	V2	0.8131	4.608024	1
LAND	V1	LAND	V3	6.2929	4.73421	0.7687
LAND	V1	WATER	V1	8.7626	2.215224	0.0012
LAND	V1	WATER	V2	11.1216	4.722662	0.1739
LAND	V1	WATER	V3	7.8615	5.119075	0.6412
LAND	V2	LAND	V3	5.4798	2.793369	0.3656
LAND	V2	WATER	V1	7.9495	4.9431	0.5934
LAND	V2	WATER	V2	10.3085	1.478258	<.0001
LAND	V2	WATER	V3	7.0484	3.405157	0.3044
LAND	V3	WATER	V1	2.4697	5.060939	0.9966
LAND	V3	WATER	V2	4.8287	2.978686	0.5848
LAND	V3	WATER	V3	1.5686	2.087557	0.9753
WATER	V1	WATER	V2	2.359	5.050139	0.9972
WATER	V1	WATER	V3	-0.9011	5.422664	1
WATER	V2	WATER	V3	-3.2601	3.558757	0.9424

Figure S1. *Least squares means estimates of signal quality (mean SWS δ/REM δ per sleep cycle) across versions and locations demonstrating significant differences between land and water for V1 and V2, but not V3. Each error bar is constructed using ±Std Error. Levels not connected by the same letter are significantly different.*

"When comparing signal quality across ages on land (where differential water intrusion would not impact signal quality), we found lower signal quality in the oldest animals (2-3 years old) compared to the youngest animals (0-1 year-old), though this was not significant (Δ SWS δ/REM δ= 5.673±2.628; p<.2593; Figure 12E). 1-2 year-olds were monitored primarily with early iterations of version 2, which had the most significant discrepancy between land and water signal quality and therefore showed the most significant decrease in signal quality due to water intrusion (Δ SWS δ/REM δ= 15.01±1.753; p<.0001; Figure 12F)."*

Signal Quality vs. Location and Age

Dataset: *05_SignalData_paired.csv - Signal quality data per each sleep cycle for each animal*
Model: *Tukey HSD All Pairwise Comparisons*
Random Effect: *Seal ID*
Response variable (y): *Standardized (SWS δ/REM δ) Signal Quality per sleep cycle*
Fixed Effects: *Age*Location*

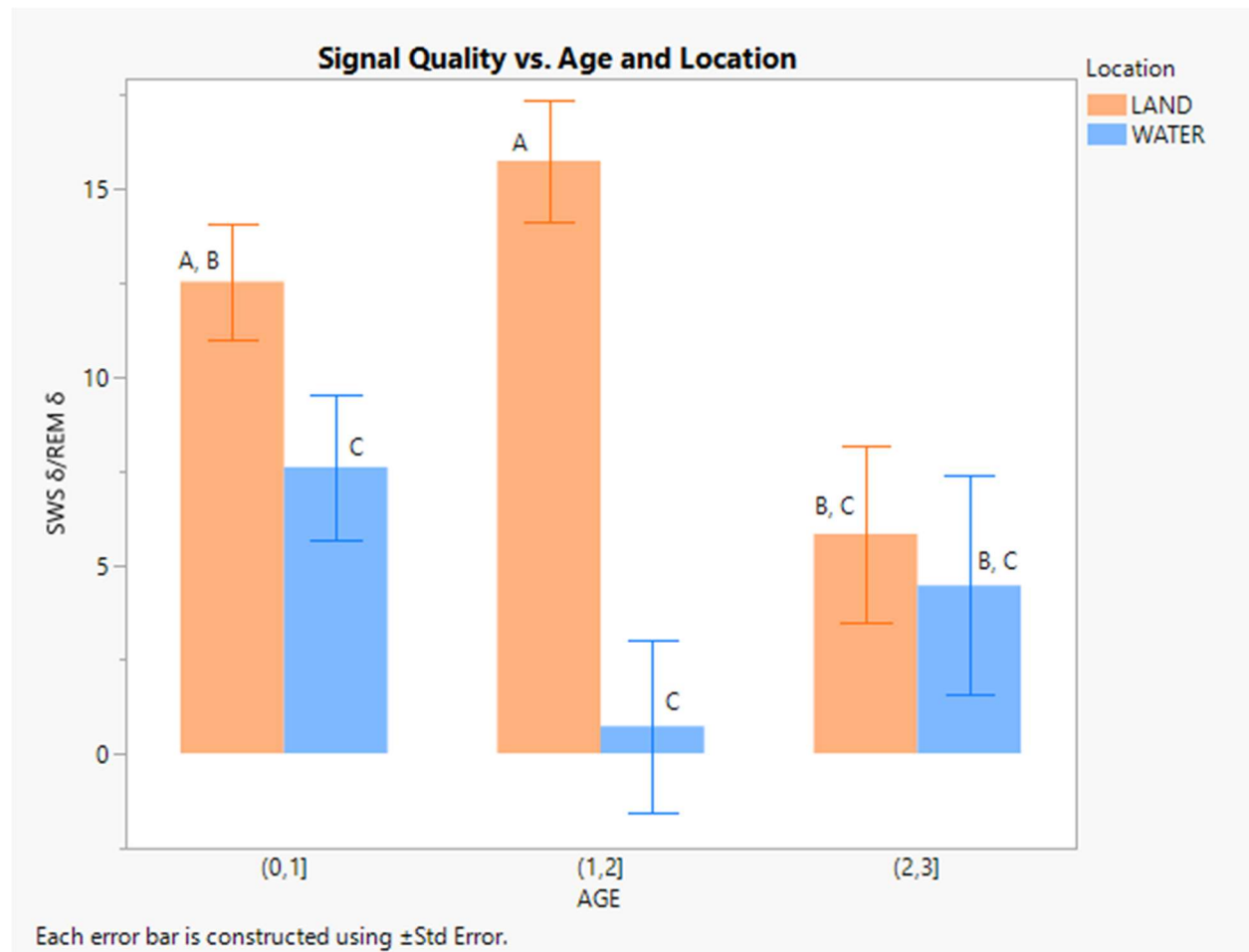| AGE	Location	-AGE	-Location	Difference	Std Error	Prob>|t|
(0,1]	LAND	(0,1]	WATER	4.9285	1.634513	0.0318
(0,1]	LAND	(1,2]	LAND	-3.1931	2.237878	0.7106
(0,1]	LAND	(1,2]	WATER	11.8089	2.752095	0.0003
(0,1]	LAND	(2,3]	LAND	6.6931	2.811521	0.1646
(0,1]	LAND	(2,3]	WATER	8.0595	3.319076	0.1481
(0,1]	WATER	(1,2]	LAND	-8.1216	2.515575	0.0164
(0,1]	WATER	(1,2]	WATER	6.8804	2.982289	0.1926
(0,1]	WATER	(2,3]	LAND	1.7646	3.037214	0.9923
(0,1]	WATER	(2,3]	WATER	3.131	3.512305	0.9485
(1,2]	LAND	(1,2]	WATER	15.002	1.765626	<.0001
(1,2]	LAND	(2,3]	LAND	9.8863	2.848746	0.0073
(1,2]	LAND	(2,3]	WATER	11.2526	3.350667	0.0107
(1,2]	WATER	(2,3]	LAND	-5.1158	3.268223	0.6218
(1,2]	WATER	(2,3]	WATER	-3.7494	3.713879	0.9148
(2,3]	LAND	(2,3]	WATER	1.3664	2.061178	0.9858

Figure S2. *Least squares means estimates of signal quality (mean SWS δ/REM δ per sleep cycle) across ages and locations demonstrating significant differences with letter labels. Each error bar is constructed using ±Std Error. Levels not connected by the same letter are significantly different.*