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A Report on Occurrence and Parasite-Host of Ligula intestinalis in Sattarkhan Lake (East Azerbaijan-Iran)

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Abstract*—Ligula intestinalis* is a three-host life-cycle Pseudophyllidean Cestode which in its plerocercoid stage infests a range of fresh water species. The objective of the present study was the worm occurrence within planctonic copepods, fishes and piscivorous birds and examine of parasite-hosts samples in the Lake of Sattarkhan Dam (near the city of Ahar, East Azerbaijan, Iran). Fish sample were collected with fyke and gill nets and the abdominal cavity was examined for the presence of ligula. Zooplanktons were captured using a planktonic net and occurrence of parasitic larval form in the body cavity was determined. Piscivorous birds were selected by telescope, they hunted and dissected for presence of parasite eggs in their gut. Results indicated that prevalence of infection was 16% for cyclopid copepoda and majority of infected cyclopid were female Cyclops. Investigation of 310 fishes specimens were indicated to infection of five species of cyprinid fishes. In addition, results indicated to manipulation of six species of migratory aquatic and semi aquatic birds by ligula. Obtained results are in agreement by previous studies. Its definite in this study that all of fishes in Sattarkhan Lake capable to infection, its important for health because they capture by native people and it is documented that ligula can be introduce as a zoonose. It's seemed that to prevent from disperses of parasite and restricted of infection, biological elimination can be effective and it's necessary to inform native people about sanitation.

Keywords*—Ligula intestinalis*, parasite-host, Sattarkhan Lake, Iran.

I. Introduction

THE *Ligula intestinalis* (L.) is a three-host life-cycle [10] Pseudophyllidean Cestode which in its plerocercoid stage infests a range of fresh water species [8], particularly member of the Cyprinidae, as its second intermediate host and it has a widespread distribution throughout the northern hemisphere [14]. While the natural host and geographical origin of the ligula is the grass carp, infection had become widespread in farmed fish (in European) as well as in a variety of wild fish in both the Asian and European [8]. The plerocercoid stage is infective to a wide range of fish-eating birds which serve as the final host.

The ligula population exhibited some unusual features: a limited specifity, a persistently low abundance and a scarcity of multiple infections. The adult worms can be form 10-100 cm in length and up to 1.2cm in width. The virulent nature of this parasite leads it to commonly filling every available space within the body cavity whatever the initial size of the host, the weight of the parasite can exceed the total body weight of the fish. Once hosted by the fish the parasite will usually reside in the body cavity for the duration of the fish's life [7]. Interestingly, the fish is not the major host of ligula, the cycle starts in the body of piscivorous birds. The life expectancy in the major host is a maximum of 5 days, but in this time they will lay a multitude of eggs. These eggs are passed in to water via the faeces of the bird. Once in the aquatic medium the coracidia hatch from the eggs, coracidium larva eaten by a wide range of copepod zooplankton, penetrates the gut wall where the procercoid stage develops. They develop to the procercoid stage within 9-10 days and will survive in the copepods for another 3-5 days [7]. The cycle continues when the planktivorus fish ingests the copepod. The procercoid then burrows through the gut wall and continues to develop in to a plerocercoid larva in the fish's abdominal cavity. The cycle is then complete when the piscivorous predatory bird eats the tapeworm hosting fish.

Differences in the reported timing of development may be explained by the following: procercoids may become infective before they complete their growth, also, copepods of different genera and species may vary in their compatibility as intermediate hosts and lastly, growth is apparently affected by the number of procercoids in the copepod [23].

Ligula pleurocercoids show very limited structural differentiation. They are flat, unsegmented and have a tapering anterior end with two bothridia pleurocercoids from different host fish vary in size, which ranges from 67-245mm in length, and 3-10 mm in width.

Ligula has been the subject of a number of studies mainly those aimed at differences in pathogenicity and parasite-host relationships [2], [3], [5], [6], [9], [10], [15], [16], [22], [23], [24], [25], [29], [31], [32], [34], [35]. The objective of the present study was the first atampted to determine the infection of organism by *ligula intestinalis* in Sattarkhan Lake and our specifically objectives were:

1)to study the worm occurrence within planctonic copepods, fishes and piscivorous birds

2) to experimentally examine of parasite-hosts.

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II. Materials and Methods

Study was carried out montly (for one year) in Sattarkhan Lake (46°, 20' E; 38°, 45' N) is suited near the city of Ahar, East Azarbaijan, Iran (Fig1). Its surface area is 7.2 km^2 with a mean depth of around 4 m and the average annual water temperature is around 11^{oc} (range 4–16^{oc}). A total of 310 fish sample were collected with fyke net and gill nets of different mesh sizes (10, 12, 14, 17, 21, 27, 32, 40, and 50 mm measured between adjacent knots) to catch a wide range of fish sizes. Samples preserved with formalin (10%), then, the body abdominal cavity was examined for the presence of *ligula intestinalis*. In parallel, the fish specimens were identified according to Carcasson [12], Eschmeyer [17] and Allen [1].

Zooplanktons were captured using a planktonic net (mesh size 45 μm), preserved with borate-buffered formalin (4% final concentration) and their genius composition were identified according to Burska and Burska [11], Davis [13], Mass [26], Newell and Newell [28] and Todd and Laverack [33]. Planktonic copepods were separated under microscope and the sex and occurrence of parasitic larval form in the body cavity of each copepod individual was determined.

Piscivorous birds were identified according to Evans [18], Harris *et al*. [20], Hudec [21] selected by telescope and they hunted for study of parasite infection. Each individual was dissected for presence of parasite eggs in its gut.

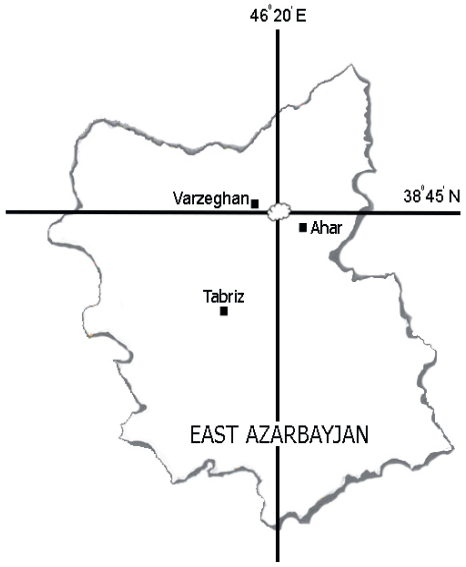

Fig. 1 Position of sampling site

III. Results

Table I presents the name and abundance of zooplankton in Sattarkhan Lake, belong to 9 geniuses in 5 phyla. The maximum diversity was seen in Rotatoria with 4 geniuses, Ciliata, Rizopoda and Cladocera with 1 genius were showed the minimum diversity. Dominated zooplanktons of lake were Cyclops, Branchionus and Polyarthra and the higher number was seen in planctonic copepoda with average 90352 individual per m^3. A total of 1000 specimen of copepoda were selected randomly and tested for occurrence of plerocercoid stage of ligula. Result indicated that prevalence of infection was 16% for two cyclopid copepoda. Interestingly, ratio of infection between female and male copepods was 15 to 1 and majority of parasite infected cyclopid were female Cyclops. Procercoid stage of ligula and sample of infected Cyclops were shown in fig2 and fig3.

Investigation of 310 fishes specimens were indicated to occurrence of 10 species and 3 families: Cyprinidae, Baltioridae and Percidae in this lake (table2). Cyprinid fishes were included: *Capoeta capoeta*, *Barbus capito*, *B. mursa*, *Carassius auratus*, *Cyprinus cpito*, *Alburnus filippi*, *Leuciscus cephalus* and *Alburnoides bipunctatus* that five of them were infected (*Capoeta capoeta*, *Cyprinus cpito*, *Alburnus filippi*, *Leuciscus cephalus* and *Alburnoides bipunctatus*), from each of Baltioridae and Percidae only one member were identified in Sattarkhan Lake (*Nemachilus bergianus* and *Stizostedion lucioperca*), there was no infected specimen between them. Pisciverous birds were examine for occurrence of ligula too, there were 16 species of migratory aquatic and semi aquatic birds in Sattarkhan Lake (table3), that results indicated to manipulation of six species by ligula (*Phalacrocorax carbo*, *Ardea cinera*, *Egretta alba*, *Egretta garzetta*, *Alcedo attnis* and *Ciconia ciconia*).

Fig. 2 Procercoid stage of *ligula intestinalis* (separated from Cyclops)

Fig. 3 Infected Cyclops, circle show procercoid in body cavity

TABLE I
LIST OF ZOOPLANKTON IN SATTARKHAN LAKE AND THEIR ABUNDANCE

Copepoda	Number per m^3	Rotatoria	Number per m^3	Rizopoda	Number per m^3	Ciliata	Number per m^3	Cladocera	Number per m^3
Cyclops male	541	*Keratella*	1081	*Difflugia*	1622	*Strobilidium*	2162	*Bosmina*	2703
Cyclops female	63784	*Polyarthra*	7027						
naplius	24405	*Brachionus*	71351						
Acanthocyclops	1622	*Asplanchna*	5405						
	Total:90352		Total:84864		Total:1622		Total:2162		Total:2703

TABLE II
LIST OF FISHES IN SATTARKHAN LAKE

	Scientific name	Family
1	*Capoeta capoeta*	Cyprinidae
2	*Barbus capito*	
3	*Barbus mursa*	
4	*Carassius auratus*	
5	*Cyprinus cpito*	
6	*Alburnus filippi*	
7	*Leuciscus cephalus*	
8	*Alburnoides bipunctatus*	
9	*Nemachilus bergianus*	Baltioridae
10	*Stizostedion lucioperca*	Percidae

TABLE III
LIST OF AQUATIC AND SEMI AQUATIC BIRDS IN SATTARKHAN LAKE

	Scientific name	Family
1	*Phalacrocorax carbo*	Phalacrocoracidae
2	*Ardea cinera*	Ardeidae
3	*Egretta alba*	
4	*Egretta garzetta*	
5	*Bubulcus ibis*	
6	*Botaurus stellaris*	
7	*Sterna hirundo*	Laridae
8	*Chalidonias leucopterus*	
9	*Larus minutus*	
10	*Larus argentatus*	
11	*Larus ridibunbus*	
12	*Alcedo attnis*	Alcedinidae
13	*Ciconia ciconia*	Ciconiidae
14	*Plegadis falcinellus*	Threskiornithidae
15	*Circus aeruginosus*	Accipiteridae
16	*Corvus frugilegus*	Corvidae

VI. DISCUSSION

Ligula intestinalis is known to infest many fresh water fishes including cyprinidae and Cyclopidea are frequent intermediate host particularly in ponds and large bodies of water [29], [15], [16].

The presence of *L.intestinalis* plerocercoids was shown by researchers to be associated with certain pathological effects in the first host: there are numerus health implications when hosting ligula, these pathological effects mainly includes the inhibition of gonadal development in the fish host [4], [15], [16]. Thus ligula plerocercoids may play a role in the regulation of their fish hosts population dynamics, via the inhibition of gonadal development. According to Kennedy *et al*., [23], ligula typically exhibits epizootic cycles over a period of 4-5 years and it has excellent power of dispersal and is brought in to a lake by migratory birds. Following its arrival in a lake, if the conditions are suitable, its population increases rapidly which in turn results in mortality of fish hosts [24]. Science the whole fish population may be infected in the course of time [23], there would be a decrease in the fish population. Several pathological changes were reported in infections of *ligula intestinalis*: fibrosis, inflammation and atrophy of the viscera, resulting from compression and displacement of the organs by the parasites, often together with accumulation of blood stained ascetic fluid [31], [27]. Clear distension of the body wall as the worm increases in size is probably the most visually astounding feature. This distension can cause impairment of muscle development and also reduce streamlining and increased risk of predation, reduced growth, anemia, dark colouration and erratic swimming is also side affects of ligula.

Although in ponds and farms some chemotherapeutic agents used to treat adult stage cestode infections may be effective, in particular Droncit 5 mg/kg direct application or incorporated in to pellets or Mebendazole (5-benzoyi-1H-benzimidazol-2-vl) specifically against migrating pleurocercoids or treatment of ponds with Neguvon (Masoten or Dipterex) to eliminate copepods [27] but there is no treatment for wild fish to restricted infection.

Ligula seems to be a thermophilic species, low temperatures seem to delay or even interrupt development and consequently completion of the life cycle. Distribution and seasonality of tapeworm infections depends not only on ambient temperatures but also on the abundance of compatible copepods, which is also seasonal and their part in the composition of the fish's food, which is both age and season related [10].

Its definite in this study that:

- All of infected fishes in lake are from cyprinidae and the most important intermediate hosts are female Cyclops that there are in agreement by previous studies [5], [6], [10], [15], [16], [20], [22], [24], [25], [29], [35].
- All of fishes in Sattarkhan Lake capable to infection, its important for health because they capture by native people and it is documented that ligula can be introduce as a zoonose.
- The lake is an important source of infection in region because infected birds have the main role in disperse of parasite and its increase the probability of epidemy.
- Existence of fish corpse and occurrence of parasite worm produce a clumsy viewpoint and there are fearful for people

because the water of lake is used for drinking.

V. Conclusion

It's seemed that because of nature of region, one of effective method for restricted infection may be biological elimination and more study is necessary for this porpoise. In addition, it's necessary to prevent from consumption of infective fish by native people and inform them about sanitation.

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