

## ***Caligus minimus* (COPEPODA, CALIGIDAE) INFESTATION OF EUROPEAN SEA BASS (*Dicentrarchus labrax*) FROM BEYMELEK LAGOON LAKE (ANTALYA, TURKEY): EFFECTS OF HOST SEX, AGE, SIZE AND SEASON**

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### **ABSTRACT**

In this study, an ectoparasitic copepod, *Caligus minimus* Otto, 1821 infestation of European sea bass, *Dicentrarchus labrax* (Linnaeus, 1758) caught from Beymelek Lagoon (Antalya, Turkey) was investigated. Fish sampling was carried out seasonally between October 2008 and July 2009. A total of 87 European sea bass was collected and examined. Their total body lengths and weights ranged from 23 to 44.3 cm and from 180 to 896 g for males, from 28 to 47.8 cm and from 179 to 957 g for females, respectively. The age distributions of fish were between 2 and 5 years. Out of 87 samples, 23 were infected with *C. minimus*. Although the prevalence and intensity of *C. minimus* were neither affected with host sex, nor size and age, its infestation showed a significant seasonal variation. The prevalence of *C. minimus* increased gradually from the autumn to the winter, reached the maximum in the spring and declined to the minimum in the summer.

**Key words:** *Caligus minimus*, *Dicentrarchus labrax*, Beymelek Lagoon, Mediterranean, Turkey

## **BEYMELEK LAGÜN GÖLÜ'NDEN YAKALANAN AVRUPA LEVREK BALIKLARINDA (*Dicentrarchus labrax*), *Caligus minimus* (COPEPODA, CALIGIDAE) ENFESTASYONU: KONAK CİNSİYETİ, YAŞI, BÜYÜKLÜĞÜ VE MEVSİMİN ETKİSİ**

### **ÖZET**

Bu çalışmada, Beymelek Lagün Gölü'nden yakalanan *Dicentrarchus labrax* (Linnaeus, 1758)'da ektoparazitik kopepod *Caligus minimus* Otto, 1821 enfestasyonu incelenmiştir. Balık örnekleme çalışmaları Ekim 2008-Temmuz 2009 tarihleri arasında yürütülmüştür. Toplam 87 levrek balığı yakalanmış ve incelenmiştir. Erkek bireylerde vücut uzunluğu 23 ila 44.3 cm ağırlık 180 ile 896 gram arasında değişirken dişi bireylerde vücut uzunluğu 28 ile 47.8 cm ağırlık 179 ile 957 gram arasında değişmiştir. İncelenen balıkların yaş dağılımı 2-5 arasında bulunmuştur. 87 balık örneğinden 23 tanesinin *C. minimus* ile enfekte olmuştur. Konak yaşı, büyüklüğü ve cinsiyete göre *C. minimus*'un yaygınlığı ve yoğunluğunda bir farklılık bulunmamasına rağmen mevsimlere göre önemli derecede değişim göstermiştir. *C. minimus*'un yaygınlığı sonbahardan itibaren artış gösterip ilkbahar aylarında maksimuma ulaşmış ve yaz aylarında minimum seviyeye inmiştir.

**Anahtar kelimeler:** *Caligus minimus*, *Dicentrarchus labrax*, Beymelek Lagünü, Akdeniz, Türkiye

### **INTRODUCTION**

It is a general recognition that fish have an important role in meeting nutritional requirements of rapidly growing human population. Fish farming makes a significant contribution to sustainability of wild fish stocks. Although aquaculture in Turkey shows a rapid

growth as in many parts of the world, fish diseases remain one of the most important challenges of the sector. Parasites as a disease agent may have a negative impact on growth performance and survival of cultured as well as wild fish populations. Parasitic crustaceans belonging to Brachiura, Isopoda and Copepoda are

known as parasites of marine and inland fish (Ragias et al. 2004, Boxshall et al. 2005, Jithendran and Azad 2008). Among these, parasitic copepods are commonly found on cultured and wild fish in marine and inland waters (Johnson et al. 2004, Piasecki et al. 2004, Boxshall and Defaye 2008). The genus *Caligus* Müller, 1785, belonging to the family Caligidae Burmeister, 1835 (Siphonostomatoida), have more than 250 parasitic species (Ho et al. 2000). There are many studies on the other species of caligids compared with *C. minimus* (Mo and Heuch 1998, Schram et al. 1998, Heuch et al. 2000, Ho et al. 2000, Gonzalez and Jarcaval 2003, Nagasawa 2004, Todd 2007, Vo et al. 2008). Moreover, available literature on *C. minimus* has generally focused on cultured European sea bass and other marine fish (Sterud 2002, Ragias et al. 2004, Mladineo 2005, 2006, Merella et al. 2006, Tanrikul and Perçin 2012). Although there are many faunistic and ecological studies on metazoan parasites of fishes living in marine and inland waters of Turkey, few studies have been reported on metazoan parasites especially ectoparasitic copepods in lagoon lakes of Turkey (Cengizler et al. 2001, Öztürk and Aydoğdu 2003, Özak 2007, Canlı 2010). In our study area, only one study on the helminth parasites of European Sea Bass was carried out by Emre (2010). Seven species of the genus have been reported on Turkish marine fish species and immigrant fish species; *C. pageti* Russel, 1925 (Altunel 1983), *C. minimus* (Tokşen 1998, Cengizler et al. 2001, Uluköy and Kubilay 2005, Özak 2007, Canlı 2010), *C. bonito* (Öktener and Trilles 2009), *C. temnodontis* (Özak et al. 2010), *C. fugu* (Özak et al. 2012), *C. apodus* and *C. brevicaudatus* (Özak et al. 2013). There is paucity of information about the infestation of *C. minimus* in natural environments. Therefore, this study was planned to determine the *C. minimus* infestation of European sea bass population in Beymelek Lagoon according to season, host sex, size and age.

## MATERIALS AND METHODS

### Study site

The Beymelek Lagoon is located in the southwestern Mediterranean coast, Turkey (30° 04' E, 36° 16' N). The lagoon has a total surface area of 255 ha and a brackish water body. Over the study period, water temperature and salinity ranged from 13 to 29 °C and from 11‰ to 14‰, respectively.

### Fish sampling and microscopic examination

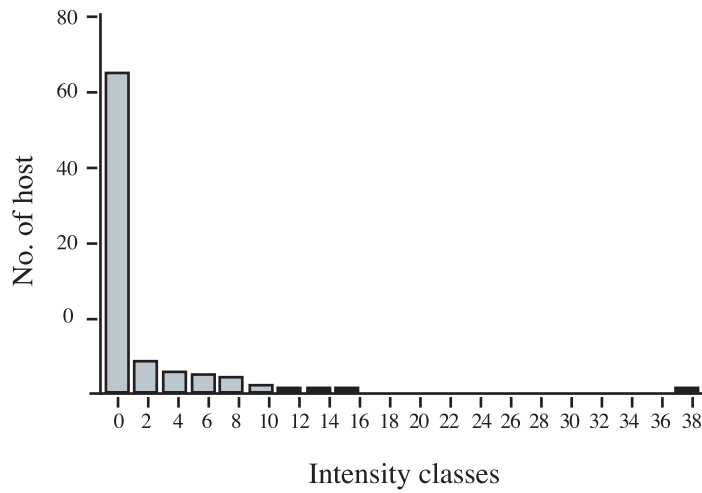
The fish samples were caught seasonally between October 2008 and July 2009 from the Beymelek Lagoon Lake. Total body lengths and weights of the samples were measured to the nearest 0.5 mm and 0.1 g respectively. The sex of samples was determined with examination of the gonads. Sample ages were determined from scales as described by Lagler (1966). The skin, nostril, buccal cavity, eyes and gills of each fish sample were examined under a stereo microscope to determine parasite specimens and number as well as infested fish samples.

### Statistical analysis

The parasitologic parameters including the prevalence, mean intensity, median intensity and mean abundance were calculated according to Bush et al. (1997). Confidence intervals were calculated for the prevalence using Sterne's exact method (Reiczigel 2003), and for the mean intensity and mean abundance using the bootstrap confidence interval (Rózsa et al. 2000). We tested differences in the prevalence and the median intensity of parasite between sexes, sizes, ages of host and seasons using the Fisher's exact test and Mood's median tests (Rózsa et al. 2000) and differences in the mean intensity and mean abundance of parasite between sexes using two-sample bootstrap t-tests (Reiczigel et al. 2005). The statistical analyses were conducted using Quantitative Parasitology 3.0 (Rózsa et al. 2000, Reiczigel and Rózsa 2005).

## RESULTS

A total of 87 European sea bass samples were caught seasonally between October 2008 and July 2009 from the Beymelek Lagoon. Total lengths and weights of European sea bass ranged from 23 to 44.3 cm and from 180 to 896 g for males, from 28 to 47.8 cm and from 179 to 957 g for females, respectively. The age distribution of the fish ranged from 2 to 5 years. All *C. minimus* specimens were only found on the gills of European sea bass during the study period. Twenty three of 87 European sea bass samples were infected with *C. minimus* (Table 1). Overall prevalence, mean intensity and mean abundance of *C. minimus* were 29.8%, 6.22 and 2.07, respectively. The intensity of *C. minimus* ranged from 1 to 37 parasites per the host sample (Figure 1). Seventeen of fifty five male European sea bass and



**Figure 1.** Frequency distribution of *C. minimus* in a total of eighty-seven European sea bass samples

six of thirty-two female European sea bass were infected with *C. minimus*. Although the parasite prevalence for male European sea bass was higher than that of female, the mean intensity and abundance for male were lower compared with female (Table 1). Accordingly, the prevalence of *C. minimus* was 30.9% in the male and 18.8% in the female. The mean intensity and mean abundance were 5.24 and 1.62 for male, and 11 and 2.06 for female, respectively (Table 1). There were no significant differences in the prevalence, mean intensity and mean abundance of parasite between sexes according to the Fisher exact's test and bootstrap two-sample t test ( $P=0.31$ ,  $t=1.04$ ,  $P=0.41$ ,  $t=0.34$ ,  $P=0.73$ , respectively). The infestation level of *C. minimus* according to host size and age are

summarized in Table 2 and Table 3, respectively. *C. minimus* was found on all size classes of *D. labrax*. The highest and the lowest prevalences were determined in the largest size class with 30% and in the third size class with 14.3%, respectively (Table 2). The highest mean intensity and mean abundance were determined in the largest size class with 13.67 and 4.10 whereas the lowest in the smallest size class with 4 and 1.09, respectively (Table 2). The Fisher's exact test and Mood's median test showed that the parasite prevalence and median intensity were not significantly different among the size classes ( $P=0.94$ ,  $P=0.47$ , respectively). *C. minimus* was found in all ages of *D. labrax*. The prevalence varied between 13.3% at 3 years class and 37.5% at 5 years class

**Table 1.** The prevalence, mean intensity and abundance of *C. minimus* according to host sex

Host sex	No of host	No of infected host	Prevalence (%)	Intensity range	Mean intensity	Mean abundance
Male	55	17	30.90	1-15	5.24	1.62
Female	32	6	18.80	2-37	11.00	2.06
Total	87	23	26.40	1-37	6.74	1.78

**Table 2.** The prevalence, mean intensity and abundance of *C. minimus* according to host size classes

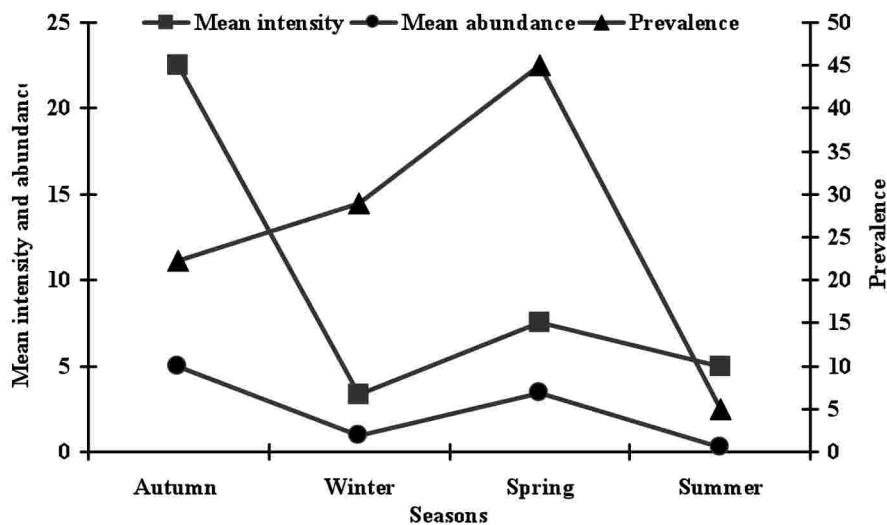
Size classes	No of host	No of infected host	Prevalence (%)	Intensity range	Mean intensity	Mean abundance
I. 23-28 cm	11	3	27.30	2-5	4.00	1.09
II. 29-34 cm	59	16	27.10	1-15	5.88	1.59
III. 35-39 cm	7	1	14.30	8	8.00	1.14
IV. 40-47 cm	10	3	30.00	1-37	13.67	4.10

**Table 3.** The prevalence, mean intensity and abundance of *C. minimus* according to host age classes

Age classes	No of host	No of infected host	Prevalence (%)	Intensity range	Mean intensity	Mean abundance
2	59	17	28.80	89 (1-15)	5.24	1.51
3	15	2	13.30	17 (7-10)	8.50	1.13
4	5	1	20.00	8 (8)	8.00	1.60
5	8	3	37.50	41 (1-37)	13.67	5.13

**Table 4.** The prevalence, mean intensity and abundance of *C. minimus* according to season

Season	No of host	No of infected host	Prevalence (%)	Intensity range	Mean intensity	Mean abundance
Autumn	9	2	22.20	45 (8-37)	22.50	5.00
Winter	38	11	28.90	37 (1-7)	3.36	0.97
Spring	20	9	45.00	68 (1-15)	7.56	3.40
Summer	20	1	5.00	5 (5)	5.00	0.25

**Figure 2.** Seasonal changes in the prevalence, mean intensity and abundance of *C. minimus*

(Table 3). The highest mean intensity and abundance were observed in the oldest age class (5 years old) with 13.67 and 5.13 whereas the lowest values in the youngest age class (2 years old) with 5.24 and 1.51, respectively (Table 3). The prevalence and median intensity did change significantly among the age classes according to the Fisher's exact test and Mood's median test ( $P=0.55$ ,  $P=0.07$ , respectively). *C. minimus* on the gills were observed in all seasons with a pronounced variation. The prevalence increased gradually from the autumn to the winter (22.20%, 28.90%) and reached the highest value in the spring with 45%, and

subsequently declined to the lowest value in the summer with 5% (Table 4, Figure 2). The highest mean intensity and mean abundance were recorded in the autumn with 22.5 and 5 while the lowest values were recorded in the winter with 3.36 and 0.25 respectively (Table 4, Figure 2). The mean intensity and abundance declined in the winter, slightly increased in the spring, sharply declined again in the summer and then reached the maximum in the autumn (Figure 2). The parasite prevalence and median intensity significantly changed among the seasons according to the Fisher's exact test ( $P=0.02$ ) and Mood's median test ( $P=0.01$ ).

## DISCUSSION

*C. minimus* infestation of European sea bass from the Beymelek Lagoon was found to be lower compared with other coastal lagoons located along the Mediterranean shore. For instance, Bahri et al. (2002) found that its prevalence on European sea bass in the El Biban Lagoon, Tunis North Lagoon and Gulf of Tunis were 97.77%, 52.17% and 45.45%, respectively. They pointed out that the differences in the parasite prevalence among the studied areas are due to larger size of fish samples captured from the El Biban Lagoon. Ragias et al. (2004) investigated some *Caligus* spp. infection of cultured sea bass in Eratino Lagoon, North Greece, and determined that the prevalence of *C. minimus* was very high changing between 85.7% and 97.9% through the year. Canlı (2010) found that *C. minimus* prevalence of European sea bass in the Hurmaboğazi Lagoon, Turkey, was 16% in only November. In the present study, the prevalence of *C. minimus* ranged between 5% and 45%. The salinity values of the Beymelek Lagoon measured over the study (11‰-14‰) were lower than the other Mediterranean lagoons. The low salinity may be a reason of the low prevalence of *C. minimus*. Abiotic factors like temperature, salinity and light are known to affect life cycle duration, developmental capabilities of eggs and free-swimming stages of parasites (De Meeûs et al. 1995, Heuch 1995, Knudsen and Sundnes 1998, Heuch et al. 2000, Gonzalez and Jarcaval 2003, Özak 2007). Todd et al. (2000) reported that *L. salmonis* infestations of wild Atlantic salmon (*Salmo salar* L.) captured in estuarine of Firth of Tay, East Scotland were lower than those captured in marine coastal waters of Strathy Point, North Scotland. They notified that low infestation levels in the estuarine environment could be influenced by fish sampling method or brackish water. The impacts of temperature, salinity, light and aeration were found to have significant effects on the lengths of nauplius and copepodite stages of *C. minimus* by Özak (2007), who determined that optimum salinity, temperature and photoperiod conditions for transition from free living stages to parasitic stage were 36‰, 15 - 21 °C and 12 light-12 dark respectively. Additionally, all developmental stages were completed between 10‰ and 36‰ but activity and reproduction of the parasite stopped at water temperatures above 24 °C. Water temperature of the Beymelek Lagoon Lake ranged

between 13 and 29 °C during the study. Uluköy and Kubilay (2005) reported that *C. minimus* infestation of cultured European sea bass was observed in a marine net cage farm between October and November 2004, when the temperature was measured between 17 to 19 °C. Akmırza (2010) carried out investigation on the monogenean trematods and crustacean parasites of the cultured and wild marine fishes near Salih Island, Bodrum, Turkey and *C. minimus* of cultured European sea bass was only observed in October 2008 during the study. In the present study, infestation level of *C. minimus* significantly varied among the seasons. The prevalence of *C. minimus* reached the highest value in the spring and the lowest value in the summer. The highest mean intensity and abundance were determined in the autumn whereas their lowest means were in the winter and summer, respectively. These results are inconsistent with the findings of several previous studies. Ragias et al. (2004), for example, reported that the highest and lowest *C. minimus* prevalence and intensities of the cultured sea bass were determined in the winter, and in the spring and autumn, respectively. These researchers ascribed this to that fish may become more sensitive to pathogenic species following previous breeding period, and since fish moved to wintering basins where swimming activity and water current were low, the parasites were able to easily transmitted from fish to the fish. Schram et al. (1998) reported that the prevalence and the median intensity of *L. salmonis* and *C. elongatus* on wild sea trout increased in the spring but declined in the winter. The differences in infestation levels of *C. minimus* in the present study can be attributed to changes in water temperature and salinities and also fish migration period, which strictly depends on closing and opening the fish barriers at the lagoon gate. The results obtained are in line with those reported by Paperna (1980), who recorded distinct seasonal changes in the prevalence and intensity of *C. minimus* in the Bardawil Lagoon, Egypt, mainly because of variations in water temperature and salinity. In this study, the mean abundance and mean intensity of *C. minimus* for the female European sea bass were higher compared with the male. The female European sea bass were larger than male. Although host sex, size and age are important factors for the parasite loads, these were not the case in current study. Similarly, Schram et al. (1998) notified that host age and condition factors were not correlated

with the intensity of *L. salmonis* and *C. elongatus*. Merella et al. (2006) reported that infection levels of *L. kroyeri* were found to be correlated with age and size of host, but this was not the case for *C. minimus* and *Ceratothoa oestroides*. Seasonal occurrences and infestations of the parasites may differ due to abiotic factors, life cycle duration, abundance of copepodites, host sex, age or size. The present study indicates that infestation of *C. minimus* was not influenced by host sex, age and size but significantly changed with season.

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