Cristiano Boiti · Adriana Ferlazzo
Alberto Gaiti · Antonio Pugliese *Editors*

# Trends in Veterinary Sciences

## Current Aspects in Veterinary Morphophysiology, Biochemistry, Animal Production, Food Hygiene and Clinical Sciences

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*Editors*
Cristiano Boiti
Dipartimento di Scienze Biopatologiche
Università degli Studi di Perugia
Perugia
Italy

Alberto Gaiti
Dipartimento di Patologia, Diagnostica
Università degli Studi di Perugia
Perugia
Italy

Adriana Ferlazzo
Dipartimento Scienze veterinarie
University of Messina
Messina
Italy

Antonio Pugliese
Dipartimento Scienze veterinarie
Università degli Studi di Messina
Messina
Italy

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# Part I
# Biology and Reproduction

# Chapter 1
# Seasonal Effect on Hematological and Innate Immune Parameters in Sea Bass (*Dicentrarchus labrax*)

**Francesco Pascoli, E. Negrato, C. Poltronieri, G. Radaelli and D. Bertotto**

**Abstract** The temperate aquatic environment is affected by two primary seasonal components, temperature and photoperiod. Many organisms respond to seasonal change physiologically, behaviorally or both. The aim of this study was to investigate the effect of seasonality on cortisol, hematological, and innate immune parameters in European sea bass (*Dicentrarchus labrax*) reared under traditional semi-intensive aquaculture. Sea bass were reared in an outdoor pond. Serum cortisol, hematocrit, leucocrit, serum lysozyme activity, and total glutathione (GSH) were monitored bimonthly for 14 months. An effect of seasonality was observed for all parameters, with generally higher values in summer and lower values in winter. These results could improve the understanding of the influence of seasonal cues on the immune system and the stress response in fish, to optimize husbandry practices.

**Keywords** Fish · Innate immunity · Cortisol · Hematology

## 1.1 Introduction

In the literature, there are numerous studies on the influence of seasonality on fish physiology. The temperate aquatic environment is influenced throughout the year by two main seasonal cues, temperature and photoperiod (Morgan et al. 2008). In fish, seasonality coordinates reproduction, affects body weight and

F. Pascoli (✉) · E. Negrato · C. Poltronieri · G. Radaelli · D. Bertotto
Dipartimento di Biomedicina Comparata e Alimentazione,
Università degli Studi di Padova, Legnaro (PD), Italy
e-mail: francesco.pascoli@unipd.it

D. Bertotto
e-mail: daniela.bertotto@unip.it

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physiological status, regulates food intake and locomotion, and is thought also to coordinate the immune response (Bowden et al. 2007). In general, physiological parameters are reduced in winter and raised in summer (Bowden et al. 2007).

The purpose of this study was to investigate the effects of seasonality on growth, cortisol, immunological, and hematological parameters in sea bass reared according to conventional semi-intensive method over a period of 14 months.

## 1.2 Materials and Methods

Juvenile sea bass (*Dicentrarchus labrax*) were reared in an outdoor tank from May 2009 to July 2010 and monitored every 2 months (initial weight 69 g; final weight 350 g; stocking density 2–12 kg/m$^3$). At each sampling, 20 animals were caught and measured (total and standard length and weight) to observe growth and condition factor (K). Blood samples were collected from the caudal vein. Serum cortisol analysis was carried out by radioimmunoassay (RIA), as described by Simontacchi et al. (2008). Hematocrit and leucocrit were obtained by micro-centrifugation of whole blood (12,500 rpm for 5 min). Serum lysozyme activity was measured by a turbidimetric assay, as described by Parry et al. (1965). Total glutathione (GSH) was determined by an enzymatic assay adapted to microtiter plate (Baker et al., 1990).

## 1.3 Results

Weight increased from 69.1 $\pm$ 3.0 g to 345.5 $\pm$ 13.6 g after 14 months. During this period, the condition factor worsened from 1.02 $\pm$ 0.03 to 1.21 $\pm$ 0.01, with the lowest values in December 2009, January 2010, and March 2010 (0.94 $\pm$ 0.02, 0.94 $\pm$ 0.02, and 0.95 $\pm$ 0.02, respectively) and a significant increase in May and July 2010 (1.22 $\pm$ 0.02 and 1.21 $\pm$ 0.01, respectively).

Serum cortisol was significantly higher in May 2009, May 2010, and July 2010 compared to the other months ($p < 0.05$; Fig. 1.1). The lowest levels were recorded in October and December 2009, and January and March 2010 ($p < 0.05$).

The hematocrit was significantly lower in January and March 2010 than the other samples ($p < 0.05$; Fig. 1.2). The leucocrit was significantly lower in December 2009, January 2010, and March 2010 compared to the other months ($p < 0.05$; Fig. 1.3). The highest value was recorded in October ($p < 0.01$).

Serum lysozyme activity increased from May to October 2009, then decreased until January 2010 and increased again after that point (Fig. 1.4). The lowest values were recorded in January ($p < 0.01$). Higher values were found in July 2010 than in May, July, and December 2009 and March 2010, but these were not significantly different from those in October 2009 and May 2010.

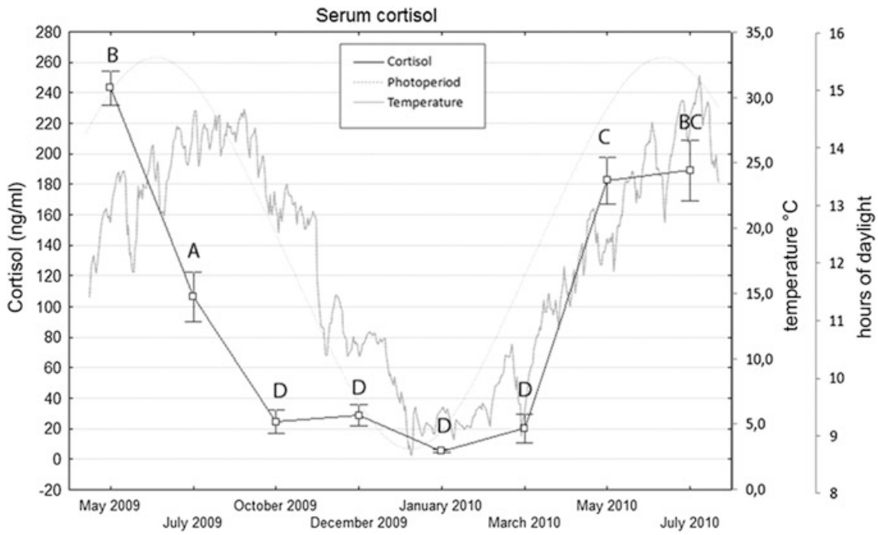


**Fig. 1.1** Variations in serum cortisol of sea bass over a 14-month period (mean ± SE). *Different letters* indicate significant differences ($p < 0.05$)

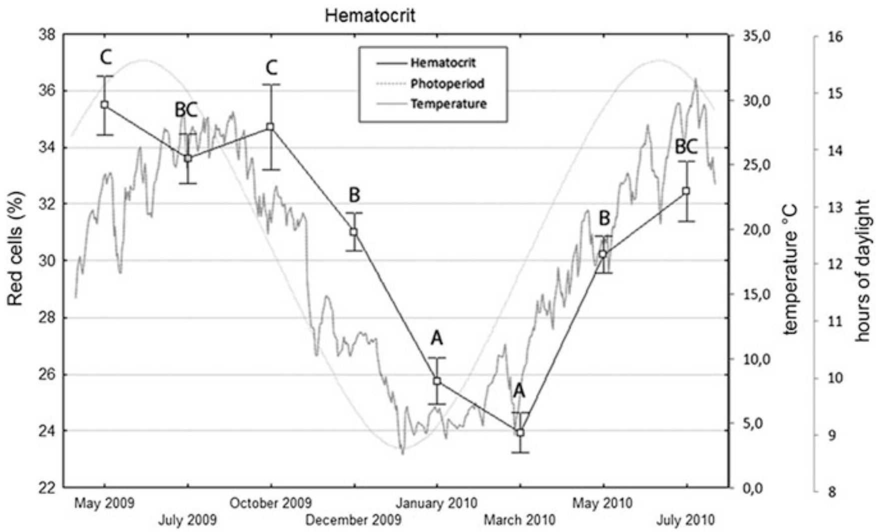


**Fig. 1.2** Variations in hematocrit of sea bass over a 14-month period (mean ± SE). *Different letters* indicate significant differences ($p < 0.05$)

The GSH decreased from July to December 2009 and then increased until July 2010 (Fig. 1.5). The lowest values were found in October and December 2009 and January and March 2010, and the highest were in July 2010 ($p < 0.05$).

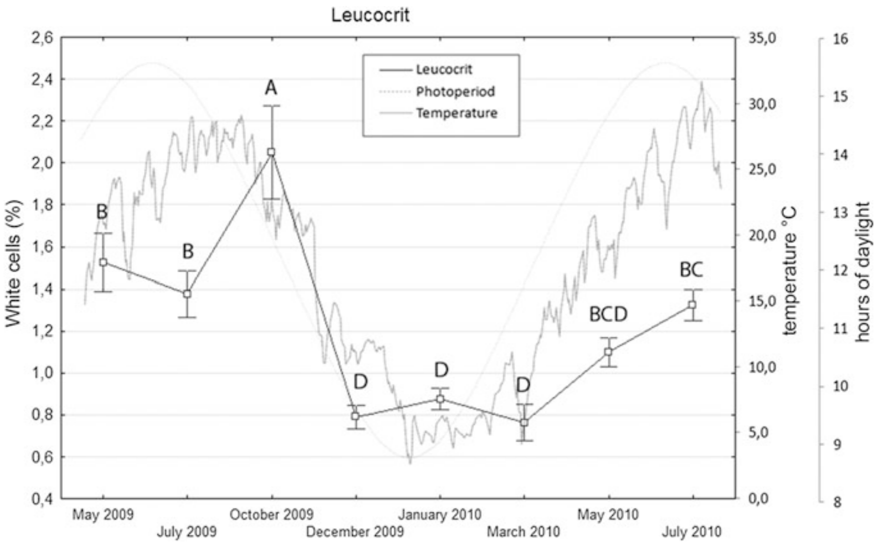


**Fig. 1.3** Variations in leucocrit of sea bass over a 14-month period (mean ± SE). *Different letters* indicate significant differences ($p < 0.05$)

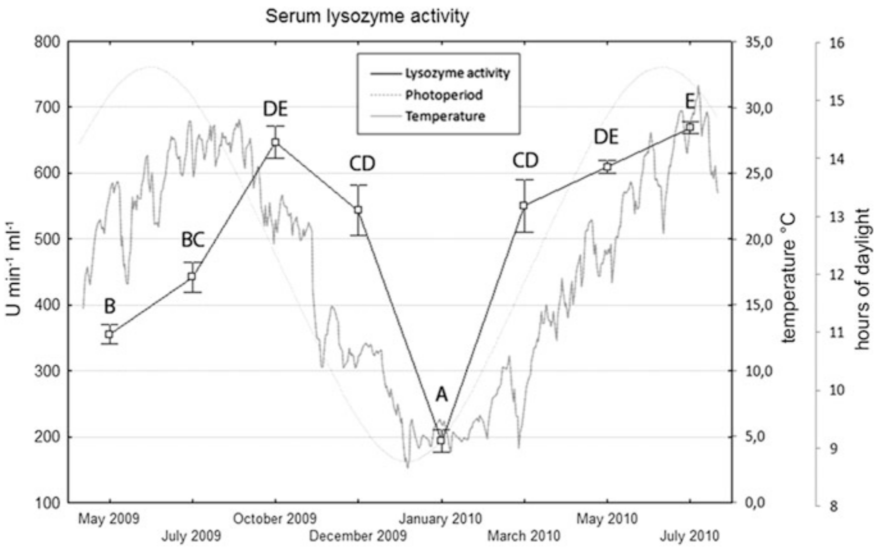


**Fig. 1.4** Variations in serum lysozyme activity of sea bass over a 14-month period (mean ± SE). *Different letters* indicate significant differences ($p < 0.05$)