VARIABILITY IN THE ASCARIDOID PARASITES LOAD IN THE EUROPEAN SARDINE ALONG THE HOST DISTRIBUTION AND ITS REPRODUCTIVE CYCLE

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Introduction

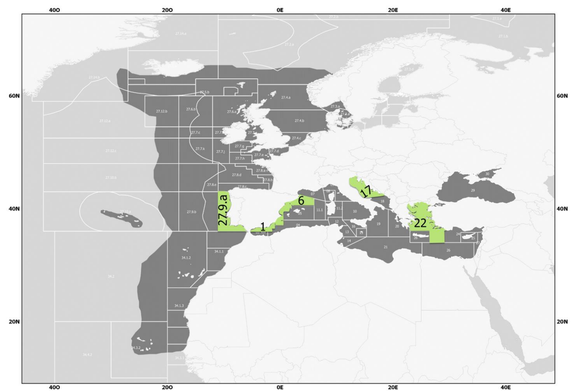
In recent years, a drop in the condition and health status of the European sardine has been observed throughout its distribution, especially in the Mediterranean Sea. Certain hypotheses have been confirmed about the environmental agents that are having the mentioned effects in the resource, such as fishing pressure, the increase in temperature as a result of the global warming, and its combination (Ramírez *et al.*, 2018; Fernández-Corredor *et al.*, 2021). Furthermore, biological factors such as food availability or parasites have been proposed as other potential agents involved.

In this regard, a gap of information is found about nematode parasitism in sardine, as it may affect host physiology, morphology, reproduction, and behaviour (Timi & Poulin, 2020).

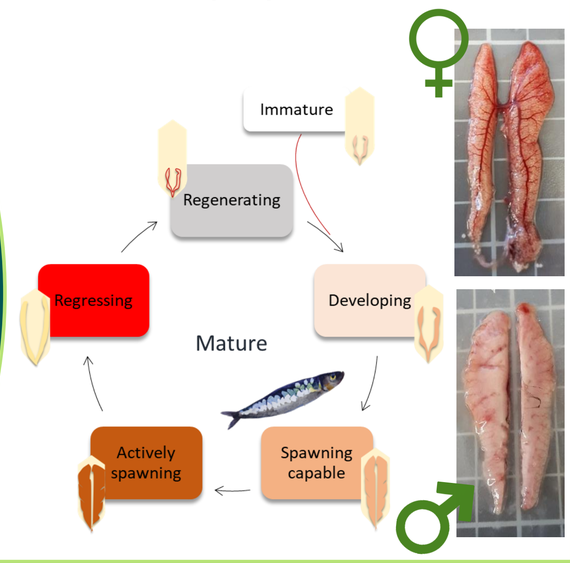
The **aim** of this study has been to characterise the nematode parasites in the European sardine along its distribution (stocks from the Atlantic and Mediterranean) by investigating the features of the infection and its occurrence throughout the reproductive cycle

Materials & methods

Sardina pilchardus (N = 760) were collected seasonally (period 2019 - 2021) from five areas along the Mediterranean, and one location in the Atlantic Ocean (Southern Portugal).



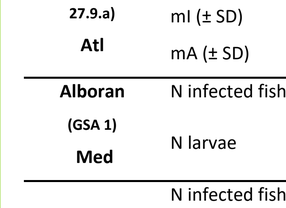
The sex and the gonadal developmental stage were determined according to the criteria of Brown-Peterson *et al.* (2011), and supported by gonadosomatic index (GSI) calculations.



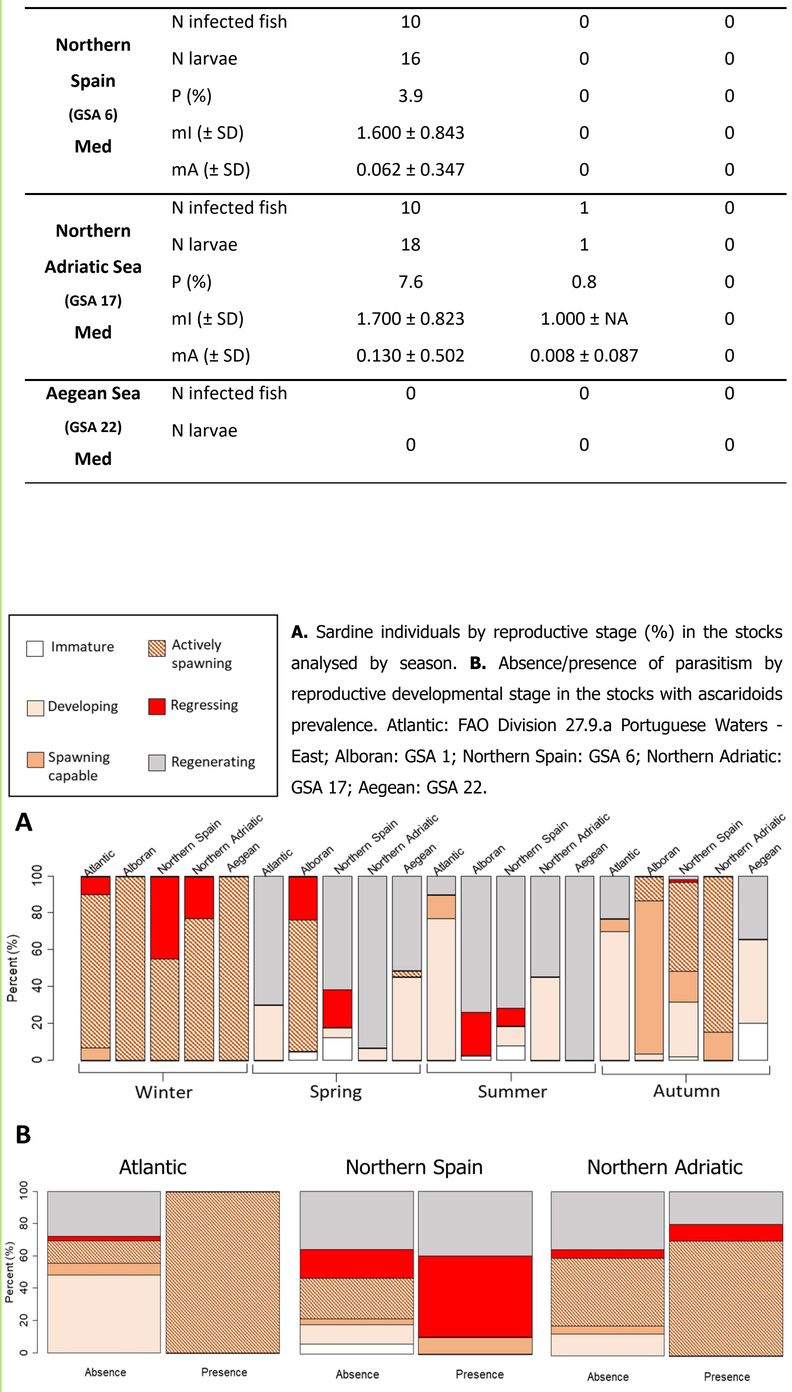
Results & discussion

Ascaridoid load by stock analysed

Subarea	Infection parameters	Ascaridoid genus		
		Hysterothylacium aduncum	*Anisakis pegreffii*	*Anisakis simplex* (s.s.)
South Portugal (FAO Division 27.9.a) Atl	N infected fish	9	1	2
	N larvae	35	1	3
	P (%)	7.5	0.8	1.7
	mI (± SD)	3.889 ± 5.278	1.000 ± NA	1.500 ± 0.707
	mA (± SD)	0.292 ± 1.712	0.008 ± 0.091	0.025 ± 0.203
Alboran (GSA 1) Med	N infected fish	0	0	0
	N larvae	0	0	0
Northern Spain (GSA 6) Med	N infected fish	10	0	0
	N larvae	16	0	0
	P (%)	3.9	0	0
	mI (± SD)	1.600 ± 0.843	0	0
	mA (± SD)	0.062 ± 0.347	0	0
Northern Adriatic Sea (GSA 17) Med	N infected fish	10	1	0
	N larvae	18	1	0
	P (%)	7.6	0.8	0
	mI (± SD)	1.700 ± 0.823	1.000 ± NA	0
	mA (± SD)	0.130 ± 0.502	0.008 ± 0.087	0
Aegean Sea (GSA 22) Med	N infected fish	0	0	0
	N larvae	0	0	0

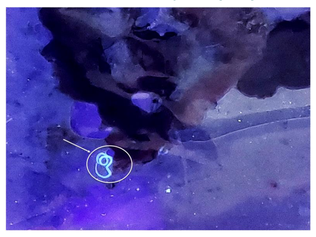


A. Sardine individuals by reproductive stage (%) in the stocks analysed by season. **B.** Absence/presence of parasitism by reproductive developmental stage in the stocks with ascaridoids prevalence. Atlantic: FAO Division 27.9.a Portuguese Waters - East; Alboran: GSA 1; Northern Spain: GSA 6; Northern Adriatic: GSA 17; Aegean: GSA 22.



UV-press results

Anisakis simplex (s.s.)



Hysterothylacium aduncum

Sardines in active spawning and post-spawning (regressing and regenerating) were the stages in which parasitisation was present. *A. pegreffii* and *A. simplex* (s.s.) were identified in the Atlantic waters of the Southern Iberia. This sympatric event, as well as some hybridization between the anisakids, have been previously described (Mattiucci *et al.*, 2016). In this stock, the highest ascaridoid intensity and abundance were determined. After the spawning period of sardine involving autumn and winter in GSA 6, individuals started to feed intensively to recover from the reproduction investment, following the capital breeder strategy (McBride *et al.*, 2015). In this way, it could be expected that the ability to acquire parasites through diet at the beginning of the reserve storage season is higher. Ascaridoid prevalence in the Northern Adriatic was significantly higher, probably related to production, as this system is one of the major chlorophyll hot spots in the Mediterranean due to the nutrient discharge from the Po River and small rivers (Caballero-Huertas *et al.*, 2022).

- UV-press method was applied for ascaridoid finding, based on the fluorescence of frozen ascaridoid larvae, which allows the visual inspection of pressed and subsequently deep-frozen fish fillets or viscera under UV-light exposure at 366 nm in a darkened room.
- Visual identification to genus level was carried out.
- Then, ITS region of rDNA and mitochondrial cytochrome c oxidase subunit II (mtDNA cox2) were amplified and Sanger sequenced to obtain genetic verification of the species.

Conclusion

The ecology and behaviour of the host, and the interplay of host-parasite and host-ecosystem interactions are the responsible for the parasitic variability in fish by species, population, and region, as well as for the divergence of parasitisation in the same fish stock throughout the year. Future studies that analyse the potential impact of nematodes on sardine stocks covering its entire distribution along the year are required.

Acknowledgements

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