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EPIZOOTOLOGICAL STATE OF THE WILD BLACK SEA TURBOT (KALKAN). GROSSLY VISIBLE PATHOLOGY: PRELIMINARY DATA

For the first time preliminary monitoring of the health status of the spawning population of the Black Sea turbot on the shelf off South-Western Crimea was carried out in 2007 – 2012. Typical signs of gross pathologies including various forms of ulcers, tumors, fin erosion, etc. were described in the wild adult turbot. The occurrence of numerous diseased turbot could be attributed to poor condition of its habitat on the South-Western Crimean shelf related to both natural and anthropogenic factors.

Keywords: Black Sea turbot, spawning population, grossly visible diseases.

Regular monitoring of diseases in wild fish with special attention to the flatfish is performed throughout last two decades in the Northern and Baltic Seas by EC countries and Russia [14, 21, 34]. Analysis of numerous monitoring data resulted in establishment of a Fish Disease Index (FDI) to assess populations' status in certain areas [20]. The use of fish diseases monitoring programmes provides an excellent indication of the overall health status of marine environment, and is recommended to be integrated with analytical data on water and sediments pollution [13]. In the Black Sea coastal area (mainly Ukrainian) long-term programmes have largely been focused on fish parasites, and the long-term parasitological monitoring on different fish populations is carried out since middle of the 1980's [10]. Still, despite the Black Sea is over-exploitated, and already during the century is subjected to intensive pollution and fisheries, deep sea trawling and dumping, sand and oil extraction and other human activities no pronounced studies on diseases of the Black Sea wild fish populations supported either by international, or by any Black Sea countries national programme were carried out to date.

Black Sea turbot or kalkan (further BST) *Scophthalmus maeoticus* (Pallas, 1814) (synonyms *Psetta maeotica*, *P. maxima maeotica*) [12] – an endemic flatfish and one of the most valuable for fisheries – could be considered a key species for monitoring and analysis of on-going processes in the environment [17] as through their life-span different stages of its development cover practically all habitats of the Black Sea. Moreover, it is known that kalkan is not a highly migratory species and consists of local assemblages in restricted geographical areas as this fish relocates mainly in autumn to feeding grounds, and in spring to spawning grounds perpendicular to coastline [23, 28]. Therefore, not only the health status of BST in certain areas can be traced through monitoring of the local spawning populations but as well the health status of the local environment can be extrapolated from such data.

Diseases of the Atlantic turbot have been studied for more than three decades but the knowledge concern predominantly the cultured fish and diseases relative to captivity [1, 6, 8, 19, 32]. No earlier studies known to the authors can provide any historical data on monitoring of diseases in the wild flatfish in the Black Sea. The only existing data on the flatfish diseases in nearby area was registration of vibriosis outbreak in the wild Azov Sea turbot (*Scophthalmus maeoticus torosus* Rathkes) in 1986 [3]. Bacterial diseases of the cultured Black Sea kalkan were studied only for the purpose of commercialisation of its aquaculture in Turkey [7].

The only up-to-date survey of the wild kalkan diseases was carried out in the Black Sea coastal line off Turkey between 2007 and 2009 to reveal the presence of viral haemorrhagic septicemia virus (VHSV) epizootioc [15].

During decades the Black Sea kalkan research was focused mainly on assessment of its stock biomass, on the basis of fishery landings and scientific swept area trawling in different areas, and assumed by mathematical models [5]. Annual monitoring of the spawning Black Sea turbot (further, BST) populations in Sevastopol region, since 2006 includes not only biological analysis and biomass assessment but also monitoring of BST pigmentation abnomalities [18].

Monitoring of the externally visible diseases of the spawning BST populations in Sevastopol region carried out by IBSS researchers during April – June 2007 – 2010 – is the first attempt to assess the health status of BST. Preliminary analysis of the state-of-art of BST showed that at least 20% of the adult fish present the gross signs of different diseases [10]. This paper presents the description of variability of externally visible diseases in their acute/ chronic and healing stages recorded in the wild kalkan.

Materials and methods. We didn't concern invasive diseases caused by specific parasites but only cutaneous gross externally visible signs of diseases. Still, during the biological analysis of the fish we recorded that practically 100% of analysed adult fish were invased by intestine helminth *Bothriocephalus gregarius* as was shown earlier [9].

Monitoring of cutaneous diseases was conducted during BST natural spawning migrations. The motorboat "Prof. Vyazemski", owned and operated by the fishman of the Institute of Biology of the Southern Seas, served as a sampling platform during this survey. Sampling of BST adult specimens from spawning population was carried out on a semi-month basis during April – June 2007 – 2012 from the turbot gill-nets at the depths 50 – 90 m near Sevastopol (Black Sea Crimean South-Western shelf). Reports on biological analysis and population structure of BST in Sevastopol region were partly published [10, 18].

The external examination of all available adult specimens: total length (TL) within 33 – 84 cm; standard length (SL) within 26 – 71 cm was carried out. In case of caudal fin injuries only SL was operated as it was meaningless to measure TL. After capture, prior to biological analysis, the fish were inspected for the presence of externally visible cutaneous diseases. A total of 1187 BST specimens were examined during 6 years monitoring in the field and in the lab. Characteristics and position of cutaneous disease were registered: whether they were located on the eyed (normally left side) of BST, or on the blind (normally right) surface of its body. The digital photos of both left (eyed) and right (blind) sides of each examined specimen were taken for further analysis. Digital images of the whole fish and macro-images of affected parts of integuments were examined. Description of the gross signs of cutaneous diseases was performed under recommendations of international guidelines [14, 16].

Analysis of externally visible cutaneous diseases led to sorting them according to different externally visible signs, their intensity and location.

Results. BST population monitoring revealed significant number of specimens with impaired integrity of skin. Undoubtedly, the specific pathology could not be diagnosed without a combination of clinical signs, histopathological features of tissues and organs, and screening for possible virulent bacteria and viruses. Still, analysis of the BST spawning population in Sevastopol region showed that according only to externally visible cutaneous signs of diseases about one fifth of adult specimens were considered sick [10].

Detailed analysis of BST digital photos from the 2007 – 2010 surveys revealed that gross cutaneous diseases of wild BST could be subdivided to several typical groups. Observations showed different – from focal to multifocal cutaneous diseases of varying degrees of severity and distribution. The following gross signs of cutaneous diseases were registered in the wild Black Sea turbot: acute / chronic / healing and healed / recovery stages of the skin ulcer disease, acute / healing stages of fin rot and fin erosion and putative neoplastic lesions**.** The abnormalities of skeletal deformities, including scoliosis, lordosis, vertebral compression and pug-headedness (multifactorial aetiology) were also registered but assumed to be published in a separate article devoted to BST skeleton problems.

From 2007 onwards wounded BST specimens from age-size group TL 36.4 – 54.7, SL 29.1 – 44.2 cm, age 4 – 7 years were recorded. Wounds could be of double origin. One posssible reason was that those were bitten, presumably by higher predators like sharks, or dolphins. Another, in some doubtful cases, could be caused by infections, followed by partial tissue necrosis, but followed later by recovery of the specimen.

Survived after injury, healed fish always had similar signs – absence of a pinched part of their trunk (all survived fish lack the part of the hindquarter) bodered by a scar area – wide margin of secondary pigmentation (irregularly scattered melanophores and xanthophores) distinctly visible on the blind side of the body (Fig. 1A) normally absent there [18]. In most cases such specimens reveal also external signs of multiple diseases, thus, the specimen on Fig. 1A presents haemorrhages of the fins, mouth and anus areas, and inflamed tubercles.

Majority of analysed BST specimens showed signs of different stages of tubercles damage and inflammation either only on the blind (Fig. 1B), or on both sides of the body at acute, chronic, or healing stages. The inflammation can vary from minor apical haemorrhagic ulceration of individual tubercle up to total destruction of numerous turbercles. In acute severe case tubercles are inflamed, and secondary infection is added. In healing stage, tubercles are crumbled and partly decayed, and are surrounded by numerous pigment cells replacing unpigmented epidermis around the damaged tubercle. Presence of secondary pigmentation on normally unpigmented side is a sign of healed dermis damage, similar to “scar”.

In case of decayed and, thereafter, healed bony tubercle, the central part of tubercle disappeared, and the surrounding elevation remained (Fig. 1C). The tissue replacing epidermis as well as underlying dermis could be seen through the formed cicular hole and always carry numerous chromatophores atypically distributed on the blind side.

A marked prevalence of ulcerative skin lesions (either focal or multifocal) was observed on the integuments of the fish. Dermal ulcers were noted both on the upper and down sides of kalkan. Localization of these dermal ulcers seems to be extended by secondary/or tertiary chronic infection supplemental to damage and inflamation of tubercles at earlier stage.

Typical appearance of skin ulcers is presented on Fig. 1D. Multiple haemorrhagic ulcers (sizes 15 – 30 mm) are centered at the place of inflamed and ruined tubercles, and a zone of red haemorrhages in the skin is located around them. Red haemorrhages at this stage are surrounded by a whitish ring of affected (necrotic) tissue.

At chronic/acute stage, multifocal haemorrhagic ulcers (up to 10) of increasing severity of disease are often observed both on the eyed and blind (Fig. 1E) sides of the BST body.

In severe cases, the ulcers have the appearance of decaying necrosed dermal and underlying tissues (Fig. 1F).

Other kind of the widespread cutaneous disease of BST specimens were the ulcerative lesions that can be depicted as circular or oval "sores" of varying severity and penetration through the skin, observed on both sides of BST body. Typical “sores” at acute and chronic/healing stage presented in the caudal area below the lateral line on the blind side of the body, are shown on Fig. 1G. Both focal deep oval sores have well-delineated (circumscribed) margins and present inflammed tissues outside of their margins.

The “fresh sore” (30 × 21 mm) (left side of the Fig. 1G) reveals the underlying dermis and penetrates through the muscles up to the rib bones. The “old sore” at chronic stage shown on the right part of Fig. 1G presents the black colour in the centre indicating the deep necrosis of derma and underlying tissues. Apart from and outside the sores, the surface of the body is covered by numerous inflamed turbercles at acute stage, different stages of healing (pigmented areas around healing tubercles), and the focal loss (depression on the place of the destroyed by inflammation) of the bone tubercles.

The most severe case of ulcerative lesion at chronic stage was found in male (TL 49.5, SL 41.1 cm) collected on 12th of April 2012 at 44°40'18"N, 33°22'17"E (Fig. 2A). The ulceration process totally eroded the dermal, muscle and bone tissues of the lower jaw. While all layers of dermal tissues were in state of significant complicate inflammation, the open wound revealed decomposition of white muscle tissue and the black necrotic bones of lower jaw – *dentale* and *articulare* (Fig. 2A). The probability of healing of this complicated lesion is doubtful.

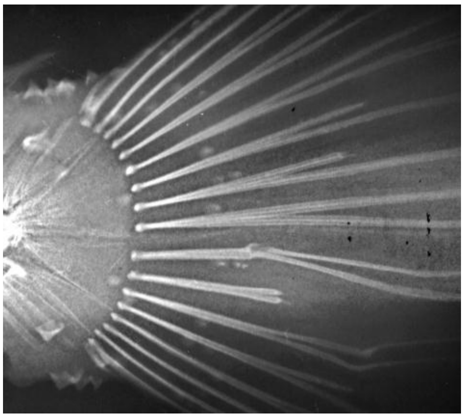

Fig. 3 X-ray photo of the eroded caudal fin of BST. Male, TL 51.6, SL 41.7 cm, 2010.06.03, 44°41'22"N, 33°25'24"E

Рис. 3 Рентгеновский снимок эродированного хвостового плавника калка-на. Самец, TL 51.6, SL 41.7 см, 03.06.2010, 44°41'22"N, 33°25'24"E

Analysis of the database on BST gross pathology revealed also that fin rot/erosion of different severity can be attributed to ordinary diseases of wild kalkan from Sevastopol region. In different catches the gross signs of fin erosion could be either totally absent from the specimens of a landing, or can cover up to 90% of a catch. In the case of non-severe, light form (presumably, at the initial stage of fin rot disease) the fin rays are still not damaged by erosion but the fringes of the fins already started the process of rotting. The thin outer rays are affected first, and then the process spreads to the peduncles of the rays. In severe cases of fin erosion (Fig. 2D) wide areas of the fin fringes in dorsal, anal and, especially, caudal fins are eroded, and part of fin rays can be significantly necrosed, deformed and shortened. As a result, the residual fin tissue reduces its functional surface.

X-Ray photo (Fig. 3) of the caudal fin at similar case of erosion confirms partial or total resorption of the distal parts of the fin rays.

In the chronic stage of disease, the distal edges of the fins are frayed as erosion leads to disappearance of connective tissue between the fin rays, total destruction of the interradial membrane takes place (Fig. 2B).

Different kinds of cutaneous gross neoplastic growth were registered in BST wild population. Neoplastic epithelial growth observed on the epidermis layer formes different variants of tumour-like swellings that could be characterised as a round raised “raspberry-shaped” neoplasm. Multiple tumour-like rosy-red swellings (nodules) in the skin on the upper pigmented side varying from 30 to 50 mm, could be resulted from neoplastic growth of the dermal tissues (Fig. 2C).

Another type of putative neoplastic growth were multiple massive pedunculated globular tumours of 60 × 48 (left), 39 × 28 (central), 64 × 53 (right) mm in diameter and up to 35 mm in height, found in male (TL 46.5, SL 37.9 cm) in 2008 (Fig. 2E). These neoplasms were located on the basis of the fin rays (both on the dorsal and ventral surface). The texture of tumours was smooth; the consistency was soft and elastic, buoyant and light. Their colour varied from completely whitish or was covered by blood-vessel reticular on the subsurface covered by a thin layer of epidermis with numerous melanophores. The pedunculated tumours were easily teared off the substrate as they were fixed to the fish integuments only by tumours’ stem. Dragging the fish out from the gillnets resulted in avulsion of pedunculated globular tumours and, thereafter, they were not registered in many cases when only crippled hiatus of the fin rays can be seen at the place of their presumable attachment.

Abnormal (secondary, irregular) pigmentation was observed on the left (normally pigmented), and the right (normally lacking pigmentation) sides of a large number of individuals, and in most cases those are scars marks after recovery from a skin, mainly ulceration, disease. In case of healing ulceration on the right side we observed rather chaotic secondary pigmentation presented both from melanophores and xanthophores. In case of healing of ulceration on the left side, the normally pigmented epidermis was replaced by either practically white patch lacking any chromatophores, or chromatophore complex consisted mainly of xanthophores resulting in patches of yellow-orange colour (Fig. 2F).

Discussion. Monitoring of epizootological state of the wild Black Sea turbot diseases during past 6 years (2007 – 2012) revealed variety of cutaneous diseases in adult Black Sea turbot in Sevastopol region (South-West off Crimean shelf of the Black Sea): inflammation of different parts of integuments, ulceration, extensive necrosis of epidermis and even underlying muscle and bone tissues, fin erosion, different types of epithelial neoplasia.

Analysis of modifications and degrees of ulcerations in BST propose the following presumable picture. Majority of ulcers seems to originate from primary damage of tubercles. These lesions can depend, to different extent on habitat state. They either can be healed in case of healthy environment, or in case of polluted and contaminated environment, be infected and develop haemorrhages (and necrosis) of epidermis. In case of highly contaminated environment and, conjuncted with it reduced immune status of fish, the lesions can develop into chronic stage, and involve muscular, and even bony tissue, subjected thereafter to tissues necrosis.

Undoubtedly, as flatfish contact continuously with the sea grounds throughout its life-span they are more vulnerable to ulcerative skin lesions, and, it is logical that skin ulcer diseases in numerous flatfish species were recorded in various coastal regions [26, 29, 30, 33, 34].

Ulcerative skin diseases in cultured fish showed that ulceration process in general has rather distinct stages; and ulcers have different distinct areas invaded by different microorganisms [6].

First stage is when the epithelial surface of the centre of lesions slough off and shallow haemorrhagic ulcers are produced. In the second stage, three distinct areas are observed: a peripheric pale zone; an intermediate greyish-dark area; and a central haemorrhagic zone. Often, different microorganisms can be detected only in ulcerative tissues, and no microbial involvement coul be detected in the internal organs of affected fish.

Mentioned gross clinic signs of cutaneous diseases could be attributed to internal infection either by vibriosis [32], or by viral haemorrhagic septicemia [15]. Erythema, hemmorrhages and ulcers registered in the BST wild population, are common with those observed in cultured Atlantic turbot in aquaculture captivities occurred with sudden increase of water temperature in Spanish farms with total of cumulative losses more than 20% [6]. In cultured turbot, the prevalent cases of haemorrhages in palate and jaws, tail and fins, and ulcerative lesions of turbot were considered to be caused by bacteria *Vibrio* and *Pseudomonas* [32]. Outbreak of ulcerative disease in cultured turbot observed at Chinese indoor farms also coincided with high temperatures [8]. The preliminary to mass mortality external signs were fins and tail turned red, and the back gradually ulcerated, and the dominant bacteria were defined as *Vibrio harveyi*.

In wild flatfish ulcerative skin lesions are usually difficult to be traced back to specific septicemic infections, and till now their etiology remains obscure as most bacteria found in them are normal bacterial residents of environment [2] but consistently have greater prevalence in the degraded habitats. Different stages of dermal ulcers with dermatitis and necrosis were common diseases of winter flounder in highly poluted Massachusetts Bay [26]. Injuries such as "sores" can be mechanical injuries due to bottom fishing gears combined with pollution and degradation of the habitat with subsequent bacterial invasions, thus there may be one factor behind the high prevalence of ulcer and "sores". Fin erosion and fin rot were reported in marine environment in different fish species [22, 25] and, particularly, in flatfish [24] since 1970-s. In most cases the origin of these pathologies cannot be traced to certain pathogen but all sites where the disease was recorded were characterised by significant pollution of the water and sediments, and in some cases when chemical analysis was provided, the rise of concentrations of pollutants in the fish tissues reflected their rised concentration in environment. Thus, fin rot/erosion syndrome was rather clearly associated with degraded estuarine or coastal environments [29], i.g. in the New York Bight fin rot epizootics was related to an interaction of gross domestic and industrial pollution.

From aquaculture practices apparently cutaneous tumours can definitely be ascribed to abnormal mechanical injuries, and in many cases they are considered to be of mixed and different etiology. The skin tumours in the wild flatfish, the black plaice *Pleuronectes obscurus* from Amursky Bay, the Sea of Japan, was classified as ectopic rhabdomyosarcomas and considered that a virus apparently induce hypertrophy of individual dermal connective tissue cells, which can lead to the formation of a raspberry-shaped tumourlike swellings in the skin [31]. We could not find any reference of neoplasms similar to pedunculated large pigmented and depigmented tumours observed on the fins of the BST (Fig. 2E).

Monitoring of the wild turbot population in Turkish Trabzon area of the Black Sea during 2005 – 2009 showed that about 21% of fish were infected by viral haemorrhagic septicemia (VHS) virus [15, 27]. Still, only 5% among infected fish showed gross signs indicative of VHS pathology – that is only 5% are seen externally [15]. Therefore, it’s possible that in case, about 20% of fish population present externally gross signs of diseases, the quota of really infected fish can be four times higher.

The prevalence of tumors in wild fish is used as an indicator of environmental quality. Multiple reasons are supposed to cause various diseases: in most cases skin ulcer disease can be presumably associated with primary, or secondary bacterial infection; fin rot / erosion is supposed to be of multifactorial aetiology, i.g. associated with bacterial infection and continous contaminantion by various pollutants); putative neoplastic lesions could be considered to be contaminant-associated but altogether the high incidence of diseases is the sign of habitat instability.

Trawl fisheries which significantly destroyed the benthic habitats and benthic communities of the Black Sea shelf [35] was totally forbidden since 1980-s but from the middle of the 1970-s the intensive sprat trawling is carried out on the shelf at the depths from 30 to 130 m, mainly at 45 – 100 m [11]. The area of the most intensive sprat trawling from Eupatoria cape to Chersonesus Cape from 30 m isobath to the depth of 100 m coincide with the main spawning and feeding grounds of BST population off Sevastopol. As confirmed earlier by biological studies and MiniRover video registrations the soft silty grounds up to 50 m which were earlier (a century ago) inhabited by various species of molluscs, hydroids, tunicates and macrophytes now are practically desert affected by sprat trawling activities [4]. Sprat benthic trawls ruin the upper bottom layer up to 20 – 40 cm depth, and cause the death of all benthic animals. Besides, large and underestimated at present time, eutrophication by innumerous Crimean resorts and large cities, dumping of sewages, including both inorganic and organic pollutants, and sand extraction lead also to destruction of biocoenosis of the soft bottom sediments of shelf near Sevastopol, and the BST habitat could be considered totally disturbed.

Black Sea kalkan inhabits 30 – 100 m depths during entire adult life, and their normal behaviour – burying in the soft silty bottom grounds. Thereafter, it is the common bycatch of sprat trawling [4]. Numerous cutaneous diseases, especially, primarily causes of different kind of “sores”, injuries of bony turbercles, tissue injuries on the places of later appearance of neoplasms – all of them can be the result of sprat fishing gears manipulations.

The occurrence of significant changes in the prevalence of externally visible cutaneous diseases can be considered a non-specific and more general indicator of chronic rather than acute (environmental) stress, and it has been speculated that they might, therefore, be an integrative indicator of the complex changes typically occurring under field conditions rather than a specific marker of effects of single factors.

High level of diseased fish in BST stock could be related to combination of permanently acting stress environmental factors in the studied area conjugated with different types of pollution, including chemical and organic; permanent destruction of nursery, stock feeding and spawning grounds through different anthropogenic activities on the shelf and deep water environment; and thereafter permanent stress reducing its immune defense system and contamination by various pathogens (both bacterial or viral origin). Combined analysis of population structure, morphology and diseases in BST local populations combined with contamination and structural analysis of their habitat is thereafter necessary on regular basis to reveal the changes in these productive Black Sea areas and to propose possible protective measures.

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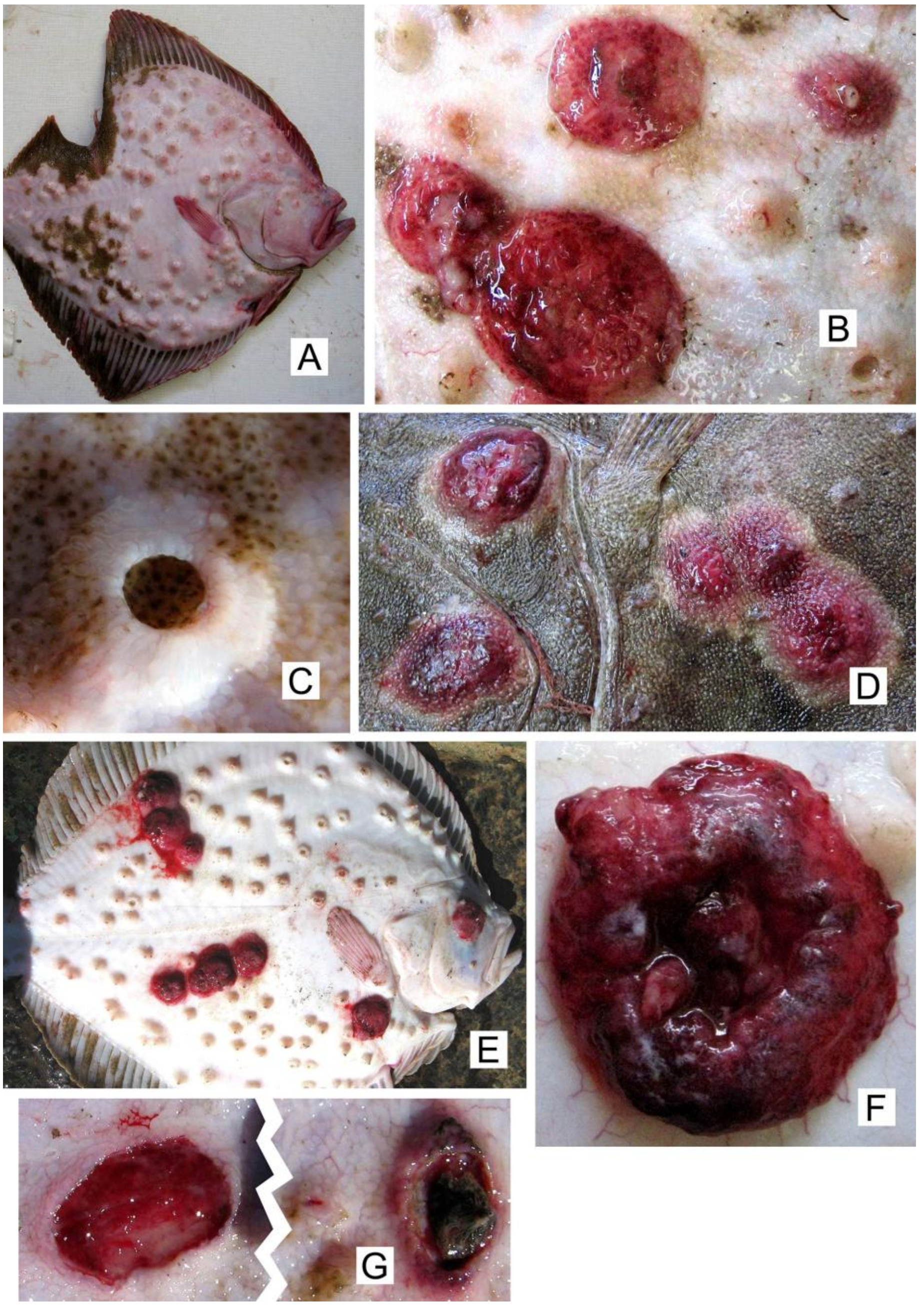

Fig. 1 Grossly visible pathology in the Black Sea turbot (part 1). **A** Right side of the wounded (at earlier age) and healed BST with external minor signs of disease (redness/hemorrhage around mouth, fins and anus areas, abscess of tubercles). ♂, TL 48.5, SL 39.7 cm, 2008.05.14; **B** Inflammation of bony tubercles and different stages of damages on the blind side of body. ♂, TL 53.0, SL 43.0 cm, 2007.05.29; **C** Decayed bony tubercle and healed cavity (diameter 7 mm) instead central part disappeared but surrounding tubercle elevation remained on the blind (right) side of the body. ♂, TL 55.0, SL 43.9 cm, 2012.04.06; **D** Typical appearance of ulcers (15 – 30 mm) on the left side of the body. ♂, TL 48.1, SL 38.4 cm, 2007.05.03; **E** Numerous hemorrhagic ulcers (18 – 36 mm) in the chronic/acute stage on the blind part of the body. ♂, TL 57.0, SL 46.3 cm, 2010.05.20; **F** Severe hemorrhagic ulcer (42 mm) with necrosed tissues replacing infected tubercle on the blind side of the body. ♂, TL 51.5, SL 40.7 cm, 2008.04.01; **G** Dermal ulcerative lesions (“oval sores”) in the caudal area on the blind side fish. On the left – the fresh acute “sore” ulcer 30 × 21 mm, on the right – chronic stage with black necrosis tissues. ♂, TL 50.3, SL 42.0 cm, 2009.04.20.

Рис. 1 Внешние патологии черноморского калкана (часть 1). **A** Правая сторона раненного (в раннем возрасте) и выздоровевшего черноморского калкана с незначительными внешними признаками заболевания (покраснение/кровоизлияние вокруг рта, плавников и в области ануса, абсцессы костных бугорков). ♂, TL 48.5, SL 39.7 см, 14.05.2008; **B** Различные стадии повреждения и воспаления костных бугорков на слепой стороне тела. ♂, TL 53.0, SL 43.0 см, 29.05.2007; **C** Разрушенный костный бугорок и его зажившая лунка (диаметр лунки – 7 мм) на слепой стороне тела. ♂, TL 55.0, SL 43.9 см, 2012.04.06; **D** Типичный вид язв (15 – 30 мм) на жаберной крышке и прилегающей области на левой стороне тела. ♂, TL 48.1 SL 38.4 см, 03.05.2007; **E** Многочисленные геморрагические язвы (18 – 36 мм) в хронической/острой стадии на слепой части тела. ♂, TL 57.0, SL 46.3 см, 20.05.2010; **F** Серьёзная очаговая геморрагическая язва (42 мм) с некротизированной тканью, заменившей инфицированный костный бугорок на слепой стороне тела. ♂, TL 51.5, SL 40.7 см, 01.04.2008; **G** Кожные язвенные поражения («овальные язвы") в каудальной части слепой стороны тела. Слева – свежая в острой форме "раневая" язва 30 × 21 мм, справа – хроническая стадия с чёрной некротизированной тканью. ♂, TL 50.3, SL 42.0 см, 20.04.2009

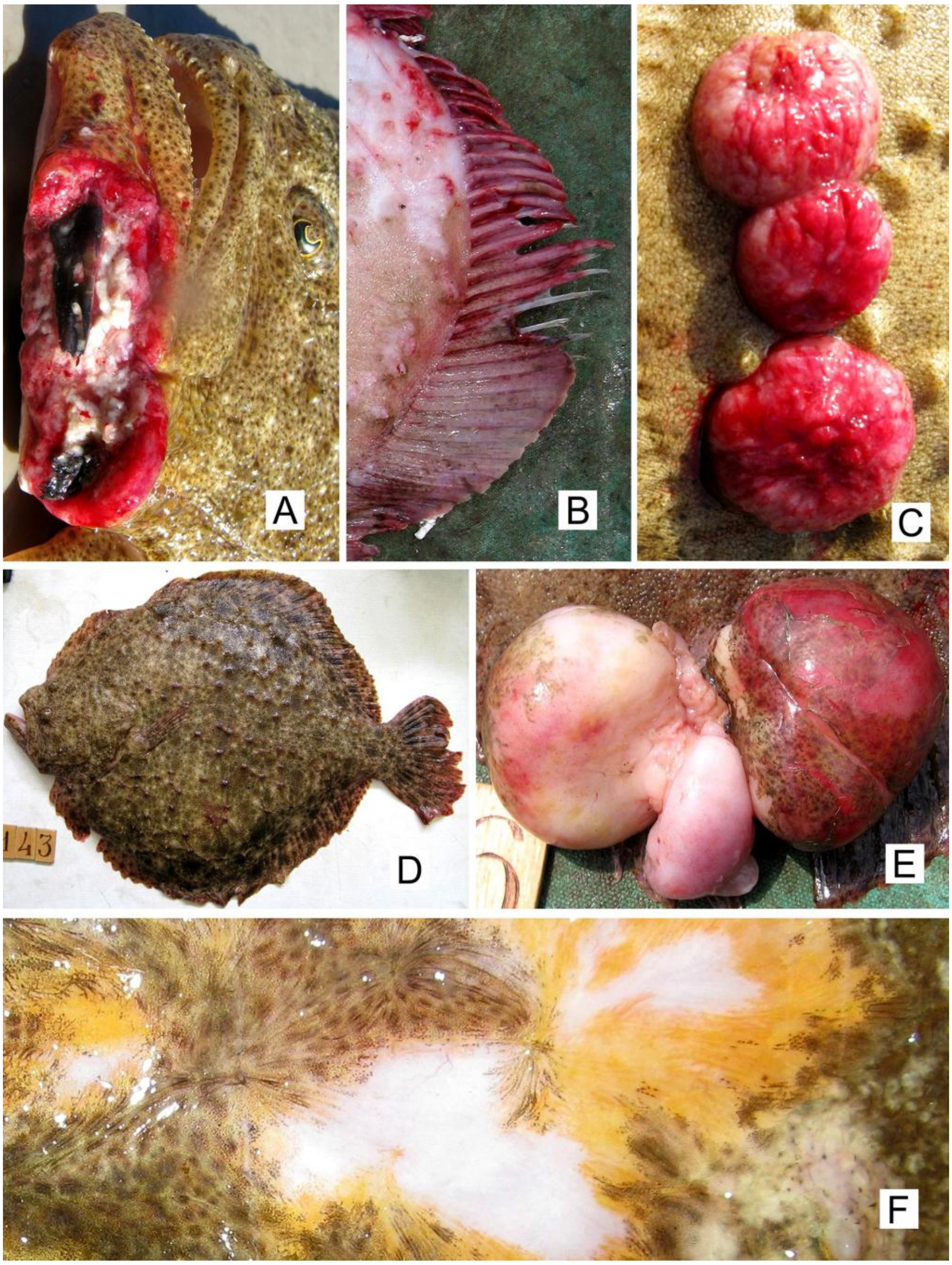

Fig. 2 Grossly visible pathology in the Black Sea turbot (part 2). **A** Chronic stage of ulcerative lesion on the lower jaw. The red color – inflamed dermal tissue around the wound. The white color – the white muscle tissue. The black color – two necrotic bones of the lower jaw – *dentale* and *articulare*. ♂, TL 50.5, SL 40.3 cm, 2012.04.12; **B** Eroded anal fin rays without connective membrane. ♂, TL 47.9, SL 38.1 cm, 2009.04.25; **C** Multifocal epidermal neoplasms (putative neoplastic lesions). Diameter of neoplasms 33 – 50 mm. ♂, TL 48.5, SL 39.0 cm, 2010.05.06; **D** Extreme fin erosion of dorsal, anal and caudal fins. ♀, TL 58.3, SL 47.2 cm, 2010.06.03; **E** Massive pedunculated tumours on the fins. Tumours' size 60 × 48 (left), 39 × 28 (central), 64 × 53 (right) mm. ♂ TL 46.5, SL 37.9 cm, 2008.05.03; **F** Abnormal xanthophore pigmentation – a scar of healed "sore" on the right side of ambicolorated BST. Area of abnormality 56 × 32 mm. ♂, TL 53.4, SL 43.2 cm, 2009.05.29.

Рис. 2 Внешние патологии черноморского калкана (часть 2). **A** Хроническая стадия язвенного поражения на нижней челюсти. Красный цвет – воспаленная кожная ткань вокруг открытой раны, белый – ткань белых мышц; чёрный – две некротизированные кости нижней челюсти – *dentale* и *articulare*. ♂, TL 50.5, SL 40.3 см, 12.04.2012; **B** Эродированный анальный плавник с разрушенными лучами и отсутствием плавниковой мембраны. ♂, TL 47.9, SL 38.1 см, 25.04.2009; **C** Множественные кожные новообразования (предположительно, опухоли). Диаметр новообразований 33 – 50 мм. ♂, TL 48.5, SL 39,0 см, 06.05.2010; **D** Экстремальная плавниковая эрозия спинного, анального и хвостового плавников. ♀, TL 58.3, SL 47.2 см, 03.06.2010; **E** Массивные опухоли на "ножках" на плавниках. Размер опухолей: 60 × 48 (слева), 39 × 28 (в центре), 64 × 53 (справа) мм. ♂, TL 46.5, SL 37.9 см, 03.05.2008; **F** Аномальная "ксантофорная" пигментация – шрам зажившей раны (язвы) на правой стороне калкана с двусторонней пигментацией тела. Размер образования 56 × 32 мм. ♂, TL 53.4, SL 43.2 см, 29.05.2009

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Епізоотологічний стан дикої чорноморської камбали-калкана. Видимі патології: попередні дані. А. М. Ханайченко, В. Е. Гірагосов, А. В. Гаєвська. Вперше проведено попередній моніторинг стану здоров'я нерестової частини популяції чорноморської камбали калкан на шельфі південно-західного Криму в 2007 – 2012 рр. Описано типові ознаки шкірних патологій, у тому числі різні форми виразок, пухлини, плавникова ерозія і т.д. у дорослих особин калкана. Виявлення численних хворих особин калкана може бути ознакою незадовільного стану середовища їх існування на шельфі Південно-Західного Криму під впливом природних і антропогенних факторів.

Ключові слова: чорноморська камбала калкан, нерестова популяція, шкірні хвороби.

Эпизоотологическое состояние дикой черноморской камбалы-калкана. Внешняя патология: предварительные данные. А. Н. Ханайченко, В. Е. Гирагосов, А. В. Гаевская. Впервые проведён предварительный мониторинг состояния здоровья нерестовой части популяции черноморской камбалы- калкан на шельфе юго-западного Крыма в 2007 – 2012 гг. Описаны типичные признаки внешних патологий, в том числе различные формы язв, опухоли, плавниковая эрозия и т.д. у взрослых особей калкана. Обнаружение многочисленных больных особей калкана может быть признаком неудовлетворительного состояния среды их обитания на шельфе Юго-Западного Крыма под воздействием природных и антропогенных факторов.

Ключевые слова: черноморская камбала калкан, нерестовая популяция, кожные болезни.