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Distribution and Control of Parasitic Diseases in the Fish Farm Pools of Azerbaijan Republic

Afet V. Suleymanova
Department of Diseases of the Fish and Bees, Institute of Veterinary, Ministry of Agriculture of Azerbaijan, Azerbaijan Scientific-Researches AZ1016, Nizami district, Boyuk Shor settlement, 8th side street, Baku, Azerbaijan.

AN epidemiological situation was revealed during the period of investigations (2013-2017) at the 10 fish farms in freshwater pools within the territory of the Azerbaijan. Totally, 2971 marketable fish were studied by the method of complete parasitological dissection. All fish specimens belonged to 14 species and 4 families (Cyprinidae, Percidae, Siluridae, Poecilidae). The number of identified parasites was 64 species from the 8 systematical groups, Protozoa (14), Monogenea (15), Cestoda (9), Trematoda (13), Acanthocephala (1), Nematoda (7), Annelida (1), Crustacea (4). The species composition of parasites fauna, biology and geographical distribution of marketable fish, effect of environmental factors on the epidemiological situation in fisheries were studied. It should be noted, that farming fishes in Azerbaijan have diseases, predominantly caused by pathogenic parasitic protozoa and flukes. Gills, intestines, body, cavity and skin were seriously infected. At the same time, diseases caused by bacteria and protozoa are capable of producing major outbreaks in the dramatic changes in environmental conditions. Control measures have been developed to prevent parasitic diseases that may occur when the temperature rises in the summer. The course of treatment is proposed to be carried out integratable by veterinary and sanitary expertise, land reclamation and zootechnics safety precautions. Before the treatment the extensiveness of invasion by bacterial diseases and acanthocephalan species were equal 47% and 58%, respectively. After the full course of treatment Antibac-100 powder and Tetramizole 20% were demonstrated the 100% efficiency. As a result of suggesting therapeutic and prophylactic arrangements, the quantity and weight of fish in fish farms were increased.

Keywords: Helminth, Fauna, Infection, Drug, Treatment.

Introduction

In the 1950s, fish stocks of Azerbaijan began to decline due to the shallowing of the Caspian Sea, the construction of dams on the Kura and Araks rivers, using of their water resources for irrigation, pollution of freshwater basins and sea with toxic waste. The projects carried out on the Kura River have led to a decrease in the stocks of migratory and semi-migratory fish species [1,2].

Over the past years, a number of comprehensive measures have been taken to restore fish stocks. The most important of these measures was the artificial breeding of fish. Thus, it was possible to partially restore the stocks of some valuable fish species. The most important issue was the fish breeding in fish farms. Restoration of fish stocks in natural reservoirs is not enough to meet the growing demand of the population for fish meat. In the Caspian Sea and on the Kura River, valuable caviar and meat of sturgeon, salmon and

Corresponding author: Afet V. Suleymanova, E- mail.: a.suleymanova67@gmail.com, Tel. +994502251825
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other industrially important fish are among the strategic resources of country [2].

During the construction of the Mingachevir and Varvara hydroelectric power stations on the Kura River, the stocks of valuable fish were significantly reduced. To compensate for these losses, new private fisheries were founded. Conducting ichthyological, hydrobiological, microbiological investigations in these farms plays an important role. Ichthyoparasitological studies have particular importance among these studies. Numerous researchers carried out systematic investigations of the geographical distribution of fish species in ponds located in different regions of the country. Also, they studied the species composition of helminthes in these fish farms [3-6].

After studying the obtained material in fish farms, preventive work was organized to carry out measures to control helminthiasis. An important issue in the development of commercial fisheries is the study of parasitic diseases of fish. Like other living creatures, fish areinvadedd by various infectious parasitic diseases. These diseases spread rapidly in fisheries and cause serious economic damage to the fisheries. Our studies carried out over the past ten years in commercial farms in the territory of Azerbaijan confirm the above conclusion [7, 8, 9,10].

Fish parasites in the natural reservoirs of Azerbaijan and the features of their distribution in various basins are well studied. Until recently, similar studies in fish farms have not been carried out to the required extent. Therefore, we considered it necessary to study the current epizootological situation in these farms with changes in the natural environment and its pollution [11].

Material and Methods

Working schedule and area

During 2013-2017, we collected parasitological material from the following fish farms: ShirvanOkean-S LLC, Salyan lake fish farm, Masally fish farm, Lankaran lake fish farm “Zaman”, Tovuz fishery, Mingachevir fish OJSC, Mingachevir Scientific and Experimental Center, Absheron fishery, Oriyad fishery, Neftchala fishery. The list of studied fish species is presented in Table 1. Thus, 2971 specimens of fishes were studied totally.

Taking fish samples

In total, 14 species of fish species were examined (Table 1). The studied fish specimens belonged to four families: *Ctenopharyngodon idella*, *Hypophthalmichthys molitrix*, *Cyprinus carpio*, *Carassius auratus gibelio*, *Abramis brama oricntalis*, *Rutilus caspicus*, *Alburnus charusini*, *Alburnoides bipunctatus*, *Gambusia affinis*,

TABLE 1. Number of fish examined and their parasite species.

Fish	Qty. of fish	Qty. of infected fishes
Grass carp (*Ctenopharyngodon idella*)	399	76 (19.05%))
Silver carp (*Hypophthalmichthys molitrix*)	384	98 (25.52%)
Eurasian carp (*Cyprinus carpio*)	386	154 (39.90%)
Prussian carp (*Carassius auratus gibelio*)	142	23 (16.20%)
Eurasian carp (*Cyprinus carpio*)	455	119 (26.15%)
Freshwater bream (*Abramis brama oricntalis*)	149	86 (57.71%)
Zander (*Sander lucioperca*)	135	25 (18.52%)
Wels catfish (*Silurus glanis*)	87	35 (40.23%)
Caspian roach(*Rutilus caspicus*)	57	19 (33.33%)
Bleak (*Alburnus charusini*)	116	50 (43.10%)
Schneider (*Alburnoides bipunctatus*)	110	48 (43.64%)
Western Mosquitofish (*Gambusia affinis*)	45	4 (8.89%)
Khramulya (*Varicorhinus capoëta gracilis*)	260	129 (49.62%)
Caspian shemaya (*Chalcalburnus chalcoides*)	246	130 (52.85%)
TOTAL	2971	996 (33.53%)

Varicorhinus capoëta gracilis, *Chalcalburnus chalcoides* (Cyprinidae); *Sander luciopersa* (Percidae); *Silurus glanis* (Siluridae); *Gambusia affinis* (Poecilidae). Fishes collected in pond farms were studied by complete parasitological dissection method. In the laboratory, we used the complete parasitological dissection [12]. During this type of investigation the body cavity, all internal organs, gills, eye lense and vitreous humor, skin and the fins were examined.

The fish were caught with gillnets, transported to the laboratory, and examined for parasites.

Parasitological investigations

In total 36 specimens of Eurasian carp were examined for hemoparasites. During the process of dissection one little drop of fresh blood from the heart was taken by plastic Paster pipette. Thin blood smears fixed in absolute methyl alcohol and stained in phosphate buffered Romanovsky-Giemsa solution, pH=7.2. Monogeneans were isolated from the gills using the dissecting needle. Cestodes were collected from the cutting intestines. The larvae and adult worms in muscles were isolated by cutting out, then studied in special compressor slide. Helminths and thorny-headed worms were kept in 70% ethyl alcohol and then stained with alum carmine [13]. Nematodes were enlightened for up to three days in lactic acid and stored in Barbagallo liquid [14].

Parasitic crustaceans were studied without preliminary staining in glycerol and 70% methyl alcohol [12]. Specimens of endoparasites were placed in Canadian balsam and examined using a stereomicroscope and biological microscope BEL SOLARİS. The microphotographs were taken with a 6.0-megapixel CMOS HDMI BEL HD-CAM digital camera and a smartphone adapter for a stereomicroscope.

Treatment of fish

Antibac-100 powder, designed by LLC "Research and Development Center AVZ" (Russia Federation), was used against pathogens of bacterial diseases. The course of treatment included using 0.5-1.0 grams of powder per kilogram of fish live weight once a day in the morning at a water temperature of 12 oC for 3-5 days.

Also the anthelmintic drug Tetramizol 20% granular produced by LLC "Rubicon" (Russia Federation) was designed against the parasitic diseases. We used this drug (1.0 gr for every kilogram in live weight) for the control of two acanthocephalan species (*Pomphorhynchus laevis* and *Metechinorhunchus truttae*). The tetramizole 20% were added in food and used for fish treatment during the period of two weeks three times per day.

All treatment of fish was conducted in pool basins in above-mentioned fish farms.

Statistical analyzes

All data were statistically processed. The Extensiveness of Invasion (EI) was calculated using the following formula:

$$EI = \frac{X_{inf}}{X} \times 100\%$$

X_{inf} – number of infected fishes.

X – total number of dissected fishes.

The Intensity of Invasion (II) was determined as the number of parasites in single fish specimen [15].

Results

The distribution of parasites by systematic groups is given in Table. 2. The most of fish parasite species (79%) in our study were multicellular (Fig. 1, A). Protozoan parasites are predominantly represented by representatives of the Kinetoplastida and Myxosporea phyla. Most metazoan parasites were monogenetic worms and trematodes (Fig. 1, B, C). Our results generally conform to conclusions of Kayis et al. [16]. Thus, among the 79 studied parasite species of farming fishes in Turkey, the following results were obtained: Protozoa (14), Acanthocephala (5), Myxosporea (3), Monogenea (12), Digenea (15), Cestoda (8), Nematoda (8), Hurudinea (1), Crustacea (12), Bivalvia (1)[16].

The high level of EI were detected in various systematical groups of parasites: Protozoa (34%), Monogenea (22%), Cestoda and Trematoda (14%), Nematoda (16%), Crustacea (12%) (Fig. 2). The infection of various tissues and organs is distinctive in fishes. Gills (28 species of parasites), intestines (11 species), body cavity (9 species) and skin (7 species) were seriously infected (Fig. 3).

The eye lens, muscles, and fins (5 species of parasites for each organ) were weakly infected in comparison with above-mentioned group of tissues and organs. Finally, the blood, gall bladder, bladder, kidneys, spleen, and liver infected only by 7 species of parasites for each organ.

TABLE 2. Parasite species and their fish hosts recorded in fish farms in Azerbaijan.

Parasite species	Fish host (EI, %)	Organs (tissues) of localization
PROTOZOA		
Kinetoplastida		
Bodonida Hollande, 1952		
Cryptobia branchialis	*Cyprinus carpio* (8.0), *Sander lucioperca* (12.3), *Alburnoides bipunctatus* (15.5)	Gills
Cryptobia cyprini Plehn, 1903	*Cyprinus carpio* (8.3)	
Trypanosomatida Kent 1880		
Trypanosoma carassii	*Cyprinus carpio* (8.0)	Blood
Myxozoa (Grassé, 1970)		
Myxosporea Bütschli, 1881		
Zschokkella nova Klokacewa, 1914	*Cyprinus carpio* (9.0), *Carassius auratus gibelio* (11.0), *Alburnus charusini* (25.0)	Gall bladder
Myxobolus bramae Reuss, 1906	*Cyprinus carpio* (5.0), *Alburnoides bipunctatus* (10.5)	Gills, skin, myocardium, kidneys, gall bladder
Myxobolus cyprini Doflein, 1898	*Cyprinus carpio* (2.4), *Carassius auratus gibelio* (17.6), *Alburnus charusini* (13.5)	Gills
Myxobolus muelleri Bütschli, 1882	*Cyprinus carpio* (12.5), *Ctenopharyngodon idella* (7.3), *Hypophthalmichthys molitrix* (7.8), *Sander lucioperca* (9.9)	Gills, fins, kidneys, bladder, spleen
Sphaerospora carassii Kudo, 1919	*Cyprinus carpio* (8.7), *Carassius auratus gibelio* (9.5)	Gills
Apicomplexa Levine, 1972		
Eucoccidiorida Léger et Duboscq, 1910		
Eimeria caprelli	*Cyprinus carpio* (6.7)	İntestines
Ciliophora Dofflein, 1901 emend		
Chilodonella piscicola (Zacharias, 1894) Jankowski, 1980	*Cyprinus carpio* (7.3), *Carassius auratus gibelio* (3.6), *Hypophthalmichthys molitrix* (7.3), *Alburnus charusini* (26.5), *Alburnoides bipunctatus* (2.3)	Gills, fins
Ichthyophthirius multifiliis Fouque, 1876	*Cyprinus carpio* (17.3), *Ctenopharyngodon idella* (9.8), *Sander lucioperca* (7.9), *Alburnus charusini* (26.4)	Gills, skin
Trichodina nigra Lom, 1960	*Cyprinus carpio* (7.8), *Sander lucioperca* (5.0), *Alburnus charusini* (16.0)	Gills, skin
Trichodinella epizootica (Raabe, 1950) Šramek-Hušek, 1953	*Cyprinus carpio* (6.2), *Alburnus charusini* (14.2)	Gills, skin
Apiosoma campanulatum Timofeev 1962	*Alburnus charusini* (12.3), *Alburnoides bipunctatus* (11.2)	Gills
METAZOA		
Platyhelminthes Claus, 1887		
Monogenea Carus, 1863		
Dactylogyrus vastator Nybelin, 1924	*Cyprinus carpio* (2.5)	Gills
Dactylogyrus extensus Mueller et Van Cleave, 1932	*Cyprinus carpio* (13.0)	Gills
Dactylogyrus anchoratus (Dujardin, 1845) Wagener, 1857	*Cyprinus carpio* (6.7), *Carassius auratus gibelio* (12.6)	Gills
Dactylogyrus ctenopharyngodonis Achmerow, 1952	*Ctenopharyngodon idella* (7.5), *Hypophthalmichthys molitrix* (1.5)	Gills
Dactylogyrus fraternus Wagener, 1909	*Alburnus charusini* (26.8)	Gills
Dactylogyrus parvus Wegener, 1910	*Alburnus charusini* (5.2)	Gills
Dactylogyrus affinis Bychowsky 1933	*Alburnus charusini* (5.3)	Gills
Dactylogyrus sphyrna Linstow, 1878	*Alburnoides bipunctatus* (7.6)	Gills
Dactylogyrus caucasicus Mikailov&Shaova, 1973	*Alburnoides bipunctatus* (10.0)	Gills
Gyrodactylus medius Kathariner, 1895	*Cyprinus carpio* (2.5), *Carassius auratus gibelio* (4.8)	Gills, fins
Gyrodactylus gracilihamatus Malmberg, 1964	*Alburnus charusini* (5.2)	Gills
Eudiplozoon nipponicum (Goto, 1891)	*Ctenopharyngodon idella* (4.7), *Hypophthalmichthys molitrix* (1.5)	Gills
Paradiploroon schulmani Mikailov, 1973	*Alburnoides bipunctatus* (7.7)	Gills
Cestoda Rudolphi, 1808		
Caryophyllaeus laticeps (Pallas, 1781) Lühe, 1910	*Cyprinus carpio* (5.0), *Rutilus caspicus* (8.8), *Abramis brama oricntalis* (11.2)	Intestines
Caryophyllaeus fimbriceps Annenkova-Chlopina, 1919	*Cyprinus carpio* (15.2)	Intestines
Bothriocephalus acheilognathi Yamaguti, 1934	*Cyprinus carpio* (2.5), *Hypophthalmichthys molitrix* (9.7), *Ctenopharyngodon idella* (12.2), *Varicorhinus capoëta gracilis* (6.7), *Alburnus charusini* (5.2)	Intestines

Bothriocephalus opsariichthydis Yamaguti, 1934	*Cyprinus carpio* (9.8), *Ctenopharyngodon idella* (12.4)	Intestines
Protecephalus torulosus (Batsch, 1786) Nufer, 1905	*Cyprinus carpio* (9.6), *Chalcalburnus chalcoides* (7.7)	Body cavity
Paradilepis scolecina (Rudolphi, 1819)	*Cyprinus carpio* (2.5), *Carassius auratus gibelio* (1.5)	Body cavity, liver
Ligula intestinalis (Linnaeus, 1758)	*Carassius auratus gibelio* (2.5), *Alburnus charusini* (26.2), *Alburnoides bipunctatus* (15.3), *Abramis brama oricntalis* (22.3)	Body cavity
Ligula colymbi Zeder, 1803	*Carassius auratus gibelio* (3.4)	Body cavity
Digramma interrupta (Rudolphi, 1810)	*Carassius auratus gibelio* (2.5), *Abramis brama oricntalis* (2.4), *Varicorhinus capoëta gracilis* (5.6)	Body cavity
Trematoda Rudolphi, 1808		
Asymphylodora cubanicum Kolesnikova, M. N., 1963	*Cyprinus carpio* (7.8), *Abramis brama oricntalis* (5.7), *Chalcalburnus chalcoides* (5.2)	Intestines
Asymphylodora demeli Markowski, 1935	*Cyprinus carpio* (5.2), *Sander lucioperca* (2.5), *Silurus glanis* (9.6),	Intestines
Posthodiplostomum cuticola (von Nordmann, 1832) Dubois, 1936	*Cyprinus carpio* (2.6), *Rutilus caspicus* (2.5), *Abramis brama oricntalis* (10.2), *Chalcalburnus chalcoides* (8.6), *Silurus glanis* (7.7), *Alburnus charusini* (11.2)	Skin, muscle
Tylodelphys clavata (von Nordmann, 1832) Diesing, 1850	*Cyprinus carpio* (2.7), *Ctenopharyngodon idella* (2.4)	Eye lense
Diplostomum chromatophorum (Brown, 1931) Shigin, 1986	*Cyprinus carpio* (5.0), *Ctenopharyngodon idella* (2.5), *Abramis brama oricntalis* (7.9)	Eye lense
Diplostomum paraspathaceum Shigin, 1965	*Cyprinus carpio* (2.5), *Carassius auratus gibelio* (11.2), *Alburnus charusini* (5.3)	Eye lense
Diplostomum spathaceum (Rudolphi, 1819) Olsson, 1876	*Abramis brama oricntalis* (7.8), *Chalcalburnus chalcoides* (6.7), *Sander lucioperca* (1.5)	Eye lense
Diplostomum helveticum (Dubois, 1929) Shigin, 1977	*Alburnus charusini* (8.6)	Eye lense
Sanguini colainermis Plehn, 1905	*Carassius auratus gibelio* (2.8)	Myocardium
Allocreadium isoporum (Looss, 1894) Looss, 1902	*Carassius auratus gibelio* (1.5), *Abramis brama oricntalis* (7.6), *Chalcalburnus chalcoides* (8.5)	Intestines
Hysteromorpha triloba (Rudolphi, 1819) Lutz, 1931	*Carassius auratus gibelio* (2.8), *Alburnus charusini* (5.2)	Muscle
Clinostomum complanatum (Rudolphi, 1814) Braun, 1899	*Ctenopharyngodon idella* (2.4), *Hypophthalmichthys molitrix*(1.5), *Chalcalburnus chalcoides* (3.5), *Sander lucioperca* (5.7)	Muscle
Echinostoma sp. Rudolphi, 1809	*Cyprinus carpio* (2.5), *Carassius auratus gibelio* (7.7), *Ctenopharyngodon idella* (7.8), *Rutilus caspicus* (4.7), *Abramis brama oricntalis* (7.5)	Gills
Acanthocephala Koelreuter, 1771		
Palaecanthocephala Meyer, 1931		
Pomphorhynchus laevis Müller, ١٧٧٦	*Alburnus charusini* (5.2)	İntestines
Nematoda Diesing, 1861		
Contracaecum microcephalum (Rudolphi, 1809)	*Cyprinus carpio* (2.6)	Body cavity
Contracaecum spiculigerum (Rudolphi, 1809)	*Cyprinus carpio* (5.2), *Alburnus charusini* (2.7)	Body cavity
Porrocoaecum reticulatum (I.) (Linstow, 1890),	*Cyprinus carpio* (25.0), *Carassius auratus gibelio* (11.2)	Body cavity
Pseudocapillaria tomentosa (Dujardin, 1845) Moravec, 1987	*Cyprinus carpio* (2.7)	Intestines
Eustrongylides excises Jägerskiöld, 1909	*Cyprinus carpio* (5.2), *Carassius auratus gibelio* (5.8), *Sander lucioperca* (5.9), *Silurus glanis* (7.8)	Body cavity
Rhabdochona denudata (Dujardin, 1845) Railliet, 1916	*Rutilus caspicus* (9.2)	Intestines
Rhabdochona gnedini Skrjabin, 1946	*Alburnoides bipunctatus* (15.3)	Intestines
Annelida Lamarck, 1809		
Hirudinea Lamarck, 1818		
Piscicola geometra (Linnaeus, 1761)	*Cyprinus carpio* (2.5), *Rutilus caspicus* (2.5), *Abramis brama oricntalis* (2.7), *Chalcalburnus chalcoides* (2.4), *Sander lucioperca* (2.5)	Skin
Arthropoda von Siebold, 1848		
Crustacea Lamarck, 1808		
Lernaea cyprinacea Linnaeus, 1758	*Cyprinus carpio* (7.5), *Ctenopharyngodon idella* (14.7), *Hypophthalmichthys molitrix* (4.8)	Skin
Argulus foliaceus (Linnaeus, 1758)	*Cyprinus carpio* (7.5), *Carassius auratus gibelio* (7.6), *Hypophthalmichthys molitrix* (7.7)	Skin
Ergasilus sieboldi Nordmann, 1832	*Cyprinus carpio* (5.0), *Ctenopharyngodon idella* (9.7), *Hypophthalmichthys molitrix* (8.7)	Gills
Lamproglena pulchella Nordmann, 1832	*Alburnoides bipunctatus* (7.7)	Gills

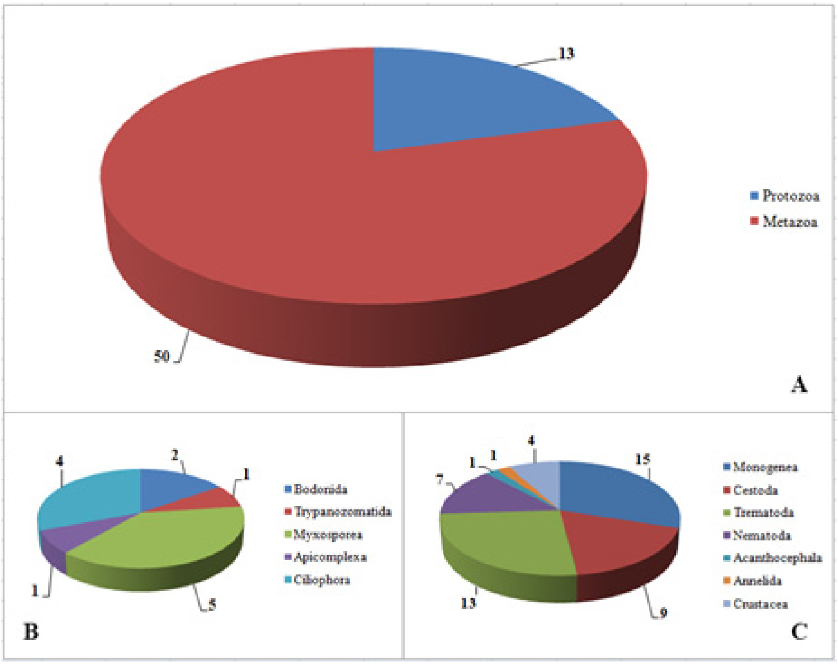

Fig. 1. Distribution of parasites from the various systematical groups in pool farms.

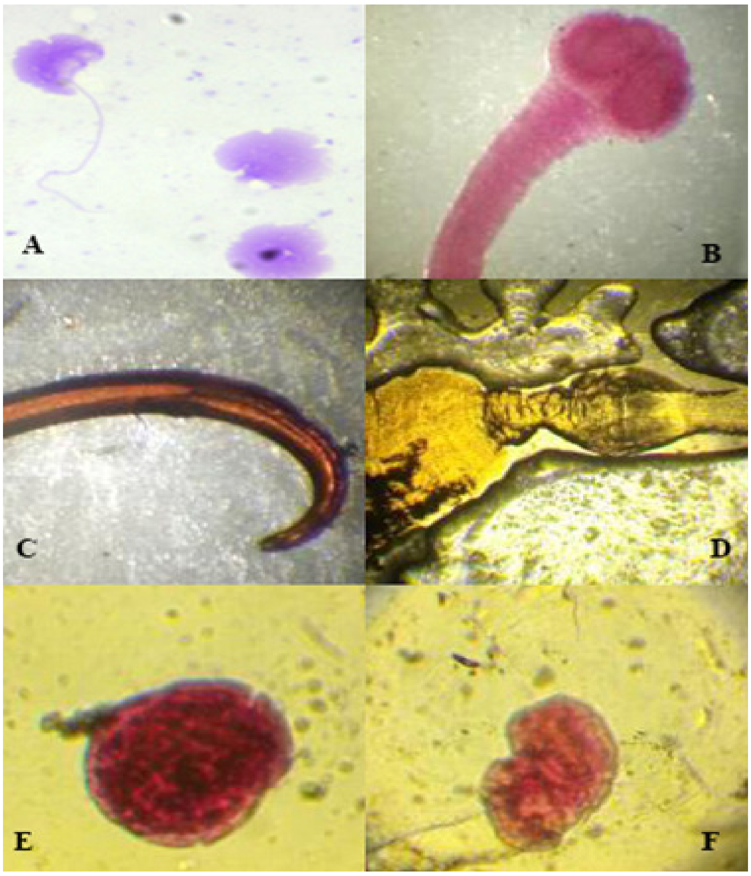

Fig. 2. Some representatives of the fish parasites. *Cryptobia branchialis*, thin blood smear (A); *Bothriocephalis achelognathi* (B); *Rhabdochona gnedini* (C); *Diplostomum helveticum* (E); *Posthodiplostomum cuticola* (F). Magnification 1000x (A), 10x (B, C, D); 15x (E,F).

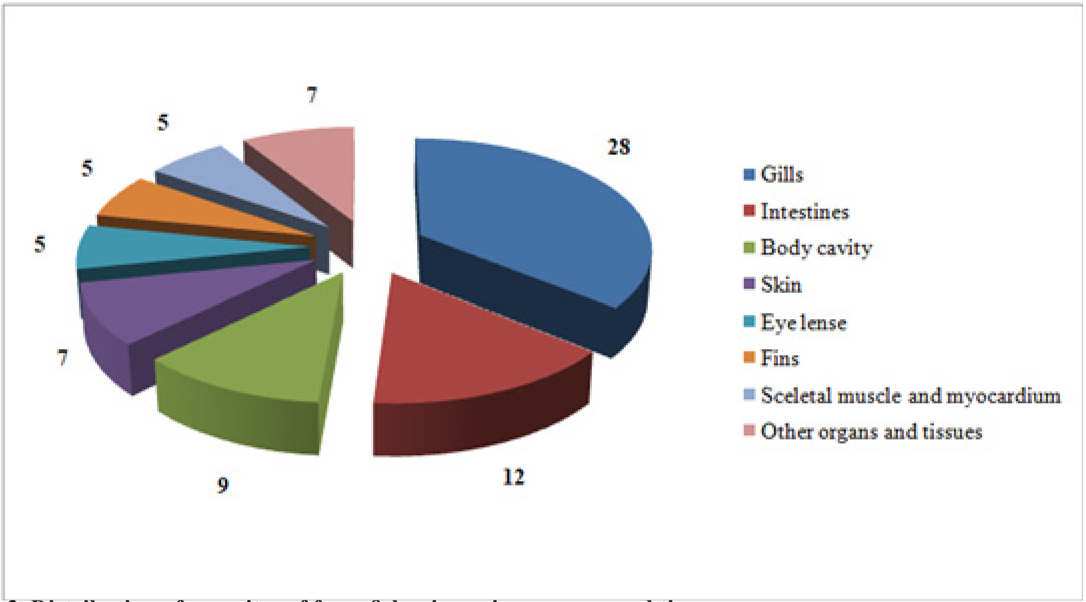

Fig. 3. Distribution of parasites of farm fishes in various organs and tissues.

Treatment of fish

Before the treatment by Antibac-100 powder the EI by bacterial diseases was equal 47%. The EI and II by acanthocephalan species were equal 58% and 1-41, respectively.

After the full course of treatment these drugs were demonstrated the 100% efficiency.

Discussion

The Western Mosquitofish (*Gambusia affinis*) is the alien species from the above-mentioned list of trash fishes in pond farms (see Table 1). This fish from North American was acclimatized in the 1930s for the biological control of malarial mosquito larvae in the South Caucasus. In the process of acclimatization, the mosquito fish has lost all parasites in its homeland and is rarely infected in new conditions with one or another widespread parasite.

The trash fishes, bleak and schneider should be noted. Both species are characterized by a rather high percentage of infection (43.10% and 43.64%, respectively).

According to our observations, trash fish species would occupy new habitats and serve as the main carriers of dangerous fish diseases. In general, one third of the fish (33.53%) in pond farms were infected by various parasites, including some species, dangerous for commercial fish farming.

The predominant infection of the gills and intestines is particularly interesting. Fish gills perform a number of other functions in addition to their direct function, and their diseases are a serious problem in the aquaculture of marine and freshwater fish around the world. Gills can be infected by a wide variety of infectious or non-infectious agents [17,18].

As can be seen in Table 3, diseases caused by pathogenic agents from all systematic groups are common in the studied farms: bacteria (furunculosis), protozoa (myxosomosis, ichthyophthiriasis, chilodonellosis), parasitic worms (dactylogyrosis, gyrodactylosis, bothriocephalosis, diplostomosis, acanthocephalosis, lernaeosis, nematodosis), arthropods (argulosis). Most of diseases are caused by parasitic worms, but ichthyophthiriasis, chilodonellosis, gyrodactylosis, bothriocephalosis and lernaeosis stand out for their epidemiological potential. At the same time, diseases caused by bacteria and protozoa are capable of producing major outbreaks in the dramatic changes in environmental conditions.

In some farms, the EI by laerneosis and bothriocephalosis in cyprinids reached 37.9% and 53.3%, respectively. At the same time, the II by laerneosis reached 1-27 worms per infected fish. However, the EI by other pathogenic parasitosis during the study period was relatively low. EI by chilodonelliosis in some pond farms ranged from

TABLE 3. The pathogenic species of parasites of marketable fishes in pond farms in Azerbaijan

Disease	Pathogen agent	Host
Furunculosis	*Aeromonas salmonicida*	*Oncorhynchus mykiss*, *Salmo trutta fario*
Myxosomosis	*Myxosoma cerebrale*	*Oncorhynchus mykiss*, *Salmo trutta fario*
Ichthyophthiriasis	İchthyophthirius multifiliis	*Ctenopharyngodon idella,Alburnus charusini*
Chilodonellosis	*Chilodonella piscicola*	*Alburnoides bipunctatus*, *Cyprinus carpio, Alburnus charusini*
Dactylogyrosis	*Dactylogyrus vastator, D. extensus*	*Cyprinus carpio*
Gyrodactylosis	*Gyrodactylus elegans*	*Cyprinus carpio*, *Alburnus charusini*, *Alburnoides bipunctatus*
Bothriocephalosis	*Botriocephalus acheilognathi*	*Cyprinus carpio*, *Ctenopharyngodon idella*
Diplostomosis	*Diplostomum chromatophorum, D.paraspathaceum*	*Cyprinus carpio*, *Ctenopharyngodon idella*, *Abramis brama orientalis, Carassius auratus gibelio*, *Alburnus charusini*
Acanthocephalosis	*Pomphorhynchus laevis*	*Cyprinus carpio*
Piscicoliosis	*Piscicola geometra*	*Cyprinus carpio*
Lernaeosis	*Lernaea cyprinacea*	*Cyprinus carpio, Ctenopharyngodon idella, Hypophthalmichthys molitrix*
Nematodosis	*Rhabdochonagnedini, Rh.denudata*	*Rutilus caspicus, Alburnoides bipunctatus*
Argulosis	*Argulus foliaceus*	*Cyprinus carpio*

15.4% to 26.5%, by ichthyophthiriasis 7.9-22.32%. EI by dactylogyrosis and acanthocephalosis could reach 18% and 19%, respectively. At the same time, sick fishes with dactylogyrosis could be infected quite strongly, with an intensity invasion 1-27 worms per specimen. The same high II was observed in acanthocephalosis (1-34). The EI in laerneosis and ligulosis was significantly lower (15.6% and 5.7%, respectively). The fish were also weakly infected with parasitic crustaceans causing argullosis (5.7% with II 1–14 per specimen). The reason for this may be the constant veterinary and sanitary control by the owners, who are not interested in a dramatic loss of fish.

Of course, the control of parasitic diseases should not be only therapeutic. To prevent the spread of trout gyrodactylosis, Natalya Kalinina and Petr Kravets recommend limiting the transportation of fry and live fish[19]. Our practice confirms the conclusions of the above scientists.

Conclusion

We can lay down the following conclusions at the end of this study. Most of the parasites described in our investigation were belonged to multicellular organisms (monogeneans and trematodes). Among the diseased organs the gills and intestines of studied fish were most infected. It is explained by the prevalence of flatworms in presented list of species composition. These parasites prefer the above-mentioned organs as comfort habitat. Despite the higher epidemiological potential of bacteria and protozoa, multicellular parasites still are the constant threat to fish farming due to their ability to effectively persist in the host organism. The most effective strategy for the control of parasites in fish farms should be recognized as an integrated approach that combines preventive measures and drug treatment.

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Conflict of Interest

The author declare that she has no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Ethical Statements

This study was conducted with the approval of National Committee on Bioethics, Ethics of Sciences and Technology of Azerbaijan (Date: 18.05.2022, No: 02).

Data availability statement

Data supporting the findings of the present study are available from the corresponding author upon reasonable request.

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