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Research Article

Histopathology of gill parasites ın cultured seabream *(Sparus Aurata)* and seabass *(Dicentrarchus Labrax)*

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ABSTRACT

This study was carried out to define the gill parasitic diseases and histopathological findings of sea bream and sea bass cultured in Turkey. Dead fish suspected of disease that came to the Kanyon Akua Veterinary Clinic Disease Diagnosis Laboratory between January 2021 and January 2022 were included in the study. A total of 5,250 fish, including 3,150 sea bass *(Dicentrarchus labrax) (D. labrax)* and 2,100 sea breams *(Sparus aurata) (S. aurata)*, weighing between 2-350 g, were used in the study. After the measurement of total length and weight, samples were divided into groups for pathological and parasitological examinations. Eight different parasites were detected that caused intense infestation in sea bream and sea bass. Among these, *Diplectanum spp.*, *Cryptocaryon spp.*, *Amyloodinium spp.*, *Trichodina spp.*, *Cryptobia spp.*, and *Costia spp.* were seen in sea bass. Parasites seen in sea bream were *Microcotyle spp.*, *Furnestinia spp.*, *Trichodina spp.*, and *Costia spp.*, *Trichodina spp.* and *Costia spp.* were seen in both sea bass and sea bream. The most common histopathological findings were epithelial lifting, necrosis, hemorrhage, telangiectasia, lamellar fusion, spills, infiltration of macrophage, lymphocyte and eosinophilic granulated cells. The most common parasitic agent in the field sea bass was *Diplectanum spp.* and the most common parasitic agent in sea bream was *Microcotyle spp.* The highest mortality (10%) and the severe histopathological lesions were detected in *Amyloodinium spp.* The incidence of multiple agents (multi-parasitism) in the cases was higher than the incidence of single agents.

INTRODUCTION

In recent years, the increasing population and therefore the need for protein has led to an increase in the demand for aquatic products. The fact that aquaculture resources are not infinite and efficient use has become a necessity that has led to the development of sustainable production (Arıkan and Aral, 2019; Demir, 2011; FAO, 2018; TAGEM, 2019).

The intensification of aquaculture and the globalization of seafood trade have led to a remarkable development in the aquaculture industry. However, the aquaculture industry is also grappling with disease problems caused by viral, bacterial, fungal, and parasitic pathogens. The most important parasites for farmed sea bass and/or sea bream are *Microcotyle spp., Diplectanum spp., Furnestinia spp., Cryptocaryon spp., Amyloodinium spp., Trichodina spp., Chilodonella spp., Scuticociliate spp., Epistylis spp., Cryptobia spp.,* and *Costia spp* (Çoban et al., 2020).

Disease outbreaks in aquaculture are becoming more frequent and cause significant mortality rates and economic losses. Therefore, diseases are undoubtedly one of the biggest constraints to the profitability and sustainability of aquaculture. Increasing growth is directly related to the effort to reduce the gap between supply and demand for fish products. However, parasitic infections and other related diseases have emerged in aquaculture systems in many parts of Europe, causing significant economic losses. Marine wild fish are believed to be the primary reservoirs of parasite infection for cage-raised fish. However, environmental conditions in aquaculture systems can facilitate disease transmission thereby threatening the productivity. (Antonelli et al., 2010, Çoban et al., 2020).

The negative effects of gill pathologies caused by gill parasites in aquaculture farms are not taken into consideration sufficiently. Fish diseases, which have become increasingly more complicated in recent years, have created a need for veterinarians to be employed who specialize in fish diseases. Although there are many studies on gill parasites in our country, the limited number of studies on their histopathological findings increases the value of our study. The purpose of our study was to diagnose and reveal the histopathology of gill parasites seen in sea bream (*Sparus aurata*) and sea bass (*Dicentrarchus labrax*) cultured in Turkey.

MATERIALS and METHODS

Study site

Dead fish samples with suspicion of disease were used in the study which were brought to the disease diagnosis laboratory of Kanyon Akua Veterinary Clinic between January 2021 and January 2022. In the study, a total of 5,250 fish weighing between 2-350 g were used, 3,150 of these were sea bass (*D. labrax*) and 2,100 were sea bream (*S. aurata*). After the total length and weight of the samples were measured, they were divided into groups for pathological and parasitological examinations.

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Pathological Examination

Approximately 2-3 transverse sections were made on fish weighing between 2-5 g. Gills were fixed in 10% buffered formalin solution. All gill arches of fish larger than 5 g were removed and fixed in 10% buffered formalin solution and routinely processed for histological examination (graduated alcohol series and xylene) and by embedding in paraffin wax to use for histopathologic evaluations. A five **µm thick section w**as taken from the tissues, which were routinely monitored on an automatic tissue tracking device (Leica TP 1020) and deparaffinized in xylene, treated in graduated alcohol series respectively. All sections were stained with hematoxylin-eosin (HxE) and examined under a light microscope (Olympus BX 51) (Culling et al., 1985; Roberts, 2012).

Parasitological Examination

Preparations were prepared by taking scrapings from the right gill arches of fish that had just died and were sent to the laboratory. The left gill arches were removed separately and placed in petri dishes containing sterile sea water. It was quickly examined under stereo and light microscopes. Identification of parasites seen in gills was made based on morphological criteria. Only protozoan parasites were photographed by applying Giemsa stain (Lom, 1958; Roberts, 2012; Stoskopf, 1993).

RESULTS

The most common parasitic agent in the sea bass in the field was *Diplectanum spp.* and the most common parasitic agent in seabream was *Microcotyle spp*. Severe histopathological lesions with the highest mortality (10%) were detected in the *Amyloodinium spp* species. The most observed histopathological findings were desquamation, hyperplasia, epithelial lifting and hyperemia in the lamellar epithelium. The incidence of multiple factors (multiparasitism) was higher than the incidence of single agents in the cases. Since the sample was sent as soon as the disease was detected, no severe pathological conditions were encountered.

Microcotyle spp. was detected extensively in seabream weighing between 20-350 g in June-July-August. Mortality remained at 6% with epitheliocyst cases. Among 2,100 sea breams, 650 breams had the *Microcotyle spp*. As a clinical finding, severe anemia with the color of the gills changing to white was observed. In the native examination of gills, adult individuals were seen in the lower part of the body, penetrating the gill epithelium with their opisthaptors, having eggs in their ovaries (Figure 1A), and releasing their eggs into the environment. In microscopic examination, parasite sections with epitheliocysts were seen in the gill filaments. In the lamellae containing the parasites, pressure, epithelial lifting, hyperplasia, lamellar fusion, and epithelial desquamation were observed (Figures 2A and 2B).

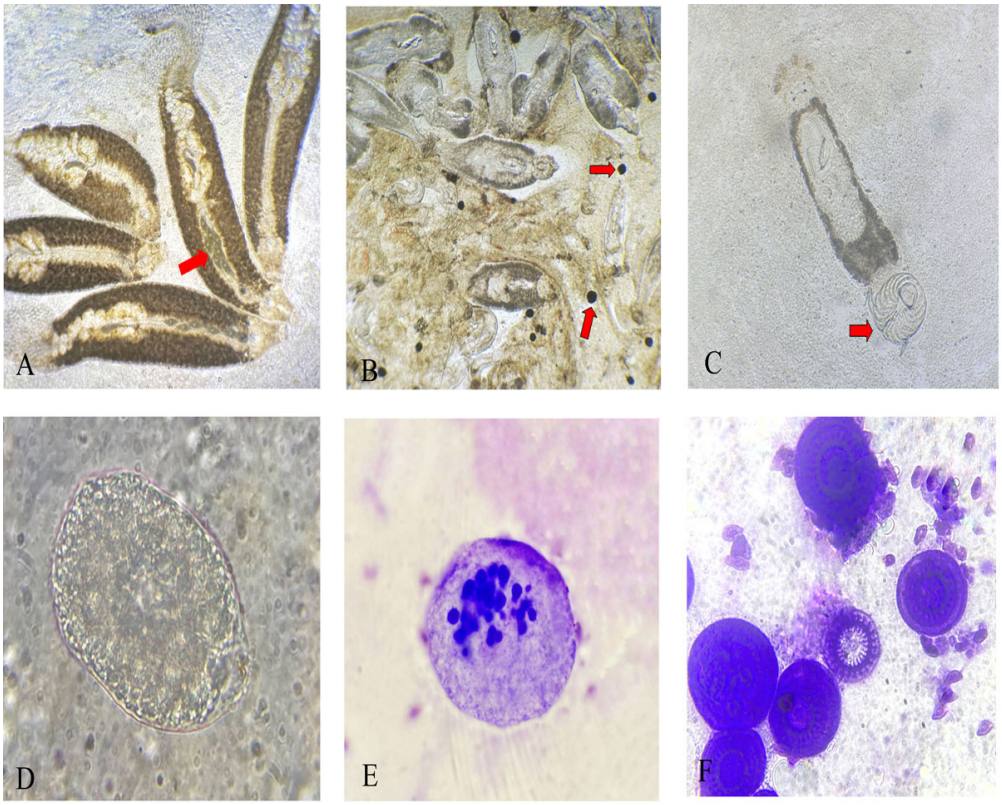

Figure 1. A) Adult, egg-bearing (arrow) Microcotyle spp. in native examination. Seabream. B) Amyloodinium spp. parasites (arrow) and the co-occurring Diplectanum spp. infestation. Seabass. C) Specific haptor (arrow) and 4 eyespots on the back of the Furnestinia spp. parasite. sea bream D) Pear-shaped Amyloodinium spp. agent in the trophont stage. Seabass. E) Amyloodinium spp. agent in the trophont stage. Seabass. Giemsa. Bar=40 µm. F) Distinctive appearance of hooked teeth of Trichodina spp. with Giemsa stain. Seabass. Giemsa. Bar=100 µm.

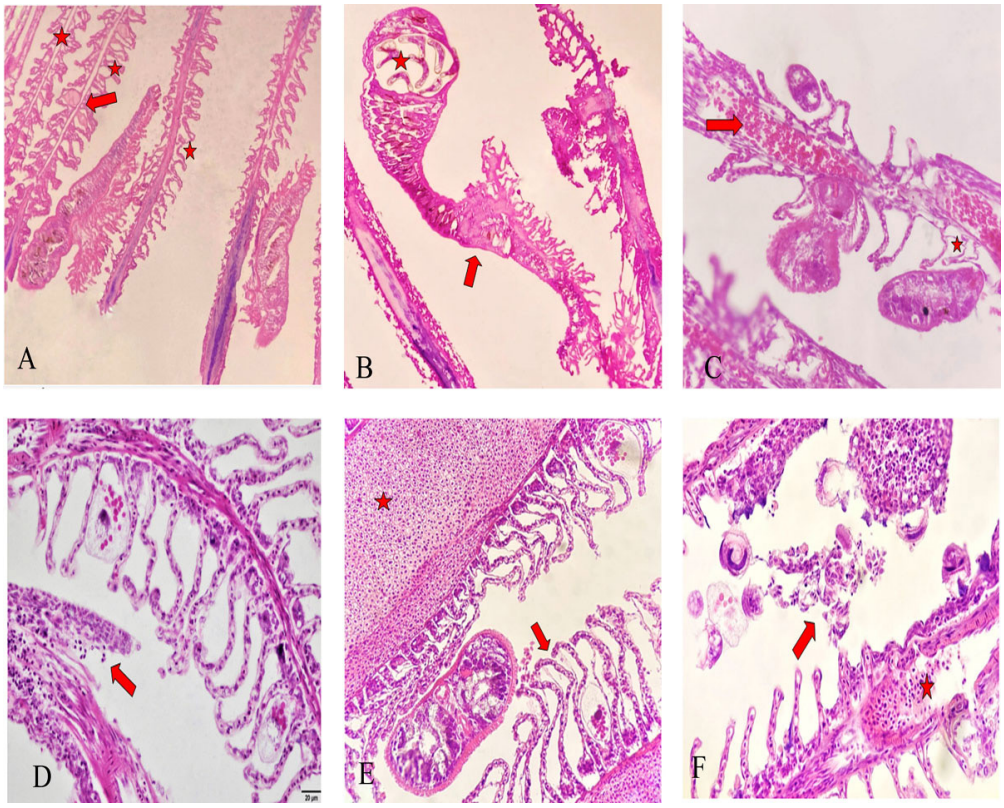

Figure 2. A) Epithelial lifting in gill filaments (star), Epitheliocyst spp. factors (arrow) and Microcotyle spp. attached to the filaments with their opisthaptors. Seabream HxE. Bar=10 µm. B) Microcotyle spp. (arrow) and eggs (star) attached to the gill filaments by their opisthaptors and carrying eggs. seabream HxE. Bar=10 µm. C) Intense hyperemia (arrow) and epithelial lifting (asterisk) caused by Diplectanum spp. in the penetration area. HxE. Bar=100 µm. D) Amyloodinium spp. trophonts penetrated between the secondary lamellae, Desquamative epithelial cells (arrow). Seabass. HxE. Bar=20 µm. E) Amyloodinium spp. and Diplectanum spp. parasites causing intense hyperemia (asterisk) in the primary lamella and epithelial lifting (arrow) in the secondary lamellae. Seabass. HxE. Bar=40 µm. F) Amyloodinium spp. and Trichodina spp. parasites causing desquamation (arrow) and hyperemia (asterisk) in secondary lamellar epithelium. Seabass HxE. Bar=40 µm.

Diplectanum spp. parasite was detected especially in seabass between 10-100 grams in July-August. Mortality remained at 3%, except for cases associated with *Amyloodinium spp*. Among 3,150 sea basses, 550 sea basses had the *Diplectanum spp*.. As a clinical finding, increased mucus secretion and petechial bleeding were observed in the gills. Native examination revealed individuals with 4 eye spots (Figure 1B). In microscopic examination, hyperplasia, hyperemia, hemorrhages, telangiectasia, epithelial lifting (Figure 2C and 2E), fusion, and necrosis were observed in the gill epithelium.

Furnestinia spp. was detected in seabream weighing between 2-100 g in October-November. Mortality remained at 0.5% except for cases with epitheliocyst. Among 2,100 seabreams, 400 breams had the *Furnestinia spp*. As a clinical finding, no changes were seen in the gills. In the native examination of gills, around-cup-shaped haptor and 4 eyespots were seen on the back of its body, which are unique to the parasite (Figure 1 C). Histopathologically, cysts in the secondary lamellae, epithelial shedding, hyperplasia, fusion were observed in cases accompanied by epitheliocyst, and macrophage, lymphocyte and eosinophilic granulated cell infiltrates were observed in cases presenting alone.

Cryptocaryon spp. was detected in August, especially in seabass between 5-200 grams. Mortality remained at 2%. Among 3,150 sea basses, 350 sea basses had the *Cryptocaryon spp.* parasite. As a clinical finding, pale white color, mild anemia and mucus in the gills were observed. Native examination of the gills revealed single or paired parasites with a 4-part macronucleus and peripheral cilia covering the entire body. Histopathologically, single or double factors embedded in the filament bottoms, epithelial lifting in gill epithelium, shedding in epithelial cells, increase in mucus cell size and number, necrosis, hyperemia, hemorrhage, and hyperplasia was seen.

Amyloodinium spp. parasite was detected especially in seabass between 20-250 gin April-May-June-July-August. Mortality remained at 10%. Among 3,150 sea basses, 500 sea basses had the *Amyloodinium* spp. As a clinical finding, bleeding and small blisters were observed in the gills. In the native examination of gills, pear-shaped trophont (Figures 1D and 1E), cystic tomont and motile dinospore forms of the parasite were observed. Histopathological examination revealed shedding of the gill epithelium, gill hyperplasia, epithelial lifting, macrophage, lymphocyte and eosinophilic granule cell infiltrates, intense hyperemia, and hemorrhage (Figures 2D and 2F).

Trichodina spp. was detected in June-July, especially in sea bass weighing 2-100 g and sea bream weighing 5-50 g. Mortality was around 3% in sea bass and 2% in sea bream. Among 3,150 sea basses, 550 sea basses and among 2,100 sea breams, 500 sea breams had the *Trichodina spp* parasite. As a clinical finding, epithelial lifting and regional bleeding were observed in the gills. In the native examination of gills, circle-saucer shaped parasites with a horseshoe-shaped macronucleus, hooked teeth and ciliary spiral were seen (Figure 1F). Histopathological examination revealed shedding, hyperemia, epithelial lifting, hyperplasia, and fusion in the secondary lamellar epithelium (2F).

Cryptobia spp. was detected in all months of the year, especially in sea bass between 2-200 g. Mortality was around 1% in sea bass weighing 2-10 grams. Among 3,150 sea basses, 400 sea basses had the *Cryptobia spp*. parasite. As a clinical finding, an increase in mucus was observed in the gills. In the native examination of gills, *Trypanoplasma* parasites with a triangle-like shape, a wavy membrane, and two flagella facing the opposite direction were seen. Histopathological examination revealed shedding, hemorrhage, mild epithelial lifting, and hyperplasia in the gill epithelium.

Costia spp. was detected especially in sea bass between 10-350 g and sea bream between 25-200 g in April-May-June. Mortality was around 2% in sea bass. Since it was seen together with *Flexibacter spp*. in sea bream, this rate remained at 5.5%. *Costia spp*. parasite was observed in 300 of 3,150 sea basses and 150 of 2,100 sea breams. Any clinical changes were observed in the gills of the sea bass. Necrotic white areas caused by *Flexibacter spp*. were observed in sea bream. In the native examination of gills, oval-comma-shaped parasites with two flagella of different sizes in the same direction were observed. Histopathologically, loss of gill filaments, epithelial lifting, and hyperemia were observed in the seabass. As for seabream, in addition, necrosis and *Flexibacter spp*. bacteria were seen.

DISCUSSION

Microcotyle spp.

According to Alvarez-Pellitero (2004), Vagianou et al. (2006), it is a monogenean gill parasite specific to *Sparus aurata* fish and has caused deaths when contacted with a high prevalence (61.5%) in fish cages. Researchers reported that it was isolated from both wild sea bream (Faisal and Imam, 1990; Rajdukovic and Euzet, 1989) and cultured sea bream (Mladineo and Marsic-Lucic, 2007). In our study, 6% mortality was recorded by isolating only from bream fish. From all fish *Microcotyle spp*. and *Epitheliocyst spp*. was also both isolated. The mortality rate, determined as 6%, included two factors together. The cause of death in fish infested with *Microcotyle* species was determined to be anemia (Sitja-Bobadilla and Alvarez-Pellitero, 2009). Throughout the study, *Microcotyle spp*. intense anemia and a pure white color prevailed in the gills of sea bream. While investigating the histopathology of infestation, attention has been drawn to the shortening of lamellae and the proliferation of epithelial tissue resulting in fusion of secondary lamellae and an increase in chloride cells (Sitja-Bobadilla and Alvarez-Pellitero, 2009). *Microcotyle spp*. caused severe pathogenicity, including systemic anemia, fusion of lamellae, and shedding of gill epithelium, even at densities of 8 parasites per gill arch (Mahmoud et al., 2014). In our study, pressure was observed in the gill epithelium in the lamellae where the parasite opisthaptors were attached, epithelial lifting in the lamellae where the parasites were present, necrosis in the epithelium, lamellar fusion, and shedding of the epithelium. *Microcotyle spp*. secondary infections caused by other parasites and bacteria are common in sea bream infested with sea bream (Cruz Silva et al., 1997).

Diplectanum spp.

In heavy infestations of *Diplectanum* seen in the spring months of each year, it causes a loss of 5-10% of the annual fry stock (Wagener (1857). In this study, it was seen in July-August and caused a loss of 3%. Llewellyn (1957) reported that; parasites are commonly found in the middle and apical parts of the lamellae. The attachment of the parasites to the gill epithelium of the host is provided by the dorsal and ventral spines of the squamodiscs and the hamuli penetrating deep into the epithelial cells, and they have 4 eyespots. In the present study, it was determined that *Diplectanum spp*. was seen singly or in clusters. The 4 eyespots were one of the most important features used in diagnosis. Oliver (1968) reported that the most common pathological findings in *D. aequans* infestations were hyperplasia and hemorrhages. Gonzalez-Lanza et al. (1991) also reported that leukocyte infiltrates were observed. In gills infested with *Diplectanum spp*., excessive mucus hypersecretion, hemorrhage and swelling, especially in the apical parts of the secondary gill lamellae were observed. Compared to non-infested fish, higher numbers of mucus cells (MC) and rodlet cells (RC) were observed in infested gills. (Oliver 1968, Yardimci and Pekmezci 2012). However, in our study, a high number of mucus and rodlet cells could not be observed.

Furnestinia spp.

It has been reported that the most common example in sea bream is *Furnestinia echeneis* from the Diplectanid family (Desdevises, 2001). In the present study, the factor was found only in sea bream. Oliver (1982) reported that, the highest density was recorded in autumn and the lowest values were recorded in spring. During periods when the water temperature dropped to 13°C, a weakening of the fish's immune system was observed. It has been stated that this situation causes a rapid increase in the parasite population (Oliver, 1982). In our study, parasites were found in October and November. High mortality rates due to this Monogenean parasite have been recorded in countries such as Spain, Italy, and Greece (Reversat et al., 1992; Silan et al., 1985). In our study, a high mortality rate was not observed, the rate was determined as 0.5%. It was reported that all fish examined did not show any macroscopic symptoms and were in good general health (Antonelli et al., 2010). flammatory reactions, cell infiltration and epithelial hyperplasia were observed in the lamellae of the connecting parts of the haptor of the parasite (Roubal, 1989). In our study, in cases with epitheliocyst, cysts and fusion in the secondary lamellae whereas, in cases where the *Furnestinia spp*. disease progressed alone, only macrophage, lymphocyte and eosinophilic granulated cell infiltrates were observed.

Cryptocaryon spp.

Lom (1984) has been reported that *Cryptocaryon* irritants, which causes white patches on the skin, are slightly smaller than Ich and therefore appear as slightly smaller nodules. Studies have found that infested skin looks like salt has been sprinkled on it. It has been stated that skin lesions appear more like multifocal white spots and sometimes as discrete white spots. In our study, no macroscopic findings were found in the sea bass that came to our laboratory. In histopathological sections, it was observed that it had a granular macronucleus with abundant cytoplasm, consisting of four interconnected bead-like sections. Multigranular macronuclei were seen in native examinations. Studies have stated that native gill examination or skin scraping is performed to detect the trophont stage of Ich (Yanong, 2009). In the present study, a horseshoe-shaped macronucleus was seen in both native examinations and histopathological sections. It has been observed that both types of Ich show a slow rotational movement originating from peripheral cilia (Yanong, 2009). In our study, it was observed that *Cryptocaryon spp.* were not yet dead and were slowly rotating around themselves with their cilia in the smears prepared from the gills of dead fish. With this finding, it was thought to be a late-dying ciliate. In studies, ich parasites caused damage to the host by initiating a hyperplastic host response in the gills and skin they invaded. During the trophont stage, ruptures in the gill and skin epithelium, loss of skin integrity, and respiratory distress in the gills due to osmotic stress were observed. Any deterioration in skin integrity and any change found macroscopically in the gills However, the shedding seen in the gill epithelium in histopathological sections was considered as the initial stage of these findings. Embedded parasite trophonts accompanied by granulomatous inflammation were observed at the tips of the gills of seabass and seabream infested with Cryptocaryon irritans. The presence of trophozoites has also been reported between the skin and muscle bundles of infested fish (Khalil et al., 2018). In our study, this parasite was not found in seabream. In seabass, trophozoites were seen in all parts of the gills, not just the tips.

Amyloodinium spp.

Amyloodinium spp., which is widespread all over the world. Infestation has been reported to be one of the most important diseases of warm water marine fish (Noga and Levy, 2006). In our study, this parasite was seen especially in sea bass reared in earthen ponds. The optimum temperature for most isolates is between 23-27°C. In the studies conducted, *Amyloodinium spp.* the factors caused infestation in salinities varying between 3-45 ppt. It has been stated that Red Sea isolates do not divide below 12 ppt salinity, outbreaks in the Gulf of Mexico are generally seen at 3 ppt salinity, and Australian outbreaks are seen at 5 ppt salinity. Salinity tolerance decreased at low temperatures (Paperna, 1984). In our study, the fact that this parasite was more common in soil ponds producing at low salinity levels supported the researchers' data. Guerra Santos et al. (2012) has reported that hemorrhage and inflammation occur in the gill filaments. Acute pathological changes include increased mucus secretion and decreased respiratory surface, resulting in difficulty breathing. In histopathological examinations, it was determined that the parasites attached to the filaments between the lamellae caused varying degrees of epithelial hyperplasia, hypertrophy in the primary and secondary lamellae, vacuolization in the lamellar epithelium, and fusion in the secondary lamellae. In addition, vacuolar degeneration, loss of epithelial tissue integrity, hyperplasia of secondary lamellae, fusion of secondary lamellae and necrosis were observed. Clinical symptoms have been reported to include anorexia, irregular and dizzy swimming at the surface, emaciation, and hyperventilation (Abreu et al., 2005; Francis and Floyd, 2011). In our study, acute deaths were observed at a rate of 10%. Any examination of the skin was performed, but macroscopically, bleeding was observed in the gills. Histopathological sections showed different forms of parasites, hyperplasia, epithelial shedding, epithelial lifting, bleeding, macrophage, lymphocyte, and eosinophilic granule cell infiltration.

Trichodina spp.

Trichodina spp. has been reported to be a parasite that infests many marine or freshwater fish. It has been observed that many species cause infestation of both skin and gills (Basson and Van, 2006). In the presented study, it was seen in both sea bream and sea bass. It has been stated that trichodinids are motile ciliates characterized by a body covered with a thin membrane surrounded by an adoral ciliary spiral, a horseshoe-shaped macronucleus, and the presence of an adhesive disc equipped with a ring of denticles (Basson and Van, 2006). It has been emphasized that the parasite appears as a saucer from above and as a circle, dome or hat when viewed from the side, that the cilia surround the entire body, that when viewed from above the parasite has a hooked part called a toothed ring, and that it characteristically rotates quickly around itself and exhibits a scooping movement (Noga, 2010; Zhao). and Thong, 2011). In our study, specific for *Trichodina spp.* in smears and histopathological sections; macronucleus, dendritic ring, rotational movement, and dome shape were observed. *Trichodina* infestation has been observed to be a relatively milder disease than other parasitic infestations, resulting in chronic morbidity or mortality (Hoffmann, 1999). However, in some cases it has caused significant losses, especially in young fish. No obvious macroscopic findings were observed in infected fish and mortality was reported to be low. It has been determined that the parasites damage the epithelial tissue in the areas they irritate with their adhesive discs and cause hyperplasia in the gill tissue. Excessive mucus production has also been observed in infested skin. According to Basson and Van As (2006), a *Trichodina spp.* is tightly attached to the surface of epithelial cells. Connection and rotation movements caused serious damage and destruction to the epithelial or epidermal cells of the fish. In acute infestations, ulcers, subepithelial epithelial lifting, hyperplasia of secondary lamellae and mononuclear cell infiltrates were observed. In chronic infestations, an increase in the mucus cells of the gill epithelium and filaments, partial or complete fusion of secondary lamellae, hyperplasia, inflammatory infiltration, and gill necrosis have been observed (Valladö et al., 2013). In this study, histopathologically; shedding and damage, hyperplasia, epithelial lifting, and fusion were observed in secondary lamellar epithelial cells.

Cryptobia spp.

Cryptobia spp. were identified by examining native preparations from skin and gills under a microscope (Kozloff, 2004). Due to the similarity between *Cryptobia spp.* and *Costia spp.*; flagella, length of the parasite, body width, nucleus diameter, and cell shape are important for differential diagnosis. It has been determined that the observation of a ripple-like tendency and contraction movement in the flagella differs from the circular movements of *Costia spp.* Kuperman et al. (2002) suggested that the parasite does not invade host cells during the attachment process and does not cause pathological changes. However, in highly infested juvenile fish, causes such as increased mucus production, epithelial lifting and necrosis in gill filaments were directly related to the decrease in respiration. In our study, any parasites were found in seabass weighing between 2-200 g. Mortality occurred at a rate of 1%, only in juvenile seabass weighing between 2-10 g. Histopathologically, shedding, epithelial lifting, slight bleeding and hyperplasia were observed in the gill filament epithelium.

Costia spp.

It has been stated that *Ichthyobodo necator* (*Costia necatrix*) is one of the smallest ectoparasites that infect fish, being the size of an erythrocyte. Noga (2010) reported that *Ichthyobodo* agents have been shown to be especially dangerous for young fish, attacking healthy fry and eggs, and being a stress factor in larger fish. It has been reported that *Ichthyobodo necator* causes disease in a wide temperature range (2-30°C), causing intense mortality in warm water fish by causing infestations mostly at temperatures below 25°C or above 30°C. It has been reported to be found in the skin and gills of infested fish. In our study, parasites were observed in seabass between 10-350 g and seabream between 25-200 g. No species specificity was observed. *Costia spp.* Infested samples were obtained in April-May-June.

Ichthyobodo spp

It has been reported that *Ichthyobodo spp.* can sometimes cause death with very few pathological findings, and tissue irritation also causes epithelial hyperplasia and increased mucus production (Isaksen, 2013; Lom and Dykova, 1992; Todal et al., 2004). In our study, a mortality rate of 2% was found in sea bass and 5.5% in sea bream. It was thought that the reason for the higher mortality rate in sea bream than in sea bass might be *Flexibacter spp.* infection. Fish that were with intense infestation, vacuolar degeneration, intense hyperplasia of goblet cells and a spongiosis appearance were observed to predominate. It has been reported that epidermis cells lose their cell membranes and begin to shed, and although there is infection in the gill filaments, there is no obvious pathological change (Yardımcı et al., 2016). Urawa et al. (1998) showed that; mild inflammatory symptoms on the ventral body surface in fish weighing between 226-463 grams. Erosion and bleeding caused by unidentifiable secondary bacterial infection also attracted attention. In the presented study, only epithelial lifting and epidermal erosion were observed in seabass in histopathological preparations, while in addition. necrotic changes were observed in the area due to rod-shaped bacteria *Flexibacter spp.* infection.

CONCLUSION

For early diagnosis of parasitic diseases, a sufficient number of samples should be taken from suspicious fish and examined as soon as possible. Duration is also a critical factor for the proliferation of parasites. However, classical methods are used as a diagnostic method and there is no different diagnostic method. There are various methods used for the treatment of parasites in the field. Applications may vary depending on the parasite type, size and family. For example, garlic extract feed additive products work for Monogeneans. For smaller ciliate and flagellate parasites, bath applications such as formaldehyde and oxygen peroxide are effective instead of oral treatment. Copper sulfate bath or copper plate is used specifically for the *Amyloodinium spp.* parasite. In the study, native examination, native examination after Giemsa staining and examination of histopathological sections were performed using light microscopy. It was deemed sufficient for species determination and description of histopathological findings. However, electron microscopy can be used for further research and studies. Our work, consists of data obtained by examining the parasitic diseases seen in sea bream and sea bass fish farmed in the Milas region for a period of one year. It is important as it is the first comprehensive study to use the histopathology method for sea bream and sea bass parasites in our country. Although there are many studies on gill parasites in our country, the limited number of studies on their histopathological findings increases the value of our study. For future studies, different geographic regions, different fish species, longer sample collection time and larger numbers of fish, and electron microscopy may be used.

DECLARATIONS

Ethics Approval

Since paraffin sections of the gills of fish that had died naturally were examined in the study, an ethics committee certificate was not required.

Conflicts Of Interest

The authors declare that there is no known financial or personal conflict that may affect the research (article).

Consent for Publication

Not applicable.

Author contribution

Idea, concept, and design: MD

Data collection and analysis: MD,SYO

Drafting of the manuscript: MD, SYO

Critical review: MD

Data Availability

The data used to prepare this manuscript are available from the corresponding author when requested.

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