BIOACOUSTICS IN *Armadillo officinalis*

(ISOPODA, ONISCIDEA, ARMADILLIDAE)

S. SFENTHOURAKIS and A. LEGAKIS

Zoological Museum
Department of Biology
University of Athens, Greece

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First and only study so far:

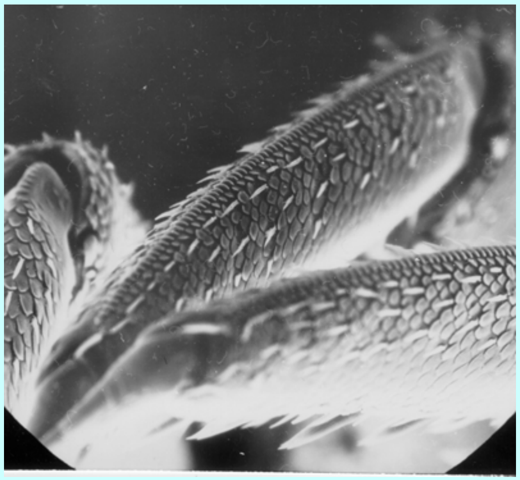
CARUSO and COSTA 1976. L'apparato stridulatore e l'emissione di suoni in *Armadillo officinalis* Dumeril (Crustacea, Isopoda, Oniscoidea). *Animalia* 3: 17-27

Schmalfuss 1996:

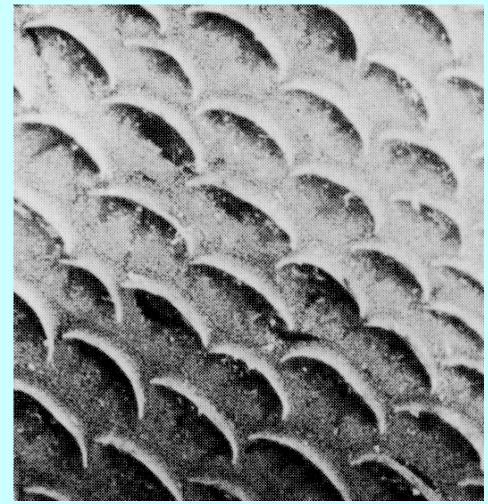
The stridulatory mechanism is a synapomorphy of the genus *Armadillo*

THE STRIDULATION MECHANISM

Plectrum in 4th and 5th propodi of pereiopods

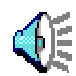


Pars stridens in ventral surface of some epimera



They can stridulate only when partially or completely rolled-up.

A defensive mechanism?



QUESTIONS ADDRESSED IN THE PRESENT STUDY REFER TO THE INTRASPECIFIC VARIATION OF SOUND PATTERNS:

- How does the sound vary in a population?
- Are males and females producing different sounds?
- Does the animal size affect the sound pattern?
- Which are the basic units of the sound?

A randomly sampled population of *Armadillo officinalis* from Spata, Attiki (Greece) was used for the analysis.

(N = 124, 45 males, 79 females)

The sex of each individual was identified and its size was measured in micrometric units as the distance between the eyes in dorsal view.

Size range: 1.7 – 4.2 m.u.

(smaller, immature, individuals were excluded because they either did not produce any sound, or their signal was very weak for proper recording)

The sound of each individual was recorded for 2min by the bat detector UltraSoundAdvice S-25 using an SM-2 microphone and the total frequency range option after mechanical stimulation (animals held between fingers), and were analyzed by the Batsound 1.1 software.

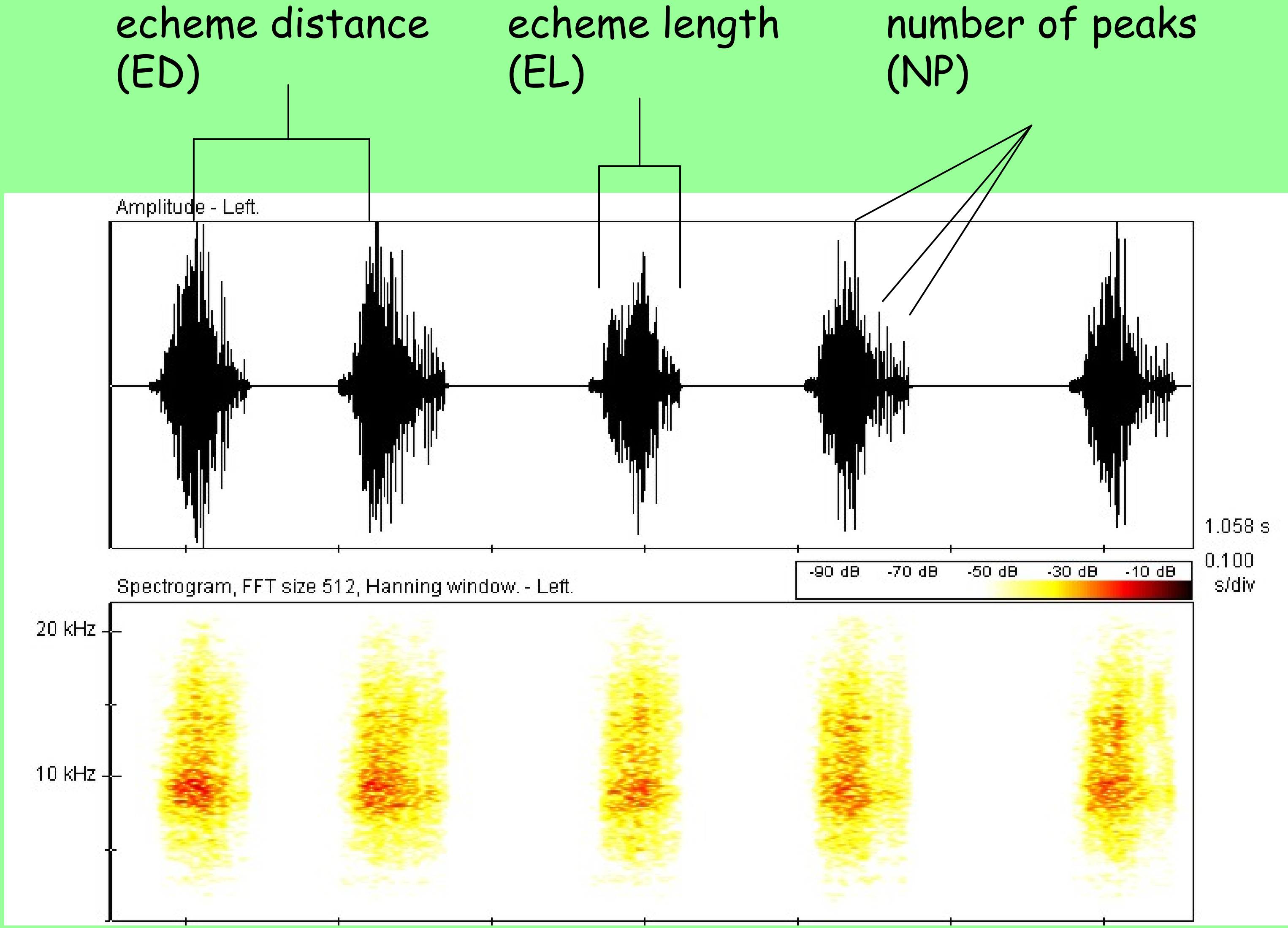
The absence of sound pattern deformation due to the ultrasound-to-audible sound transformation performed by the recorder was checked by direct sample recordings in a professional sound studio.

The stridulation leads to complex sound patterns, characterized by regions of intensive sound production and regions of sparse stridulations, depending on the physiological condition of the animal, the intensity of stimuli and possibly also the fatigue of the animal after intense stridulation.

Nevertheless, each series of stridulations is made up of similar units (echemes), corresponding to a fast sequence of several leg motions.

For each individual, we selected a series of good signal and intense stridulation in order to take 10 samples of each of the following measurements from the oscillogram:

- echeme length (in seconds)
- echeme distance (in seconds)
- number of peaks in each echeme



ECHEME MEASUREMENTS USED IN THE ANALYSIS

THE EFFECT OF SIZE

	ALL N=106	MALES N=40	FEMALES N=66
ED	**0.54***	**0.59***	**0.48***
EL	**0.36***	**0.57***	**0.27***
NP	-0.05	-0.15	-0.04

* $P<0.05$

Larger individuals have longer and more distant echemes, obviously due to their longer legs and larger scales in plectrum.

The effect of size on number of peaks is weakly negative.

THE EFFECT OF SEX

1-WAY MANOVA

	F	P
ED	2.33	0.130
EL	0.81	0.371
NP	1.18	0.279
AS	**9.37**	**0.003**

Males and females differ only in size (males are smaller).

The sound patterns are the same in both sexes.

Therefore, we can assume that the sound is not related with sexual behavior

THE MAKING UP OF THE OVERALL SOUND PATTERN

The overall sound is the composite result of the synchronous rubbing of four legs.

In order to see how is the sound pattern affected when fewer legs are used, we recorded 18 mutilated animals.

We used:

- 5 animals with 1 functional leg
- 7 animals with 2 functional legs
- 6 animals with 3 functional legs

COMPARISONS OF ANIMALS WITH DIFFERENT FUNCTIONAL LEGS

Only significant results are given

They differ only in the Number of Peaks

Functional legs	F	P
4-2	**0.941**	**0.008**
4-1	**18.602**	**0.002**
2-3	*4.599*	*0.055*
1-3	**12.424**	**0.006**

In the comparisons with non-mutilated animals, randomly chosen equal sized individuals were used

The basic structure of the sound depends on the single leg movement.

All legs are moved effectively at the same time time, with slight variation possibly due to the relative anatomy of leg positions.

WHAT NEXT ?

- Check for variation among populations
- Analysis of other species
- Is the sound species-specific ?
- Are the various morphs of the polymorphic species *Armadillo tuberculatus* producing different sounds ?
- Which (predators?) are the 'receivers' of the sound ?

An integrative method for the comparison of complex sound patterns is needed