Diel behavioral rhythms of the painted comber (*Serranus scriba*) at Palma Bay Marine Reserve (western Mediterranean)

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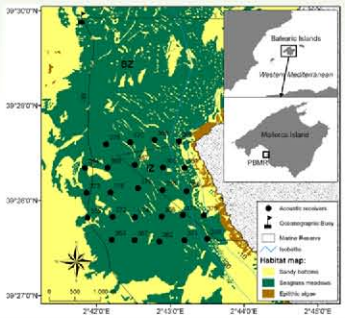
ACOUSTIC TRACKING EXPERIMENT



Acoustic listening station (SUR-1, Sonotronics)

Fifteen adult individuals of *Serranus scriba* (Serranidae) were surgically implanted with acoustic transmitters and monitored within an array of 25 acoustic listening stations at Palma Bay Marine Reserve (Mallorca, Balearic Islands, Spain). We selected 8 individuals with 5 or more days of detection period to look for chrnobiologic rhythms.

S.scriba swimming over the seagrass

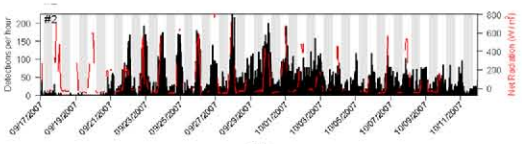
S.scriba Individual after the surgery

CHRONOBIOLOGIC STATS FOR HOURLY DETECTIONS

Step 1. Time series visualization

Chronograms: A marked diurnal rhythmicity was reported in the 50% of the tested individuals (N = 8)

Double-Plot Actograms: similar pattern can be alternatively represented by plotting activity over consecutive days vertically

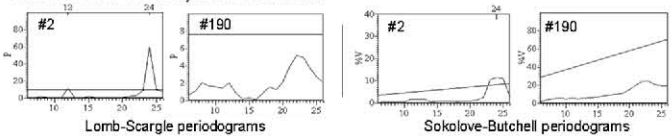


Chronogram

Actogram

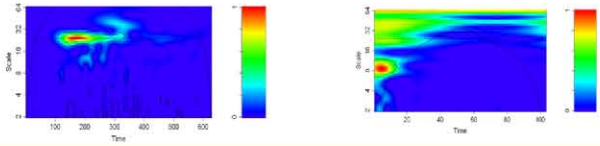
Step 2. Periodicity detection

Periodograms: Lomb-Scargle (left) and Sokolove-Butchell (right) periodograms on same datasets provided similar results (peaks exceeding the confidence line of $p < 0.001$ indicate significant periods for a weakly bimodal and an arrhythmic individual



Lomb-Scargle periodograms | Sokolove-Butchell periodograms

Continuous Wavelet Transform (CWT): We computed the two-dimensional wavelet spectrum using a Morlet wavelet. High wavelet coefficients signify a high degree of similarity between the time series and the mother wavelet on a specific scale. CWT allowed to identify 24h periodicities through the time.



Step 3. Phase identification

Mann-Whitney U-test: We used a non-parametric Mann-Whitney U-test to evaluate the hypothesis that the number of detections was different between day and night, being higher during the photophase.

Results

Fish ID	Tracked days	CWT	L-S	S-B	Mann-Whitney	IOR
2	26	24, 12	24,12	24	<0.01	0.95
3	29	24	24	-	<0.01	1
5	6	-	-	-	n.s.	1
18	35	-	-	-	n.s.	1
20	30	24,12	24	-	<0.01	0.99
35	9	24	24	-	<0.05	0.82
131	9	~12	13	-	n.s.	0.86
190	5	-	-	-	n.s.	0.72

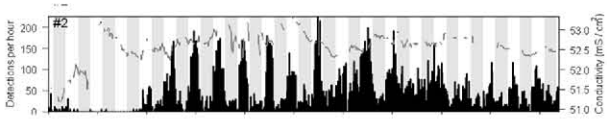
CWT, continuous wavelet transform; L-S, Lomb-scargle periodogram peaks; S-B, Sokolov-Butchell periodogram peaks; IOR, index of reuse (see next box).

Results present clear 24h periodicities for some fish, related to the day-night cycle

BEHAVIOUR INFERENCE FROM ACOUSTIC DATA

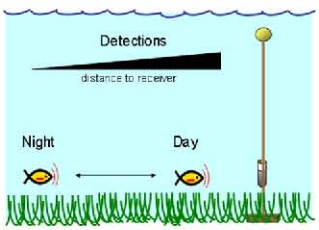
Oceanographic parameters affect detection data?

NO: Oceanographic parameters such as water temperature or salinity affected the transmission of acoustic signals. No apparent effect of **conductivity** was detected in chronograms.



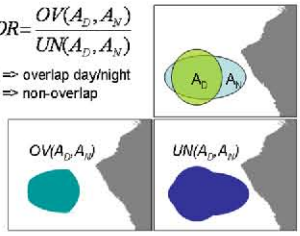
Diel shifts in the home range?

NO: We did not detect diel differences in horizontal movement patterns. We computed the **Index of Reuse (IOR)** based on fixed kernel estimators (i.e. 95%).



$$IOR = \frac{OV(A_D, A_N)}{UN(A_D, A_N)}$$

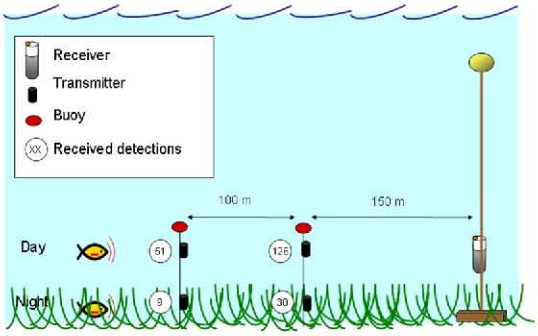
IOR=1 => overlap day/night
IOR=0 => non-overlap



Diel differential behavior related to the seagrass?

PROBABLY YES: Seagrasses have a significant effect on sound propagation due to their lacunar air system. Therefore, if during the night, *S. scriba* hid under the canopy of the seagrass, the number of detected signals should be lower at night.

SYSTEM TESTING FOR SEAGRASS: We deployed two transmitters over the seagrass and other two under the canopy.



Overall conclusion

Our findings support the hypothesis that *S. scriba* could exhibit a differential behavior, with a high activity period during the day, and a resting period under the canopy of the seagrass during the night

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