Observations on Fecundity of Adult *Spirometra* tapewormin Relation to Time ofHighest Production of Eggs and Number of Eggs Produced per Day in experimentally infected cats

**Abstract**

In the life cycle of *Spirometra* species, cat is a definitive host. The adult worm develops in the small intestine and starts to discharge eggs in the faeces of the cat. The faeces can be used as a diagnostic material for the infection of cat with *Spirometra*. In this study five cats were used. Each cat was orally fed with scolex of Spargana obtained from experimentally infected Hamster or mice?. Eggs were observed microscopically in the stool of cats. Egg count using McMaster slide was initiated from day one of production of eggs. Cat A: Started discharging eggs on day 14 post infection, eggs per day was 9,060. Highest number of eggs produced was on day 40, eggs per gram of feces was 1,550 and eggs per day 50,220. Cat B: started discharging eggs on day 12 post infection, eggs per day was 5,960. Highest number of eggs produced was on day 65, eggs per gram of feces was 1,350 and eggs per day 41,840. Cat C: started discharging eggs on day 60 post infection, eggs per day was 3,010. Highest number of eggs produced was on day 89, eggs per gram of feces was 1,350 and eggs per day 41,040. Cat D: started discharging eggs on day 13 post infection, eggs per day was 1,565. Highest number of eggs produced was on day 33, eggs per gram of feces was 1,300 and eggs per day 39,650. Cat E: started discharging eggs on day 10 post infection, eggs per day was 4,605. Highest number of eggs produced was on day 25, eggs per gram of feces was 1,050 and eggs per day 32,445. This study determined the first day the adult worm started discharging eggs, eggs per gram of faeces and eggs produced per day.

Write the results comprehensively without mentioning each cat A,B,C,D,E in the abstract. Or it can be written compiling or combining the data and the numbers and finally …..cat A, B, C, D and E, respectively—like that..

**Keywords:** Cat, definitive host, fecundity, *Spirometra,* eggs

**Introduction**

*Spirometra* is a [genus](https://en.wikipedia.org/wiki/Genus" \o "Genus) of [pseudophyllid](https://en.wikipedia.org/wiki/Pseudophyllidea" \o "Pseudophyllidea) [cestodes](https://en.wikipedia.org/wiki/Cestoda" \o "Cestoda) that reproduce in [canines](https://en.wikipedia.org/wiki/Canidae" \o "Canidae) and [felines](https://en.wikipedia.org/wiki/Felidae" \o "Felidae), but can also cause pathology in human if infected.[1]. *Spirometra* is distributed worldwide . As an adult, this tapeworm lives in the [small intestine](https://en.wikipedia.org/wiki/Small_intestine" \o "Small intestine) of its [definitive host](https://en.wikipedia.org/wiki/Definitive_host" \o "Definitive host) and produces eggs that pass in the animal's [feces](https://en.wikipedia.org/wiki/Feces" \o "Feces). When the eggs reach water, they embryonate and hatch into [coracidia](https://en.wikipedia.org/w/index.php?title=Coracidum&action=edit&redlink=1" \o "Coracidum (page does not exist)) which is eaten by [copepods](https://en.wikipedia.org/wiki/Copepod" \o "Copepod). The copepods are eaten by a second intermediate hosts such as amphibians, reptiles, birds to continue the life cycle [1]. Humans can become infected if they drink water containing infected Cyclops, eat frog legs or fish with the plerocercoid stage encysted in the muscle. In humans, infection with *Spirometra* is termed [sparganosis](https://en.wikipedia.org/wiki/Sparganosis" \o "Sparganosis). Sparganosis is an infection of tissues by second stage larvae (spargana or plerocercoid) of pseudophyllidean tapeworms. Sparganosis can occur in body cavities or in tissues of intermediate and paratenic hosts.  The definitive hosts of Spirometra spp. are carnivores where adult worm develops and shed eggs in feces of the definitive host.

The pathology of  *Spirometra* infection depends on the ending location of the migrating sparganum. The adult stage causes little to no pathology in the host. In paratenic hosts, plerocercoids migrate mainly to [subcutaneous tissues](https://en.wikipedia.org/wiki/Subcutaneous_tissue" \o "Subcutaneous tissue). Sparganosis usually appears as slowly growing migratory subcutaneous nodules in the tissues of infected intermediate or paratenic hosts. The parasite can be found anywhere in the body including central nervous system [1].  To diagnose *Spirometra* infection in humans, serodiagnosis using ELISA can be used to target anti-sparganum IgG antibodies within the blood. This diagnostic method is useful around 10–12 days post infection and is almost 100% effective at detecting the anti-sparganum antibodies in the 14–22 days post infection [2]. Serodiagnosis of sparganosis is a useful early detection method. Another method of diagnosing sparganosis is biopsy of subcutaneous sample. Cysteine protease is early detected in some species of *Spirometra* excretory-secretory proteins [3]. This option proves to be the best choice for early diagnostic methods with regards to early antigen identification.[3]. Some imaging methods such as CT or MRI scans can be used to identify spargana larvae in other areas of the body, like the brain.[4]

When diagnosing an infection in animals, proglottids from the worm itself may have broken off and ended up in the feces along with eggs [5]. The proglottids can be microscopically identified as being in the Order of *Pseudophyllidea* because they have medial genital pores, but the actual genus of the worm cannot be identified from proglottids alone [5]. The specificity of the worm genus or species would require differentiation based upon the uterus and egg morphology. Therefore, the aim of this study was to evaluate fecundity of adult *Spirometra* worm in relation to time of highest production of eggs and number of eggs produced per day.

**Materials and methods**

A total of 5 cats (breed, age, sex ???) were used in this study (Any approval from animal ethical committee obtained? Give the details here). Cats were reared in the animal house, each in a separate cage (Fig.1) (Add details of the cage-dimensions, material of cage etc). Cats were fed with commercial cat pellets and water. Before being fed with spargana they were dewormed (Which dewormer? Add details with dose and frequency). Then each cat was fed with one scolex (scolex alone or its entire spargana) of spargana (How it was collected from lab animal?How it was fed?Along with food?-How it was ensured all cats ate the scolex-add all details)which developed to adult stage and started producing eggs. Eggs (Fig.2) were observed microscopically in stool of cats. Egg count using McMaster slide was initiated from day one of observation of eggs in the stool of cats.



Figure 1. Cat reared in a cage

**Egg count**

The aim of egg count per gram of faeces of cat was to study the fecundity of the worm in relation to time of highest production of eggs and the number of eggs produced per day. *Spirometra* eggs were collected from faeces of 5 infected cats. In the laboratory, the whole amount of faeces collected per day was weighed in order to get the average weight of faeces produced by a single cat, then 3 gm were taken for egg count. Egg count was carried out using McMaster slide. The McMaster method is a quantitative technique used to count the number of eggs per gram of faeces [6]. 3 gm of cat faeces were dissolved in 42 ml of water in a beaker and mixed up thoroughly. Mixture was poured through mesh sieves (aperture 250, 150, 75 and 53 μm). 15 ml of the filtrate was collected in a test tube. The test tube was centrifuged at 2000 rpm for 2 minutes. The supernatant was poured off. The tube was filled to previous level with saturated Sodium Chloride (NaCl) solution which is a floatation solution. The tube was inverted 6 times and solution was removed with a pipette and this was used to fill both chambers of McMaster slide. The two chambers were examined under a light microscope and the total number of eggs were multiplied by 50 to arrive at the number of eggs per gram of faeces (EPG). Only the eggs present within the grid of the McMaster slide were counted as this grid is calibrated to give ´100 eggs per gram´ of faeces.

This calculation is based on:

If 3g of faeces are dissolved in 42 ml

Total volume is 45 ml

Therefore 1 g 15 ml

Therefore, the number of eggs is multiplied by 100

If two chambers are examined then multiply by 50.

In this study two chambers were used, the number of eggs obtained was multiplied by 50.



Figure 2. Egg of *Spirometra*

**Results**

Eggs produced were taken measurements (How?). Had average length 59.6 μm, width 36.4 μm. The range was length 51-68 μm and width 30-42 μm. A table can be inserted to fill all the data given below.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| No. of days of observation | Day of Start of egg discharge after infection | EPG | Eggs per day | Day of highest egg excretion in stool of cats | EPG | Eggs per day |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |

Fecundity of *Spirometra* in experimentally infected cats

Number of eggs per gram of feces.

CAT A

Number of days observed 120 days. Day 14 post infection started discharging eggs. Eggs per gram of feces was 300, eggs per day was 9,060. Highest number of eggs produced was on day 40, eggs per gram of feces was 1,550 and eggs per day 50,220 (Fig.3).

CAT B

Number of days observed 120 days. Day 12 post infection started discharging eggs. Eggs per gram of feces was 200, eggs per day was 5,960. Highest number of eggs produced was on day 65, eggs per gram of feces was 1,350 and eggs per day 41,840 (Fig.4).

CAT C

Number of days observed 120 days. Day 60 post infection started discharging eggs. Eggs per gram of feces was 100, eggs per day was 3,010. Highest number of eggs produced was on day 89, eggs per gram of feces was 1,350 and eggs per day 41,040 (Fig.5).

CAT D

Number of days observed 40 days. Day 13 post infection started discharging eggs. Eggs per gram of feces was 50, eggs per day was 1,565. Highest number of eggs produced was on day 33, eggs per gram of feces was 1,300 and eggs per day 39,650 (Fig.6).

CAT E

Number of days observed 40 days. Day 10 post infection started discharging eggs. Eggs per gram of feces was 150, eggs per day was 4,605. Highest number of eggs produced was on day 25, eggs per gram of feces was 1,050 and eggs per day 32,445 (Fig.7).



Figure3.Eggs per day (EPD) in the faeces of cat A experimentally fed with spargana of *Spirometra* species. Lack of data on the graph indicates no faeces was collected on that day.



Figure 4.Eggs per day (EPD) in the faeces of cat B experimentally fed with spargana of *Spirometra* species. Lack of data on the graph indicates no faeces was collected on that day.



Figure 5. Eggs per day (EPD) in the faeces of cat C experimentally fed with spargana of *Spirometra* species. Lack of data on the graph indicates no faeces was collected on that day.



Figure 6.Eggs per day **(**EPD) in the faeces of cat D experimentally fed with spargana of *Spirometra* species. Lack of data on the graph indicates no faeces was collected on that day.



Figure 7.Eggs per day (EPD) in the faeces of cat E experimentally fed with spargana of *Spirometra* species. Lack of data on the graph indicates no faeces was collected on that day.

**Discussion**

Add few lines about *Spirometra* and its zoonotic importance. Concise…its again repetition of materials and methods…No need to repeat again in discussion.

The pre-patent period of *Spirometra* has been investigated by many -researchers previously, who found that the methods used to asses the pre-patent period can be influenced by many factors, such as: (a) the size of faecal samples and the method by which the eggs were detected [7;8], (b) host species [9], (c) age and diet [10], (d) parasite age [10] and (e) crowding of the parasites in the definitive host [10].These findings conform to what it has been observed and reported in the study as methods were optimized using the above mentioned studies as a guide. The pre-patent period for *S, erinacei* in the cat has been observed to be more than 45 days and 15 days, respectively [11; 12]. Also it has been reported the pre-patent period of *S.erinaceieuropaei* to be 8-10 days [13]. All these observations conform with the observation in our study. Among the 5 cats which were used in this study (Cats A, B, C, D and E), only Cat C was male and the others were all females. This gender difference could be the cause for the delayed pre-patency of the cat in our study (Any literature to support this reason? Please add).

The daily egg out is an important measurement of the biology and fecundity of the parasite as reported by [14;13]. They reported that daily egg production had a cyclical fluctuation, with peaks and intervening periods when no eggs were produced. In the present study, the daily egg output of 5 cats showed cyclical fluctuations, with peaks and intervening periods when no eggs were produced (Fig.3-7). The thousands of eggs produced by single worms establishes the fact that the fecundity of these parasites are in line with survival instincts of species in harsh and difficult environmental conditions. It is difficult for a parasite to locate the right intermediate hosts and definite host. Therefore, an extremely fecund parasite will be much adapted to the ever changing environmental conditions.

**Conclusion and Recommendation**

The micro-environment of the adult parasite inside the definitive host which is the small intestine is important for its survival. This study is of public health importance. The adult *Spirometra* discharges a large number of eggs in the environment, when the eggs come in contact with water, they develop and hatch to coracidia which is eaten by *Cyclops*. Humans can get infection by drinking water contaminated with infected *Cyclops*. It is therefore recommended to use safe water such a piped and treated water to avoid getting infection from contaminated water. Also, it is recommended to deworm cats and dogs regularly as per the directions of the veterinarian which are common pets.

**Ethical issue**

There is no ethical issue in this manuscript because no human material was used.

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