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Parasites of the common carp *Cyprinus carpio* L., 1758 (Teleostei: Cyprinidae) from water bodies of Turkey: updated checklist and review for the 1964–2014 period

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Abstract: A synopsis is provided of the parasites of common carp *Cyprinus carpio* L. from water bodies of Turkey based on literature data from 1964 to 2014. In total, 45 studies were included in the review and these provided data from 41 water bodies, comprising 12 man-made reservoirs, 21 natural lakes, and 8 water courses. Forty-one different taxa (including molluscan *Glochidium* sp.) in total were recorded. Of these taxa, 2 had not been previously reviewed for Turkey, and 4 were excluded from the list because of dubious identification. The Turkish parasite fauna of common carp living under natural conditions was dominated by ciliates (Ciliophora) among the protozoans and by flatworms (Platyhelminthes) among the metazoans, and this was both in terms of occurrence on fish and across water bodies. The absence of 7 taxa from both the European and North American checklists can be explained by the location of Turkey at the frontier between Asia and Europe. Additionally, the parasite fauna of the common carp in Turkey was consistently different from that of the far eastern species' specimens. Lack of differences among water bodies in both taxon richness and composition indicates overall homogeneity, likely a result of the species' relatively long-term establishment across the region. It is suggested that management options could benefit from this level of homogeneity.

Key words: Ciliophora, Platyhelminthes, Anatolia, parasite richness

1. Introduction

The common carp (*Cyprinus carpio* L., 1758) is one of the most widely distributed freshwater fishes worldwide (Welcomme, 1988). This is due to its large native area of Eurasian distribution (Balon, 1995) combined with historical translocations and introductions for farming, aquaculture, and sport fishing (Hoffmann, 1995; Copp et al., 2005; Balon, 2006). As a result, a large number of organisms are known to parasitize the common carp (e.g., Jeney and Jeney, 1995; Hoffmann, 1999; Baruš et al., 2002), and this causes concerns about the potential transmission of associated diseases to other fish species (e.g., Dove and Fletcher, 2000).

In Turkey, the common carp is native to the northernmost areas of Anatolia and Thrace (Memiş and Kohlmann, 2006; Vilizzi, 2012) but 'naturalized' (sensu Copp et al., 2005) elsewhere following translocations for fisheries and aquaculture (Innal and Erk'akan, 2006; Çetinkaya, 2010). Indeed, the common carp represents the most important species for inland fisheries of Turkey, along with the tarek (or 'inci kefali') *Alburnus tarichi* (Güldenstädt, 1814) (Turkish Statistical Institute, 2012). However, current lack of a national legislation protocol for the management of nonnative and translocated species in general has recently spurred interest in a reappraisal of the status of common carp in the region (Önsoy et al., 2011), along with an evaluation of its potential for further establishment and dispersal (Tarkan et al., 2014).

Apart from 2 reviews on the cestode *Ligula intestinalis* (İnnal et al., 2007) and hirudinean annelids (Arslan and Öktener, 2012), 2 main checklists of common carp parasites in water bodies of Turkey are available for the 1964–2003 (Öktener, 2003) and the 2004–2008 (Kayis et al., 2009) periods, together with a more recent checklist for Platyhelminthes for the 1964–2014 period (Öktener, 2014). An additional checklist is also available for the 1964–2008 period (Öktener et al., 2009), even though it includes parasites recorded under both natural and farming/aquaculture conditions.

The aim of this study was to provide an updated checklist for the 1964–2014 period of the parasites of common carp living under natural conditions in water bodies of Turkey. Parasite occurrence both on individual fish and across water bodies is reported, and the validity of some previous identifications is critically reviewed. As part of ongoing research on the ecology of common carp

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in Turkey (Vilizzi et al., 2013, 2014a, 2014b, 2015), the ultimate objective of the present synopsis is to help inform better management options for this species through provision of state-of-the-art review material.

2. Material and methods

Data on common carp parasites in Turkey were obtained from published literature sources, including peer-reviewed papers, thesis dissertations, conference proceedings, and, occasionally, reports. Notably, inclusion of studies was limited to those reporting occurrence of parasites on common carp under natural conditions from one or more water bodies. For this reason, studies carried out on common carp held in ornamental ponds (Pişkin and Utuk, 2008) or under farming/aquaculture conditions (Özer and Erdem, 1998, 1999; Selver et al., 2013) were excluded from review. For each taxon (i.e. species or unidentified species, plus mollusk larvae or *Glochidia* sp.), the corresponding phylum, class, order, and family were recorded (after http://www.ncbi.nlm.nih.gov/guide/taxonomy/; accessed 13 February 2015). Whenever provided, the percentage occurrence of a taxon in the sample of fish examined was also noted or otherwise computed as ratio of infected:examined fish. Finally, water bodies for which parasite data were retrieved were categorized as man-made reservoirs, natural lakes, and water courses.

Differences among water body types in mean number of taxa (= richness) were analyzed by permutational univariate analysis of variance (PERANOVA), and differences in parasite composition (phylum, class, order, family, and taxon level) were analyzed by permutational multivariate analysis of variance (PERMANOVA). For taxon richness, following normalization of the data, a Euclidean distance was used to produce a distance matrix and differences among water body type were tested based on a single-factor (i.e. water body type) experimental design. For parasite composition, a Bray–Curtis dissimilarity measure was applied to the presence/absence data for each taxonomic level and the resulting distance matrices were each tested based on the above design. Statistical analyses were carried out in PERMANOVA+ for PRIMER v.6 (Anderson et al., 2008), with 9999 permutations of the raw data. Briefly, the advantage of PERANOVA and PERMANOVA over traditional parametric analysis of variance is that the stringent assumptions of (multivariate) normality and homoscedasticity/sphericity in the data, which very often prove unrealistic when dealing with ecological datasets, are considerably relaxed (Anderson, 2001a, 2001b).

3. Results

In total, 52 studies were reviewed that investigated parasites on common carp under natural conditions. However, the studies by Burgu et al. (1988), Oğuz et al. (1991), and Erkul (1997) were excluded from analysis due to their reporting occurrence and number of parasites pooled over different water bodies (hence, without distinction among the same). Of the 49 studies preliminarily retained, 45 reported occurrence of parasites (Table), whereas the remaining 4 did not record any presence of parasites (i.e. Cengizler et

Table. Checklist of the parasites of common carp from water bodies of Turkey (with indication of source study).

	Man-made reservoirs													Natural lakes											
	Çamlıdere	Doğancı	Emre	Emre	Karacaören I	Karacaören II	Karakaya	Keban	Keban	Kepez I	Kunduzlar	Selevir	Tahtalı	Yamula	Akşehir	Akşehir	Antakya	Bafa	Bektaşağa	Beyşehir	Çapalı	Çavuşcu	Çavuşcu	Dalyan Lagoon	Durusu
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17[4]	18	19[5]	20	21	22	23	24	25
Kingdom PROTOZOA																									
Phylum CILIOPHORA																									
Class OLIGOHYMENOPHOREA																									
Apiosoma piscicola (Blanchard, 1885)																			√						
Epistylis sp.																			√						
Ichthyophthirius multifiliis Fouquet, 1876																									
Trichodina sp.																									
T. acuta Lom, 1961																			√						
T. mutabilis Kozubsky & Migala, 1968																			√						
T. nigra Lom, 1960														√					√						
Class PHYLLOPHARYNGEA																									
Chilodonella sp.																									
Kingdom METAZOA																									
Phylum ACANTHOCEPHALA																									
Class EOACANTHOCEPHALA																									
Neoechinorhynchus sp.																									
N. rutili (Müller, 1780)									√																
Class PALAEACANTHOCEPHALA																									
Acanthocephalus clavula (Dujardin, 1845)																									

Table. (Continued).

	Man-made reservoirs																Natural lakes								
	Çamlıdere	Doğancı	Emre	Emre	Karacaören I	Karacaören II	Karakaya	Keban	Keban	Kepez I	Kunduzlar	Selevir	Tahtalı	Yamula	Akşehir	Akşehir	Antakya	Bafa	Bektaşağa	Beyşehir	Çapalı	Çavuşcu	Çavuşcu	Dalyan Lagoon	Durusu
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17[4]	18	19[5]	20	21	22	23	24	25
Phylum ANELLIDA																									
Class HIRUDINEA																									
Hemiclepsis marginata (Müller, 1774)																		√			√				
Hirudo medicinalis L., 1758[2]																					√				
Piscicola geometra (L., 1758)																						√			
Phylum ARTHROPODA																									
Class ARACHNIDA																									
Unionicola sp.[2]																									
Class MAXILLOPODA																									
Argulus foliaceus L., 1758				√	√	√						√						√	√			√	√		
Ergasilus sieboldi Nordmann, 1832																								√	
Lernaea cyprinacea L., 1758						√							√												
Phylum MOLLUSCA																									
Class BIVALVIA																									
Glochidium sp.																									
Phylum NEMATODA																									
Class ADENOPHOREA																									
Pseudocapillaria tomentosa (Dujardin, 1843)																									
Class SECERNENTEA																									
Contracaecum sp.													√												
Rhabdochona denudata (Dujardin, 1845)[2]																									
Phylum PLATYHELMINTES																									
Class CESTODA																									
Bothriocephalus sp.																									
B. acheilognathi Yamaguti, 1934					√	√			√		√	√								√					
Caryophyllaeus sp.																									
C. brachycollis Janiszewska, 1951																	√								
C. fimbriceps Annenkova-Khlopina, 1919																									
C. laticeps (Pallas, 1781)					√	√				√		√								√				√	
Khawia sinensis Hsü, 1935[3]							√		√																
Ligula sp.																									
L. intestinalis (L., 1758)	√				√																				
Paradilepis scolecina (Rudolphi, 1819)[2]															√										
Proteocephalus sp.																									
Class MONOGENEA																									
Dactylogyrus sp.																									
D. anchoratus (Dujardin, 1845)						√													√						
D. chalcalburni (Dogiel & Bychovsky, 1934)[1,2]																									
D. extensus Müller & van Cleave, 1932		√	√							√		√	√			√			√					√	√
D. minutus Kulwiec, 1927					√	√		√												√					
D. vastator Nybelin, 1924														√				√							
Gyrodactylus sp.			√																√						
G. cyprini Diarova, 1964[1]																									
G. elegans Nordmann, 1832[2]												√				√									
G. scardinii Malmberg, 1964[2]																									
Paradiplozoon sp.																									
P. homoion (Bychowsky & Nagibina, 1959)										√															
Class TREMATODA																									
Clinostomum complanatum (Rudolphi, 1814)																									
Diplostomum sp.							√																		
D. spathaceum (Rudolphi, 1819)																									
Posthodiplostomum cuticola (Nordmann, 1832)																									
Tylodelphys clavata (von Nordmann, 1832)																									

[1] Taxon not previously reviewed for Turkey (i.e. Öktener, 2003, 2014; İnnal et al., 2007; Kayis et al., 2009; Arslan and Öktener, 2012).

[2] Taxon not previously reported in either Europe (Baruš et al., 2002) or North America (Hoffmann, 1999).

[3] Likely erroneous identification in source study for *K. armeniaca* (Cholodkovsky, 1915).

[4] Lake Antakya (Lake of Antioch) or Lake Amik (Hatay Province) was a large freshwater body that was drained between the 1940s and 1970s. Information on parasites of common carp from this water body is therefore retained in the present study only for historical purposes and consistency with previous reviews (i.e. Öktener, 2003, 2014; Kayis et al., 2009).

[5] Fully scaled and mirror variants.

Source studies: (1) İnnal et al. (2007); (2) Aydoğdu and Altunel (2002); (3) Öztürk (2011a); (4) Öztürk (2012); (5) Kır et al. (2004); (6) Kır et al. (2013); (7) Barata and Dörücü (2014); (8) Sağlam (1992); (9) Dörücü and İspir (2005); (10) Soylu and Emre (2007); (11) Öztürk (2011b); (12) Öztürk and Bulut (2006); (13) Karakişi and Demir (2012); (14) Kılınçaslan (2009); (15) Buhurcu and Öztürk (2007); (16) Kartal and Öztürk (2009); (17) Paperna (1964); (18) Geldiay and Balık (1974); (19) Özer and Erdem (1999); (20) Tekin-Özan et al. (2008); (21) Ceylan (2002); (22) Öktener et al. (2007); (23) Alaş et al. (2010); (24) Aydogdu et al. (2001); (25) Soylu (2009).

Table. (Continued).

	Natural lakes																	Water courses								
	Eber	Hazar	İznik	İznik	İznik	Karamık	Kovada	Kovada	Manyas (Kuş)	Manyas ' (Kuş)	Marmara	Mogan	Sapanca	Sapanca	Sığırcı	Terkos	Uluabat (Apolyont)	Aksu	Aras	Büyük Menderes	Gediz	Kızılırmak	Porsuk	Seyhan	Creeks (Van region)
	26	27	28	29	30	31	32	33	34	35	18	36	37	25	38	39	40	1	42	18	18	41	43	44[4]	45
Kingdom PROTOZOA																									
Phylum CILIOPHORA																									
Class OLIGOHYMENOPHOREA																									
Apiosoma piscicola (Blanchard, 1885)																									
Epistylis sp.																									
Ichthyophthirius multifiliis Fouquet, 1876																								√	
Trichodina sp.												√													
T. acuta Lom, 1961																									
T. mutabilis Kozubsky & Migala, 1968																									
T. nigra Lom, 1960																								√	
Class PHYLLOPHARYNGEA																									
Chilodonella sp.												√													
Kingdom METAZOA																									
Phylum ACANTHOCEPHALA																									
Class EOACANTHOCEPHALA																									
Neoechinorhynchus sp.															√										
N. rutili (Müller, 1780)			√	√																					√
Class PALAEACANTHOCEPHALA																									
Acanthocephalus clavula (Dujardin, 1845)																									√
Phylum ANELLIDA																									
Class HIRUDINEA																									
Hemiclepsis marginata (Müller, 1774)											√														
Hirudo medicinalis L., 1758[2]																									
Piscicola geometra (L., 1758)																√									
Phylum ARTHROPODA																									
Class ARACHNIDA																									
Unionicola sp.[2]												√													
Class MAXILLOPODA																									
Argulus foliaceus L., 1758	√			√			√		√		√									√	√			√	
Ergasilus sieboldi Nordmann, 1832													√												
Lernaea cyprinacea L., 1758																									
Phylum MOLLUSCA																									
Class BIVALVIA																									
Glochidium sp.													√		√										
Phylum NEMATODA																									
Class ADENOPHOREA																									
Pseudocapillaria tomentosa (Dujardin, 1843)									√																
Class SECERNENTEA																									
Contracaecum sp.																									
Rhabdochona denudata (Dujardin, 1845)[2]																									√
Phylum PLATYHELMINTES																									
Class CESTODA																									
Bothriocephalus sp.												√					√								
B. acheilognathi Yamaguti, 1934	√		√		√	√		√	√				√		√				√						√
Caryophyllaeus sp.																							√	√	
C. brachycollis Janiszewska, 1951																									
C. fimbriceps Annenkova-Khlopina, 1919															√										
C. laticeps (Pallas, 1781)			√		√		√	√	√				√												√
Khawia sinensis Hsü, 1935[3]																									
Ligula sp.												√													
L. intestinalis (L., 1758)							√											√							
Paradilepis scolecina (Rudolphi, 1819)[2]																									
Proteocephalus sp.																							√		

Table. (Continued).

	Natural lakes												Water courses												
	Eber	Hazar	İznik	İznik	İznik	Karamık	Kovada	Kovada	Manyas (Kuş)	Manyas' (Kuş)	Marmara	Mogan	Sapanca	Sapanca	Sığırcı	Terkos	Uluabat (Apolyont)	Aksu	Aras	Büyük Menderes	Gediz	Kızılırmak	Porsuk	Seyhan	Creeks (Van region)
	26	27	28	29	30	31	32	33	34	35	18	36	37	25	38	39	40	1	42	18	18	41	43	44[4]	45
Class MONOGENEA																									
Dactylogyrus sp.												√													
D. anchoratus (Dujardin, 1845)																									
D. chalcalburni (Dogiel & Bychovsky, 1934)[1,2]																						√			
D. extensus Müller & van Cleave, 1932	√	√			√	√			√				√	√	√	√	√					√			
D. minutus Kulwiec, 1927								√																	
D. vastator Nybelin, 1924																								√	
Gyrodactylus sp.													√		√										
G. cyprini Diarova, 1964[1]																						√			
G. elegans Nordmann, 1832[2]	√					√										√					√			√	
G. scardinii Malmberg, 1964[2]										√															
Paradiplozoon sp.															√										
P. homoion (Bychowsky & Nagibina, 1959)																									
Class TREMATODA																									
Clinostomum complanatum (Rudolphi, 1814)															√										
Diplostomum sp.													√		√										
D. spathaceum (Rudolphi, 1819)																√									
Posthodiplostomum cuticola (Nordmann, 1832)	√																								
Tylodelphys clavata (von Nordmann, 1832)															√										

[1] Taxon not previously reported in checklists and reviews for Turkey (i.e. Öktener, 2003; İnnal et al., 2007; Kayis et al., 2009; Arslan and Öktener, 2012).
[2] Taxon not previously reported for Europe (Baruš et al., 2002) or North America (Hoffmann, 1999).
[3] Likely erroneous identification in source study for *K. armeniaca* (Cholodkovsky, 1915).
[4] Mirror variant.
Source studies: (1) İnnal et al. (2007); (18) Geldiay and Balık (1974); (26) Öztürk (2005); (27) Aksoy et al. (2006); (28) Türkmen and Tüzer (1992); (29) Aydoğdu et al. (1997); (30) Aydoğdu and Altunel (2002); (31) Kutlu and Öztürk (2006); (32) Becer and Kara (1998); (33) Kır and Tekin Özan (2007); (34) Öztürk and Altunel (2006); (35) Öztürk (2010); (36) Sönmez (1996); (37) Uzunay and Soylu (2006); (38) Çolak (2013); (39) Demirtaş and Şenel (2012); (40) Oğuz et al. (1996); (41) Öztürk and Özer (2014); (42) Aslan (2009); (43) Yetim (1985); (44) Cengizler et al. (2001); (45) Topçu and Taşçı (1993).

al., 1991; Özbek and Öztürk, 2010; Öztürk, 2011c; Turgut et al., 2011). The 45 studies in total retained for review provided data from 41 water bodies, which comprised 12 man-made reservoirs, 21 natural lakes, and 8 water courses (Table). Notably, parasites of the mirror scalation variant were reported from Seyhan Stream (Cengizler et al., 2001) and from Lake Bektaşağa (Özer and Erdem, 1999), where this variant occurred together with the fully scaled variant. The latter variant was sampled from all other water bodies.

Forty-one different taxa in total (including molluscan *Glochidium* sp.) were recorded. Among the Protozoa, Ciliophora (ciliates) was represented by 5 identified and 2 unidentified species (notation hereafter: 5, 2); among the Metazoa, Platyhelminthes (flatworms) was the dominant phylum including Cestoda (7, 4), Monogenea (9, 3), and Trematoda (4, 1), followed by Arthropoda (3, 1), Acanthocephala (2, 1), Nematoda (2, 1), Annelida (3 species), and Mollusca (1 'taxon').

The trematode *Diplostomum spathaceum* had the highest occurrence on the fish examined (84.0%), followed by the monogenean flatworm *Dactylogyrus extensus*, the ciliate *Trichodina mutabilis*, the arthropod *Ergasilus sieboldi*, the trematode *Diplostomum* sp., and the acanthocephalan *Acanthocephalus clavula*, which were all parasitizing >50% of the fish (Figure 1). Across water bodies, *Dactylogyrus extensus* had the highest occurrence of all taxa (46.5%) and was followed by the arthropod *Argulus foliaceus* and the cestodes *Bothriocephalus acheilognathi* and *Caryphyllaeus laticeps*, which were present in >20% of the water bodies (Figure 2).

The monogeneans *Dactylogyrus chalcarburni* and *Gyrodactylus cyprini*, both from the Kızılırmak Delta (Öztürk and Özer, 2014), had not been previously reported for Turkey. In addition, 7 taxa in total, including the hirudinean annelid *Hirudo medicinalis*, the arachnid *Unionicola* sp., the secernentean nematode *Rhabdochona denudata*, the cestode *Paradilepis scolecina*, and the monogeneans *Dactylogyrus chalcalburni*, *Gyrodactylus elegans*, and *Gyrodactylus scardinii*, were not present either in the European (cf. *C. c. carpio*, the subspecies present in Turkey) or North American parasite checklists (Table).

There were no statistically significant differences among water bodies in taxon richness ($F^{\#}_{2,38}$ = 1.33, $P^{\#}$ = 0.285; # = permutational value), nor were there any differences in parasite composition at either the phylum ($F^{\#}_{2,38}$ = 0.73, $P^{\#}$ = 0.751), class ($F^{\#}_{2,38}$ = 0.94, $P^{\#}$ = 0.556), order ($F^{\#}_{2,38}$ = 1.09, $P^{\#}$ = 0.284), family ($F^{\#}_{2,38}$ = 1.03, $P^{\#}$ = 0.409), or taxon ($F^{\#}_{2,38}$ = 0.96, $P^{\#}$ = 0.593) level.

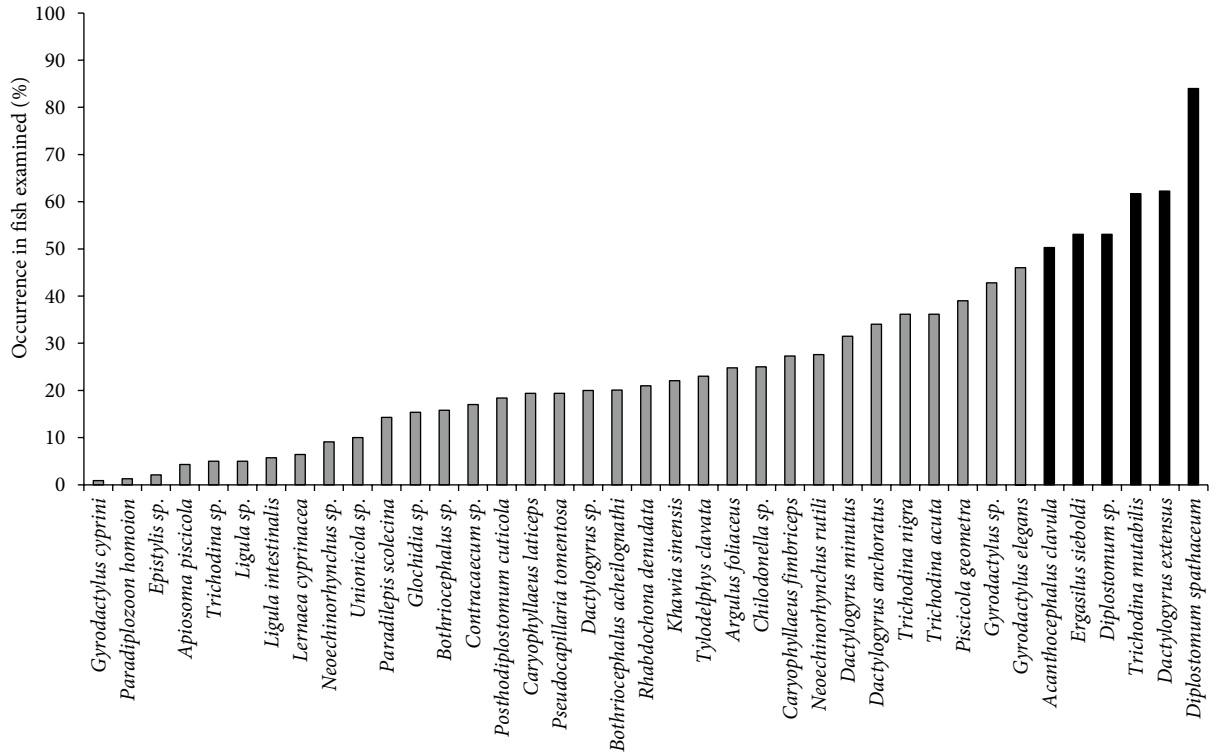

Figure 1. Percentage occurrence of parasite taxa of common carp (proportion of fish examined) from water bodies of Turkey. Taxa parasitizing more than 50% of individuals are in black. See also the Table.

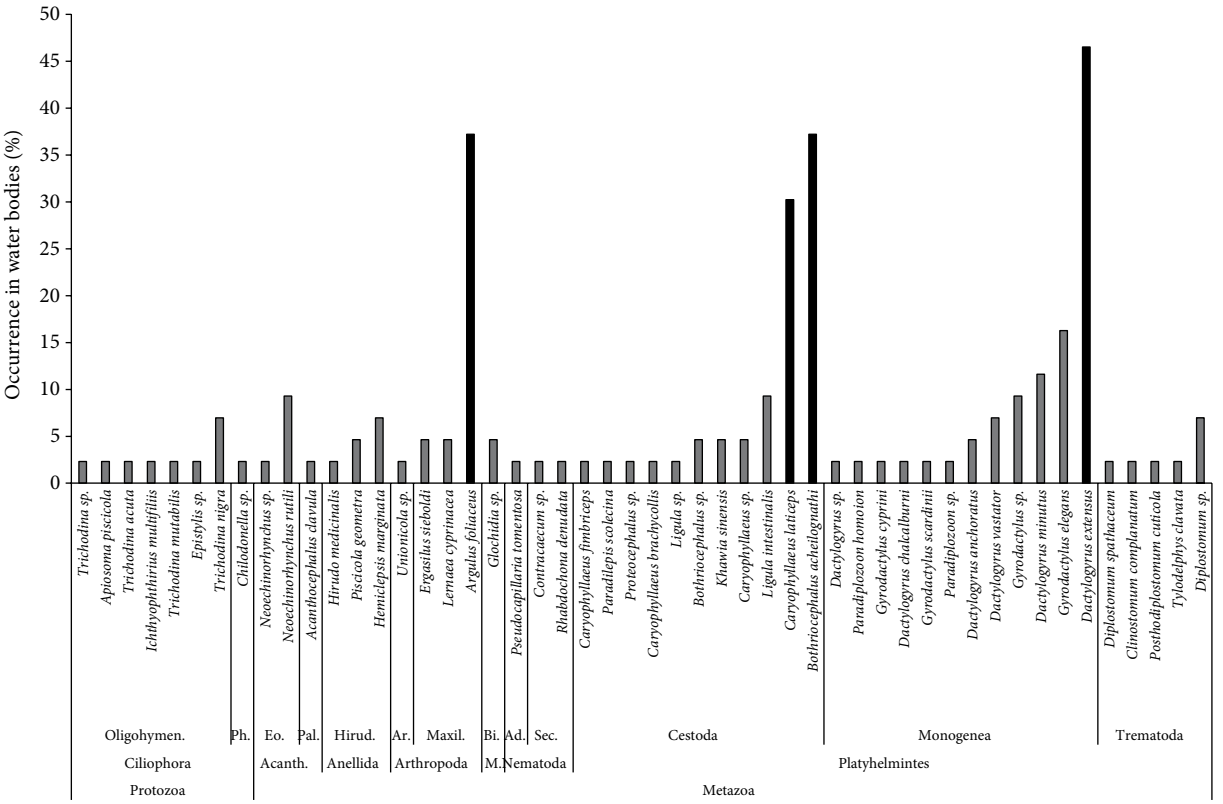

Figure 2. Percentage occurrence of parasite taxa of common carp from water bodies of Turkey. Taxa occurring in more than 20% of the water bodies in black. See also the Table.

4. Discussion

Based on this review, 41 different taxa of common carp parasites (including *Glochidium* sp., but excluding unidentified species for which at least one species was identified) have been recorded in water bodies of Turkey in the 1964–2014 period. The previously reported dominance of ciliates among protozoans (Kayis et al., 2009) and of flatworms among metazoans (Öktener, 2003) was confirmed in terms of occurrence both on fish and across water bodies.

The absence of some taxa from the checklists for Europe (Baruš et al., 2002) and North America (Hoffmann, 1999), where introduced common carp is of European origin (e.g., Panek, 1987), can be explained by the location of Turkey at the frontier between Asia and Europe (Tarkan et al., 2014), with the sea straits of İstanbul and the Dardanelles separating the zoogeographical provinces of Thrace and Anatolia (Kosswig, 1955). On the other hand, the present data on the parasite fauna of common carp in Turkey were in agreement with those of Molnár (2009), who reported consistent differences with the parasite fauna of the far eastern individuals of the common carp (Balon, 1995; Chistiakov and Voronova, 2009).

Because the focus of this study was on parasites occurring on common carp under natural conditions, taxa reported under farming and aquaculture (cf. Jeney and Jeney, 1995; Baruš et al., 2002) were not included, and this limited to some extent possible comparisons with other review studies for Turkey (see Öktener et al., 2009). Furthermore, the very limited information on parasites affecting the mirror relative to the fully scaled common carp prevents an in-depth analysis of possible differences in parasitic fauna between the 2 variants. In this respect, the only study explicitly investigating this topic reported similar infestation rates by *Dactylogyrus extensus* on both variants coexisting in Lake Bektaşağa (Özer, 2002), and the 6 parasite species reported for mirror carp from Seyhan Stream (Cengizler et al., 2001) were all recorded for the fully scaled variant in other water bodies (Table). However, it is also argued that distinction of parasites affecting mirror and fully scaled variants of feral common carp (sensu Balon, 1995) may not be as critical as that between domesticated and wild/feral forms (see Baruš et al., 2002). This is because domesticated common carp, when released under natural conditions, is known to revert quickly to its feral form, resembling its wild ancestor (Balon, 1995). Notably, this occurs regardless of scale cover, which is the result of variation in 2 unlinked autosomal loci, each with 2 alleles (Kirpichnikov, 1999) and of no taxonomic value (e.g., Balon, 1995; Vilizzi, 2012).

The original record of *Khawia armeniaca* (Cholodkovsky, 1915) from Keban Lake (Dörücü and İspir, 2005) was likely a misidentification of *Khawia sinensis*, which instead commonly parasitizes common carp (Scholz et al., 2011). Additionally, 4 additional dubious identifications were provisionally excluded from the present checklist pending further investigation. Specifically, the monogenean *Dactylogyrus ancylostylus* Chien, 1974, from Keban Reservoir (Sağlam, 1992) is known to be a specific parasite of the North American cyprinid genus *Nocomis* (Chien, 1974). Similarly, the monogenean *Dactylogyrus phoxini* Malewitzkaja, 1949 from Lake Sapanca (Uzunay and Soylu, 2006; Soylu, 2009) has Eurasian minnow *Phoxinus phoxinus* as its specific host (Chubb, 1977). The dinoflagellate *Piscinoodinium pillulare* (Schäperclaus, 1954) from Keban Reservoir (as *Oodinium pillularis* Schäperclaus: Sağlam, 1992) is known to affect common carp only under aquarium conditions with other ornamental fishes (Lom, 1981). Finally, the cestode *Schistocephalus* sp. from Seyhan River (Cengizler et al., 2001; Öktener, 2014) is known not to be able to affect cyprinids (e.g., Bråten, 1966).

The lack of differences among water bodies in terms of both parasite richness and composition indicates overall homogeneity. This is in agreement with recent findings on the biology/ecology of common carp in Anatolia, including weight–length relationships and condition factors (Vilizzi et al., 2013), natural diet composition (Vilizzi et al., 2014a), reproductive biology (Vilizzi et al., 2014b), and age–growth patterns (Vilizzi et al., 2015), all of which can be explained by the relatively long-term establishment of the species across the region. Management options for common carp should therefore take into consideration the present findings, especially in regard to the possible advantage provided by the existence of a limited number of population dynamics parameters applicable to common carp stocks at the regional level. Finally, the potential risks posed by actual and potential translocations of common carp parasites to water bodies of Turkey and their possible spread to native fish species require further investigation (e.g., Kennedy, 1993; Dove and Fletcher, 2000).

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