PREVALENCE OF GASTROINTESTINAL HELMINTH PARASITES OF DOMESTIC DUCKS (*Anas platyrhynchos* Linnaeus, 1785) IN CHITWAN DISTRICT, NEPAL

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Submitted to
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DECLARATION

I hereby declare that the work presented in this thesis has been done by myself, and has not been submitted elsewhere for the award of any degree. All sources of information have been specifically acknowledged by reference to the author(s) or institution(s).

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This is to recommend that the thesis entitled "**Prevalence of Gastrointestinal Helminth Parasites of Domestic Ducks (*Anas platyrhynchos* Linnaeus, 1785) in Chitwan District, Nepal"** has been carried out by Miss. **Rashmi Paudel** for the partial fulfillment of Master's Degree of Science in Zoology with special paper **Parasitology** This is her original work and has been carried out under my supervision. To the best of my knowledge, this thesis work has not been submitted for any other degree in any institutions.

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This thesis work submitted by **Miss. Rashmi Paudel** entitled "**Prevalence of Gastrointestinal Helminth Parasites of Domestic Ducks (*Anas platyrhynchos* Linnaeus, 1785) in Chitwan District, Nepal**" has been accepted as a partial fulfilment for the requirements of Master's Degree of Science in Zoology with special paper Parasitology.

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LIST OF ABBREVIATIONS

GI	-	Gastrointestinal parasite
µm	-	Micrometer
et al	-	and his associates
Rpm	-	Revolution per minute
FAO	-	Food and Agriculture Organization
GDP	-	Gross domestic products
ILO	-	International Labor Organization
NTNC	-	National Trust for Nature Conservation
DPX	-	A mixture of Distyrene, Plasticiser and Xylene

ABSTRACT

Domestic ducks are reared in Chitwan for eggs and meat which plays key role to enhance the economic status of local people. The present investigation was conducted to determine the general prevalence, identification, municipalities wise comparison of helminth parasites of domestic ducks of Chitwan. A total 120 fecal samples were collected from April- June 2017 and examined macroscopically as well as microscopically, by saline wet mount, Concentration methods (Floatation and sedimentation). Macroscopic examination of intestine of ducks revealed (6.67%) of adult nematode parasitic infection. The parasite was taxonomically identified as *Heterakis* sp. Out of 120 fecal samples examined, an overall prevalence of (75%) were found positive for helminth parasites. Ten different helminth parasites were recorded in present study which includes eight genera of nematodes, and one genus each of trematodes and cestodes. The prevalence rate of nematode parasites (66.67%) where found higher than cestode parasites (1.67%) and trematode parasites (6.67%). The prevalence rate of helminth parasites was higher in Rapti municipality and lowest in Khairahani municipality. Similarly the ducks of Chitwan were found infected with more than single helminth parasites. The result of this study provides baseline data on prevalence and diversity of helminth parasites of domestic ducks in three municipalities of Chitwan, Nepal.

1. INTRODUCTION

1.2 Background

Poultry is the trend of rearing birds like chicken, duck, pigeon turkey and ostrich for dual purpose i.e. meat and eggs, poultry production as a commercials enterprises in Nepal started since last three decades and is now becomes one of the main national agriculture industries. There is a tremendous growth of poultry farming in the last six decades; it has created income generation in urban and rural areas (Bhattarai, 2008).

Poultry products like eggs and poultry meat has been recognized as the fastest way to fulfill protein supply to human in shortest run. FAO has recommended the average intake of protein by an individual should be around 65gm per day of which more than 50% should be from the animal source (FAO, 2009). Poultry industry has been increasing rapidly with well –equipped housing system in most of the developed countries, least developing countries has many marginal poultry farmers with small scale of farming as their business for livelihood (Alders and Pym, 2009). Data indicate that many poultry farming in the world follow the conventional methods of rearing the poultry in developing countries (Gueye, 2009; Sonaiya, 2009). Indeed the farmers fall the problem of poor production and reproductive performance, disease and mortality (Conroy *et al.*, 2005).

Nepal has two third of the population directly engaged in agriculture that contributes for 34% of national GDP (Gross Domestic Products) of which 15% is from livestock sector (MOAC, 2014) in most developing countries live stock farming plays key role in human food and nutritional security, livelihood regional balance, gender mainstreaming and rural poverty alleviation (ILO, 2004).

Duck farming plays a vital role for income generation, nutritional fulfillment and employment generation (Islam *et al.,* 2012). Ducks are the indicators of the richness and diversity of wetland ecosystem and they are the object urgent attention. According to department of livestock services, Livestock and poultry inventory, (2009/10), poultry production is moving towards self sufficiency and the growth rate of Nepal's commercial sector is satisfactory at around 17-18 percent annually and its contribution to overall GDP is also encouraging and increasing.

1.2 Duck farming practices in Chitwan

Duck Farming in Nepal is an agricultural occupation of plain regions for home use to produce eggs and meat. Nowadays Duck farming popularity increasing in plains and hilly regions of country. Commercial duck farming in Chitwan is going popular between farmers. They maintained duck farm and fish farm at the same place (Dhakal, 2005).

Duck farming started in Nepal since 1970, Duck meat is an alternative of chicken (MOAC, 2006). Duck farming is a best source to generating income in rural areas of

Chitwan. Commercial duck productions increasing rapidly peoples are used to maximize their benefits and survive their lives (Bhattarai, 2008). Organic farm of Nepal started commercial duck farming using the modern technology and raise free range duck for meat and eggs. Duck is strong than chicken and least chance to surfing from diseases and easy to feed and grow (Bhandari, 2007).

Duck keeping practices can be categorized in two ways on the basis of the presence or absence of larger water bodies. The ducks are raised together with indigenous fowls and livestock in the Chitwan district. The prime purpose of duck farming is for domestic consumption of meat and eggs along with its contribution to generating emergency cash to fulfill household requirement. Rural people have been encouraged to take up duck-raising as a source of additional protein and income and, in the case of fish farmers, in helping to produce more fish, through the nutrient supply from duck manure to the fish ponds (Hossain *et al*., 2005). Ducks are also reared for religious and culture significance. Every Tharu member of an indigenous caste rears ducks as it is necessary to offer ducks and duck eggs to gods, goddesses and in the festivals throughout the year. Besides that there are other groups (Newars) that offer duck eggs during Dashian and Tihar, which are important hindu festivals. Rapid urbanization and migration trends in cities and towns have limited the availability of water bodies and this in turn in influencing the decrease in households raising ducks and duck flock size in Chitwan. Geographical location, climatic condition water logged and plain area of Country are suitable for duck habitat although such factors also favor growth multiplication development survival and spread of intestinal parasites. Different diseases in the ducks are due to parasitic infection which retards growth and productivity. The duck is non migratory, utilizes temporary ponds wetlands of local area which also favors both external and internal parasites (Musa *et al*., 2012). Intestinal infections may cause the considerable damage and great economic loss to the poultry industry in Chitwan district due to malnutrition, decrease feed conversation ratio, weight loss, lowered egg production and death in young birds. Many infections of parasites are due to free range of poultry farming system in locality of Chitwan (Bhandari, 2008). Interest of the helminthofauna of domestic ducks results largely from the specific ecology of these Birds, due to dual living environment of domestic ducks – land and water hence have the greatest chance of contact with invasive forms of parasitic.

1.3 Disease in domestic ducks

Different Nepalese veterinary organizations have reported 85 new outbreaks of highly pathogenic avian influenza at various farms across Bagmati, Bheri and Narayeni affecting broilers, layers, parent's stock birds and backyard birds. High death was reported in poultry due to infectious bursal disease, infectious bronchitis, coccidiosis, ascariasis, new castle disease and fowl cholera (Jha *et al*., 1996). Maximum mortality occurred in birds older than 20 weeks due to Gumboro disease (Singh and Bhurtel 1999). Marek's disease apart from coccidiosis and chronic respiratory disease was reported by Dhakal (2000). Collibacillosis was a key disease affecting birds yonger than 8 weeks followed by cocciodiosis and aspergillosis (AHRD, 1999/2000). Ducks parasites commonly seen

include protozoa, helminths, and arthropods and the effects vary from begining to acute death (Ritchio *et al*., 1997). Parasitic diseases come first among other disease that cause reduction in productivity of poultry in rural area (Adjinmi and Oke, 2011). Intestinal parasites like round worm, cecal worm and type worm causes diseases in ducks where as mycotoxixcosis, fowl cholera, duck plague, duck viral hepatitis and botulism have been also reported in duck (NARC Annual report, 2072/73).

1.4 Parasites of ducks

Parasites are those organisms living outside the body and within their hosts in the eye, lacrimal duct, trachea, lungs, oesophagus, crop, proventiculus, entire intestinal tract, small intestine, oviduct, caeca, gizzard, rectum, bursa fabricus, liver and cloaca of the host (Permin and Hansen, 1998). They completely depend upon their host causing infection and even morbidity. Especially, the protozoan and helminthes (nematode, trematode, and cestode) have been reported as endoparasites in birds including domestic ducks. The major external parasites of poultry are lice, mites, and ticks which do not lead to death but production losses due to the irritation in birds such as many external parasites suck blood which causes birds to suffer from anemic (Musa *et al*., 2012). Nematodes are common in poultry, ducks, and wild birds. Major species of nematodes that affect poultry include species of large roundworms (*Ascaris* sp., also known as ascarids), species of small roundworms (*Capillaria* sp., also known as capillary worms or threadworms), and cecal worms (*Heterakis gallinarum*). The common cestodes that infect duck include *Hymenolepis* sp., *Fimriaria fasciolaris, Diorchis nyrocae, Cotugnia fastiga*, *Raillietina* sp. etc. The common trematodes are *Echinostoma revolutum, Hypoderaeum conoideum, prosthogonimus* sp.

1.5 Objectives

1.5.1 General objective

- To determine the prevalence of gastrointestinal helminth parasites of domestic ducks (*Anas platyrhynchos* Linnaeus, 1758) in Chitwan, Nepal.

1.5.2 Specific objectives

- To identify adult gastrointestinal helminth parasites based on morphology.
- To determine the prevalence of gastrointestinal helminth parasites of ducks.
- To compare prevalence of duck parasites in three different municipalities of Chitwan.

1.6 Significance of the study

Globally lots of works have been done on duck infection, disease and parasites regarding its importance but limited work have been done on parasites of ducks. Every year in rural area farmers have to bear heavy loss due to high mortality of duck due to different kinds of infection and parasitic diseases. The main cause of outbreak of such disease is still unclear. Although the outbreak due to the other microbial infection have focused, parasitic infections and their role in duck morbidity and mortality has not been focused yet. Thus, there is a need for studying and documenting the prevalence of parasites to understand the mode of infection and the potential transmission of parasites between species. The present findings will provide some baseline information on the parasitic burden in ducks of Chitwan district.

2. LITERATURE REVIW

Ducks are familiar and widespread birds that can be found in nearly every river, lake, pond and even ocean in the world, missing only from Antarctica (Cracken and Wilson, 2011). But while most ducks share many characteristics and they are all members of the *Anatidae* bird family (Al-Labban *et al*., 2013) There are more than 100 species of ducks in the world, and many of them are uniquely specialized for different habitats, climates and diets (Musa *et al*., 2012). Terai region of the Nepal is more suitable for the duck farming. Domestic ducks play a major role in rural area of terai to enhance the economy in the form of meat and eggs. Geographical location, subtropical climatic condition, water lodged and low areas of the country are suitable for duck habitat but these factors also favor growth, multiplication, development, survival and spread of parasites (Farjana *et al*., 2004). Ducks is infected by many external and internal parasites. The ducks are also susceptible to various parasitic disease caused by different Protozoans and helminthes parasites. The common internal helminth parasites include nematodes, cestodes and trematodes. Parasitic infestation cause diseases in ducks and affect directly as well as indirectly to their productivity and growth (Anisuzzaman *et al*., 2005). The major external parasites of poultry are lice, mites and ticks. Deaths resulting from infestations of external parasites are rare, but production losses often occur because of the irritation caused to the birds. For example many external parasites suck blood which often causes birds to become anaemic (Kavetska *et al*., 2012). Infections may cause considerable damage and great economic loss to the poultry industry due to malnutrition, decreased feed conversion ratio, weight loss, lowered egg production and death in young birds.

2.1 In global context

Only few study reports are available regarding parasites of ducks. The Bangladesh was one major country in which parasites of duck is major concern of veterinary studies so; more work has been carried out regarding parasites of ducks than other countries. Though Mexico, Egypt, Nigeria, Japan and Iraq were also other major countries for the exploration of parasites in ducks.

Nematodes

Nematodes are common in poultry, ducks, and wild birds. Major species of nematodes that affect poultry include species of large roundworms (*Ascaris sp*. also known as ascarids), species of small roundworms (*Capillaria sp*. also known as capillary worms or threadworms), and cecal worms (*Heterakis gallinarum*). Roundworms can cause significant damage to the organs they infest. Most roundworms affect the digestive tract; others affect the trachea (windpipe) or eyes.

In Asian countries large numbers of domestic duck have been reported to be infected by various helminth parasitic infections. Three species of nematodes *Capillaria anatis,*

Amidostom acutum, Echinuria uncinata were reported during fecal examination of ducks in Japan (Yoshino *et al*., 2009). But in Bangaladesh, *Amidostomum anseris* and *Capillaria contorta*, was recorded during postmortem examination of domestic ducks (Yousuf *et al.*, 2009). Four species of nematodes namely *Lipeurus squalidus, Gonicofes hologaster, Menopon leukoxanthum* and *Enacanthus stramineus* (Musa *et al*., 2012) from Bangladesh. Similarly, Hoque *et al*. (2014) examined 105 domestic ducks in Bangadesh among which 55% were infected by three species of nematodes namely *Ascaridia* spp., *Capillaria* sp. and *Heterakis* sp. While *Amidostomum acutum* was reported from ducks of Central Iraq (Mohammad, 1758). Al-Labban *et al*. (2013) examined internal organs and fecal samples of 80 ducks in Iraq where a single species of nematodes *Hystrichis tricolor* was recorded. Similarly Farjana *et al*. (2008) dissected and necropsied 300 ducks in Bangladesh among which 290 ducks were infected with *Amidostomum anseris* and *Echinuria uncinata*. But same genus but different species *Amidostomum acutum* was recorded for the first time from duck of Japan (Yoshino *et al*., 2012). Yousuf *et al*. (2010) examined 206 ducks by postmortem among which 167 ducks in Bangladesh were infected with 10 species of helminthes in which 2 species were nematode, *Amidostomum anseris* and *Capillaria contorta* were conformed.

As Asia, studies on duck nematodes parasite has been found in African countries. Nematodes of genus *Ascaridia* sp*., Heterakis* sp., and *Capillaria* sp., were encountered in GI tract of duck in Egypt (Nagwa *et al.,* 2013). Similarly, *Ascaridia galli* was reported from ducks in Nigeria (Adang, 2014). Aboulaila *et al*. (2011) dissected and necropsied 110 domestic ducks, *Ascaridia galli* and *Heterakis gallinaraum* was recovered among which *Ascaridia galli* was highly prevalent in Egypt likewise *Ascaridia sp*., *Capillaria* sp. and *Heterakis* sp. was reported from intestinal tract of ducks in Tanzania (Muhairwa *et al*., 2007). Adejinmi and Oke (2008) examined 175 fecal samples from Nigeria, 167 samples were found positive by different helminthes parasites among which *Ascaridia galli*, *Heterakis* sp., *Capillaria* sp. and *Echinuria uncinata* were identified nematodes with high prevalence of *Ascaridia galli.* In the same way *Ascaridia galli, Trichostrongylus tenus, Heterakis gallinarum, Capillaria* sp. were recorded from caecam of ducks in Nigeria (Paul *et al*., 2015).

Most of the studies in American countries, parasitic infections have been found in maximum Mexican ducks. Single nematodes of genus *Strongyloides* were found during fecal examination of duck in Sourthern Florida (Donald *et al*., 1994). While *Tetrameres crami, Echinuria uncinata, Epomidostomum uncinatum, Amidostomum* sp., *Heterakis dispar* were reported in postmortem examination of 71 ducks in Central Oklahoma (Michael and Kocan, 1980). Similarly nematodes of species *Amidostomum acutum, Strongyloides sp., Capillaria contortata, Echinuria uncinata* was found during post mortem of Florida ducks (John and Donald, 1972). Likewise *Amidostomum* sp. was reported from gizzard in U.S.A (Clark *et al*., 1957). Farias and Canaris, (1986) dissected 129 Mexican ducks, *Amidostomum acutum* and *Echinuria* sp. was recorded from Mexico.

Few numbers of domestic ducks have been reported to be infected by helminth parasitic infection in European countries. Kavetska *et al*. (2012) examined 152 wild ducks and found three species of nematodes, *Ascaridia* sp., *Capillaria* sp., *Amidostomum* and *Echinuria* sp. among which *Amidostomum* sp. from Gizzard was recorded highly prevalent. Similarly *Amidostomum acutum* was encountered from 8 ducks of southern England (Soliman, 2009). In the same way *Amidostomum Acutum* and *Capillaria* sp. were recorded from caecum of ducks in Netherland (Borgsteede *et al*., 2005).

Studies in helminth parasites in Australian countries were very limited. The available literature showed a single article relative to nematode parasitic infection in duck of New Zealand. Taylor and Francis (1977) examined the part of alimentary canal, gizzard and encountered six male and 12 females of *Echinuria uncinata* from grey duck.

Cestodes

Poultry reared under free range conditions are more likely to be infected with cestodes compare to indoor condition. The best known species are commonly called tapeworms they specially live in digestive tract, though some may found out of the alimentary canal. All tapeworms of poultry have indirect life cycles with intermediate hosts such as earthworms, beetles, flies, ants or grasshopper. The intermediate hosts are essential to complete the life cycles and infections are therefore rare in indoor systems (Permin and Hansen, 1998). The common cestodes that infect duck include, *Hymenolepis* sp., *Fimriaria fasciolaris, Diorchis nyrocae, Cotugnia fastiga*, *Raillietina* sp. etc.

The Asian ducks have been reported to be infected by more species of cestode parasites. *Hymenolepis coronula* and *Fibriaria fasciolaris* was recorded from domestic ducks in Bangladesh (Yousuf *et al*., 2009). While Musa *et al*. (2012) examined 20 ducks in Bangladesh via postmortem record 2 species of cestodes namely *Cotugnia cutneata* and *Hymenolepis columbae*. Similarly Yoshino *et al*. (2012) found *Hymenolepis* sp. for the first time from Aigamo ducks in Japan. Farjana *et al.* (2008) recorded *Hymenolepis coronula, Hymenolepis lanceolata, Schillerius longiovum* and *Fambriaria fasciolaris* from small intestine of 290 ducks in Bangladesh likewise *Hymenolepis coronula* and *Fimriaria* sp. were recorded by postmortem of 167 ducks in Bangladesh (Yousuf *et al*., 2010). While Mohammad (1758) confirmed *Diploposthe laevis* from GI tract of domestic ducks in Iraq.

In African ducks *Raillietina* sp. and *Hymenolepis* sp. are highly prevalent cestodes parasites. Three species of cestodes namely *R. cesticullus, R.magninumida* and *Hymenolepis carioca* were reported from domestic ducks in Nigeria (Adang *et al*., 2014). Whereas two species of cestodes namely *R. tetragona* and *R. echinobothridia* was reported from GI tract of duck in Egypt (Negwa *et al*., 2013). While *Cladogynia phoeniconaiadis, Echinolepis carioca* and *Baerfainia anoplocephaloides* were recorded from ducks in Egypt (Aboulila *et al*., 2011). Muhairwa *et al*. (2007) examined 192 ducks in Tanzania 100 ducks were infected with 14 different helminthes among which 4 species of cestode *namely Raillietina echinothridia*, *Raillietina tetragona, Subulura strongyillna*

and *Subulura sucturia*. Similarly *Raillietina echinobothridia, Raillietina tetragona, Hymenolepis cantaniana* were reported from slaughtered ducks in North Eastern Nigeria (Paul *et al*., 2015).

In case of American countries ducks from Florida have been reported to be infected by more species of cestode parasites. *Dicorchis* sp. was reported from ducks in Sourthern Florida (Donald *et al*., 1994). Whereas six species of cestodes*, Cloacotaenia megalops, Fimbrianiaria fasciolaris, Hymenolepis* sp., *Diorchis longiovum, Microsomacanthus compressa* and *Dicranotaenia coronula* were recorded from ducks in Central Oklahoma (Michael and Kocan, 1980). Kinsella and Donald (1972) dissected Florida ducks and seven species of cestodes were found among which *Dicranotaenia coronula* was new for the host florida duck. While *Hymenolepis* spp. was reported from Mexican ducks (Reyes *et al*., 2010). Farias and Canaris (1986) reported 10 species of cestodes namely *Anomotaenia ciliata, Cloacotaeria megalops, Diorchis bulbodas, Diorchis* sp*. Drepanidotaenia laneolata, Echinocotyle rosseteri, Fimbriaria fasciolaris, Fimbriariaroides* sp*., Hymenolepis* spp*. and Sobolevicanthus gracilisv* from the postmortem examination of 76 Mexican ducks.

Cestode parasitic infection in ducks of European countries has been reported least in numbers in comparison to other countries. *Eustrongylide jagerskiold* and *Hystrichis dujardin* were reported in gizzard of wild ducks in North western Poland (Kavetska *et al*., 2012). Though 5 species of cestodes were recorded from domestic ducks in England, among which *Hymenolepis anatine* and *Hymenopis abortiva* were Firstly recorded in England (Soliman, 2009). Although, Davies (1938) examined fecal sample of ducks in Welsh he found six species of cestodes among which *Hymenolepis coronula* was highly prevalent.

Trematodes

Digenea and Aspidogastrea are the two sub class of class trematoda, all poultry treamatodes belongs to the subclass Digenea. Molluscans are intermediate hosts for all digenea (Permin and Hansen, 1998). The common trematodes are, *Echinostoma revolutum, Hypoderaeum conoideum, Prosthogonimus* sp.

The ducks from Asian countries have been reported to be infected by more than five species of trematode parasites. Four species of trematodes namely *Echinostoma revolutum, Notozotylus attenuates, Hypoderaeum conoideum* and *Echinoparyphium recurvatum* were reported from 167 ducks dissected in Bangladesh (Yousuf *et al*., 2009). Similarly *Echinostoma revolutum* was found during the post mortem of 20 ducks in Bangladesh (Musa *et al*., 2012). Farjana *et al*. (2008) found 11 species of trematodes from domestic ducks by postmortem in Bangladesh among which *Echinostoma revolutum* was found highly prevalence around large intestine and small intestine. Likewise *Echinostoma revolutum, Echinoparyphium recurvatum, Hypoderaeum conoideum* were found from wild ducks in Thailand (Saijunthe *et al.,* 2013). *Tracheophilus cymbium* was reported during dissection of domestic ducks in Iraq (Al-Labban *et al*., 2013). In the same

way four species of trmatodes namely, *Echinostoma revolutum, Notocotylus attenuatus, Hypoderaeum conoideum* and *Echinoparyphium recurvatum* were encountered during the postmortem of domestic ducks in Bangladesh (Yousuf *et al*, 2010). Equivalently *Echinostoma revolutum* was reported from domestic ducks in Japan (Yoshino *et al*., 2012).

In case of African countries ducks were found to be minimum infected with trematode parasites. Aboulaila *et al*. (2011) examined 110 fecal samples of domestic ducks in which 2 species of trematodes namely *Echinoparyphium paraulum* and *Echinoparyphium recurvatum* were recorded While one species of trematode, *Echinostoma revolutum* was found in the large intestine in Egypt (Nagwa *et al*., 2013).

As Asia, studies on duck trematode parasites has been found in American countries. Michael and Kocan (1980) reported six species of trematodes such as *Zygocotyle lunata, Tracheophilus cymbius, Apatemon gracils, Hypoderaeum conideum* and *Psilochamus oxyuris* and *Echinostoma revolutum* from ducks in Central Oklahoma among which Echinostoma *revolutum* was highly prevalent. However *Echinostoma trivolvis* and *Typhlocoelum cucumerinum* were recorded from duck from Southern Florida (Donald *et al*., 1994). Similarly *Echinostoma revolutum* has been reported from fecal examination of ducks in Florida (Kinsella and Donald, 1972) and alimentary canal of Mexican ducks in north central Mexico (Farias and Canaris, 1986).

Studies on trematode parasites in Europeans countries were very limited. Soliman (2009) encountered 13 species of helminth parasites in 18 ducks in Southern England among which four species were trematodes. In the same way Borgsteede *et al.* (2005) examined fecal samples of domestic ducks in Netherland, 15 species of helmiths were encountered in which 12 species were trematodes with highest prevalence of *Echinostoma* spp.

2.2 In National context

Poultry production as commercial enterprises in Nepal started since last three decades and is now becomes one of the main national agricultural industries. Poultry products (meat and eggs) are good source of food with high biological value. Therefore poultry farming is becoming an important business enterprise in both rural and urban areas of the country. Poultry alone contributes 4% of the agricultural GDP (Gross Domestic Product) of the country with an output of 10 billion rupees from their sector (Dhakal, 2005). But farmers are facing different kinds of problems regarding poultry like avian influenza and different kinds of parasitic infestation which leads to decrease in quantity and quality of poultry production. In national scenario, very few works has been carried out on diseases regarding ducks compared to chicken. The gastrointestinal parasites encountered in ducks are common parasites of domestic chickens (Fowler, 1996 and Muhairwa *et al.,* 2007). Adhikari (2006) collected sample to determine the avian influenza in wild birds of Nepal and also found 3 species of blood parasites from the wild ducks. Bhurtel (1995) examined 12 poultry birds from eastern part of Nepal and found 7 were infected by parasites among them 4 were infected by both ecto and endo parasite whereas 3 were infected only by ectoparasites. Singh and Bhurtel (1998) reported maximum mortality occurred before 8 weeks of age followed by 8-20 weeks and lowest mortality occurred in birds older than 20 weeks due Gumboro disease. Chaudhary (2017) reported six species of nematodes and 2 species of trematodes from domestic ducks in Parsa, Nepal.

3 MATERIALS AND METHODS

3.1 Study area

Chitwan district is one of the popular district out of the 75 district of Nepal. Chitwan harbors subtropical climate with a summer monsoon from mid-june to late September and a relatively dry winter. Mean annual rainfall is 2400mm. temperature ranges from 6^0C-40^0C the geographical coordination of Chitwan is 27^0 40' 34" N and 83^0 52'45" E. The present study covers three municipalities of Eastern Chitwan, Sauraha is one of the key attraction of tourist which lies in Ratnanagar Municipality. Rapti and Khairahani municipalities are very near to the Sauraha. Present study areas are main residential area of Tharu community. Most of the Tharu people are engaged in the poultry. During festival like Dashain, Tihar and Jitiya, large number of ducks are sold in the local market besides of these festivals the ducks from community are sold in the hotels of the Sauhara. Sauraha is the main attraction of Chitwan National park, sophisticated hotels and taste of local food are key features to attract the tourists. Many dishes prepared from egg and meat of the ducks is very popular around Sauraha and large numbers of ducks are imported from the three municipalities which are close to Sauraha.

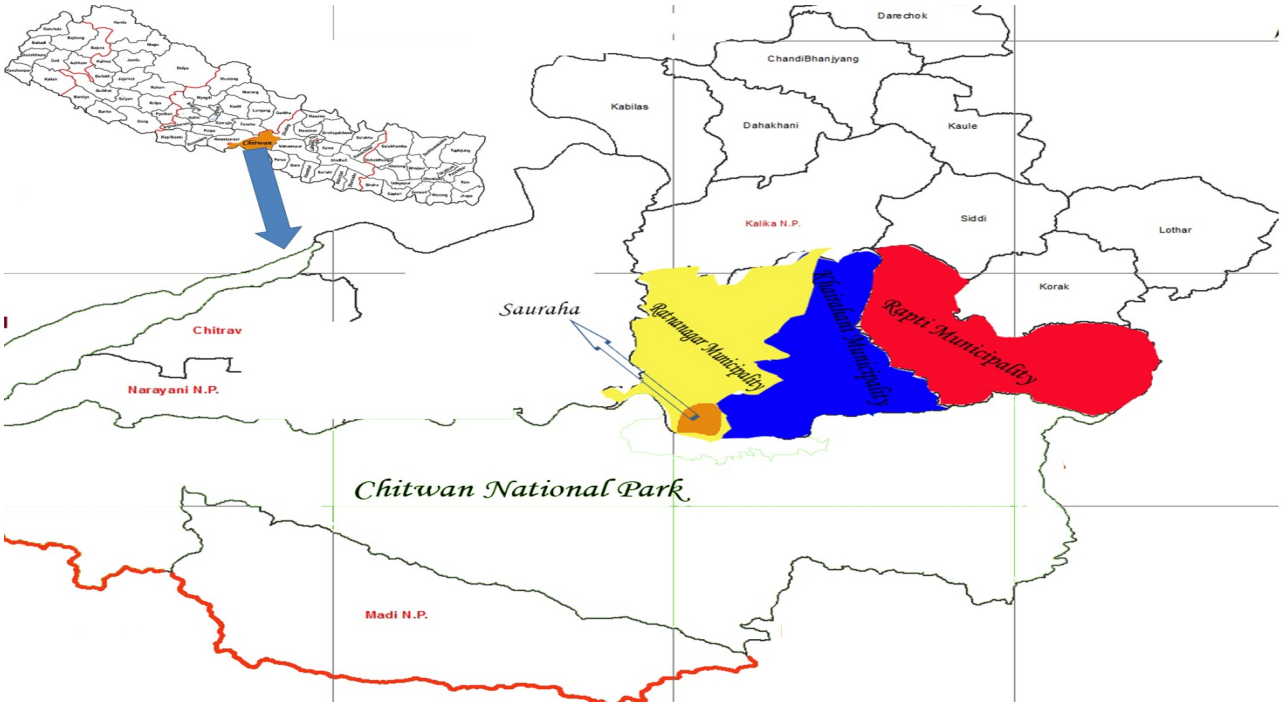

Photo 1 Map of study area

3.2 Materials

i) Electric microscope

ii) Ocular micrometer

iii) Stage micrometer

iv) Centrifuge machine

v) Centrifuge tubes

vi) Brush

vii) Cover slips

viii) Slides

ix) Cotton

x) Tea strainer

xi) Glass rod

xii) Mortar/pestle

xiii) Cavity slide

xiv) Watch glass

xv) Dropper

xvii) Tooth picks

xviii) Mask

xix) Glass vials

xx) Gloves

xxi) Camera

xxii) Forceps

xxiii) Binocular microscope with ocular and stage micrometer scale

xxiv) Needles

Chemicals

I. Potassium dichromate (2.5%)
II. Iodine solution
III. Methylene blue
IV. Distilled water
V. 70% alcohol
VI. Sodium chloride solution (NaCl)
VII. Glycerol
VIII. DPX
IX. Lacto phenol
X. Nail polish

3.3 Methods

3.3.1 Study design

A cross sectional study was carried out to assess the parasitic prevalence among ducks of Ratnanagar municipality, Khairahani municipality and Rapti municipality. The ducks population comprised of Mallard, Muscovy, Peking, Khaki Campbell, Indian runner and their cross breeds reared by farmers in conventional practice. The study included a) selection of eight major hotels where dishes usually prepared from meat of ducks collected from three municipalities b) collection of fecal samples in sterile vials c) examination of fecal samples macroscopically d) Preservation of fecal samples in 2.5% Potassium dichromate solution. d) Examination of fecal samples by using flotation, sedimentation and iodine wet mount techniques and e) Identification and measurements of eggs of different parasites.
For the conformation of municipality from where ducks were collected, direct question was asked to the collector of hotels.

3.3.2 Sample size

A total of 120 ducks collected from three municipalities of Chitwan for meat purpose were examined from randomly selected eight hotels in Sauraha. Out of 120 ducks, 60 were from Ratnanagar municipality, 40 were from Khairahani municipality and 20 were from Rapti Municipality.

3.3.3 Sample collection

From each of the selected hotels fecal from intestine of duck was collected freshly at the time of slaughtering. Fecal was examined macroscopically before preservation.

3.3.4 Sample preservation

Adult nematodes found during macroscopic examination were shaked vigorously in the normal saline to make them free from mucous and other foreign materials adhering to them and preserved in 70% alcohol. After macroscopic examination same fecal sample were preserved in 2.5% Potassium dichromate solution.

3.3.5 Fixation and permanent slide preparation of nematodes

The preserved nematodes were brought at parasitlogy lab of Central Department of Zoology for slide preparation and identification. The nematodes have a thick cuticle so that they were kept in lacto-phenol solution for about 15 minutes to clear due to which internal organ of nematodes become more visible. Finally mount in glycerin sealed with nail polish.

3.3.6 Identification of nematode parasites

Microphotography of taxonomically important organs of nematode was done and identification of nematode was carried out with the help of taxonomic key (Yamaguti, 1961).

3.3.7 Microscopic examination

The collected fecal samples were examined in veterinary lab of National Trust for Nature Conservation (NTNC), Chitwan and laboratory of Central Department of Zoology, T.U., Kirtipur, Kathamandu. The eggs of different parasites were identified according to the morphology of eggs by iodine wet mount technique and different concentration methods (floatation and sedimentation).

3.3.8 Iodine wet mount technique

One tooth pick of fecal samples were emulsified in drop of Lugol's iodine solution on a clean glass slide and then covered with a clean cover-slip. The smear was examined under electric microscope at 10X and 40X (Soulsby, 1982).

3.3.9 Concentration techniques

Eggs, cyst and trophozoites are often in such low number in feces, that they are difficult to be detected in direct smears or mounts. Therefore, these procedures were performed which includes floatation and sedimentation techniques (Soulsby, 1982).

3.3.10 Floatation technique

This technique ensures the eggs float in the floatation liquid, which helps to separate protozoan cyst, oocyst, helminthes eggs and larva through the use of liquid with a high specific gravity. Approximately two gram of fecal samples was put in a beaker and 20 ml of NaCl solution was added. The sample was grinded lightly with the help of rod or pistle and the solution was filtered by tea striner. The filtrate solution was poured into a centrifuge tube of 15 ml and centrifuged at 1000 rpm for five minutes. After centrifuged, more saturated Nacl solution was added to develop convex meniscus at the top of the tube and one drop of Methylene blue (to stain) was also added. A cover slip was placed for a five minutes. It was then removed from tube, placed on glass slide and examined microscopically at 10X and 40X. The photographs of eggs and cysts of parasites were taken and identified on the shape, shell and size (Soulsby, 1982).

3.3.11 Sedimentation technique

This technique is used for detection of trematode eggs. It provides a better result as the eggs of trematode are bit heavier than the other. Sediements of centrifuged contents were taken for eggs detection saturated Nacl solution was removed gently from the centrifuge tube after examination of floation portion and the sediment content was poured into the watch glass and the content was stirred gently to mix it. One drop of fecal from the mixture was taken to prepare a second slide. The specimen was stained with iodine wet mount's solution and examined microscopically at 10x and 40x (Soulsby, 1982). In this way two slides were prepared from one sample (one from floatation and one from sedimentation).

3.3.12 Measurement of diameter of eggs

The eggs were identified in fecal samples of duck, on the basis of their shape and size. Eggs size was measured by use of micrometry.

3.3.13 Eggs identification

Table 1: identification of eggs with their morphological characteristics

S. N.	Parasites	Size(µm)	Content of egg	Morphological Characteristics of egg
1	*Ascaridia* sp.	73-92 X 45-57	Not embryonated	Oval with thick shell.
2	*Heterakis* sp.	59-75 X 43-60	Not embryonated	Ellipsoid with thick shell.
3	*Trichostrongylus* sp.	93-118X 42-52	Both embryonated and unembryonated	Oval, thin shell
4	*Amidostomum* sp.	110-150X 82-90	Embryonated	Ellipsoid with thick shell.
5	*Capillaria* sp.	53-80 X 20-35	Not embryonated	Barrel shape with bipolar plugs, thick and rough shell.
6	*Echinuria* sp.	40 X 20	Larvae	Elliptical, thick shelled egg
7	*Strongyloides* sp.	70-85X 40-47	Larvae	Oval,single thin shell,
8	*Echinostoma* sp.	88-116 X 58-69	Not embryonated	Ellipsoid with thin shell.
9	*Raillietina* sp.	75-88 X 25-50		Spherical with hooks

Eggs were identifies on the basis of morphology and content of eggs as published literature, journals and books (Soulsby, 1982), (Khatri, 2016) and (Permin and Hansen, 1998).

3.3.14 Data analysis

On the basis of laboratory experiments, the data was recorded. The recorded data were analyzed using “R” version 3.4.1 software packages. Chi-squared test was carried out for statistical analysis of data. $P<0.05$ was considered for statistically significant difference. Percentage was used to calculate prevalence.

Laboratory Activities

Photo 1- Samples collection and preservation

Photo 2- Samples observation under electric microscope in T.U.

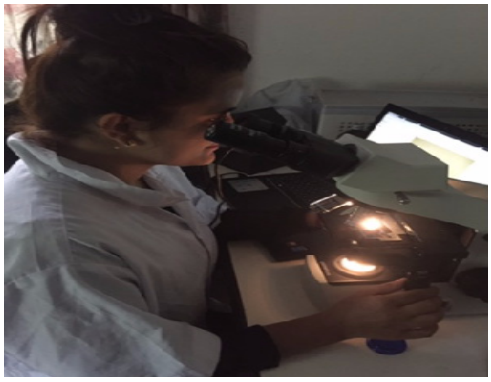

Photo 3- Samples observation under electric microscope in NTNC

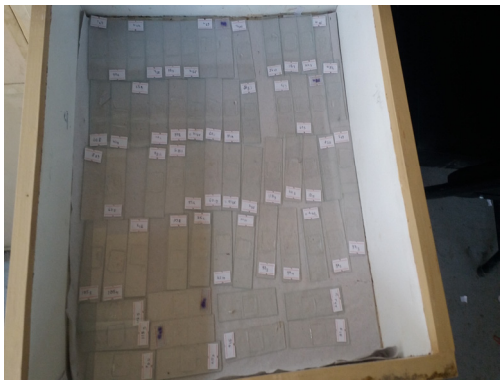

Photo 4- Preparation of permanent slides

Photo 5- Preparation of samples for examination

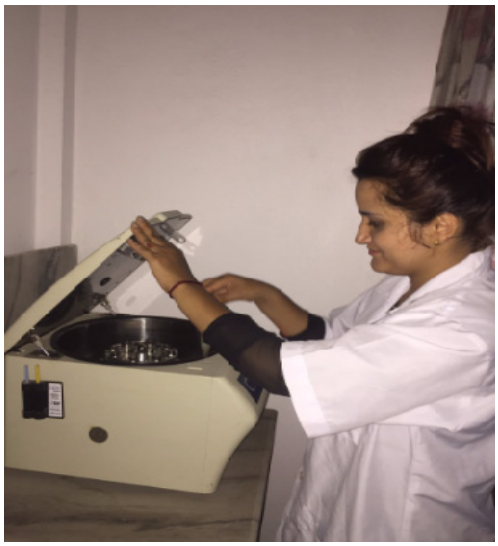

Photo 6- Sample centrifugation in lab of NTNC

4 RESULTS

A total of 120 fecal samples of ducks were examined from eight randomly selected hotels of Sauraha. The ducks were collected by butcher of the hotels from three municipalities of Eastern Chitwan namely Ratnanagar, Rapti, Khairahani for meat purpose. The fecal samples were collected directly from intestine of ducks which were slaughtered for meat purpose in respective hotels. Out of 120 ducks, 60 from Ratnanagar municipality, 40 from Khairahani municipality and 20 from Rapti municipality were examined during the study period.

4.1 Taxonomy of adult endoparasites of ducks

For the taxonomic purpose, the adult parasites were thoroughly searched macroscopically in the fecal samples collected from intestine. Out of 120 fecal samples examined a single nematode parasite was recovered in 6.67% samples and was identified as *Heterakis* sp.

***Heterakis* sp.**

Class : Secernentea

Order : Ascaridida

Family : Heterakidae

Genus : *Heterakis*

Host - Domestic duck (*Anas platyrynchos*)

Habitat - Intestine

Location - Chitwan

Description

Male – Parasite found in fecal samples. Body is smooth and unstraited measuring, 10.08mm long by 0.32 mm wide (photo1,2,3), laterally flanges oesophagus measuring 0.29 mm (photo 4), tail tapering, pre-anal sucker not so close to anus (photo5), labial and pharyngeal teeth and inter-labia absent. Oesophagus with a short pharynx and a distinct posterior bulb containing vulvular apparatus (photo6). Caudal alae well developed supported by 6-15 pairs of pendunculate papillae, Spicules similar and equal (photo7).

Female - Body is longer than male, 10.9 mm long by 0.40 mm wide (photo 1,2,3,4), oesophagus similar to male (photo 5), Vulva near middle of body (photo6), tail elongate (photo7), oviparous, eggs usually thick shelled, containing unsegmented ova (photo 8) .

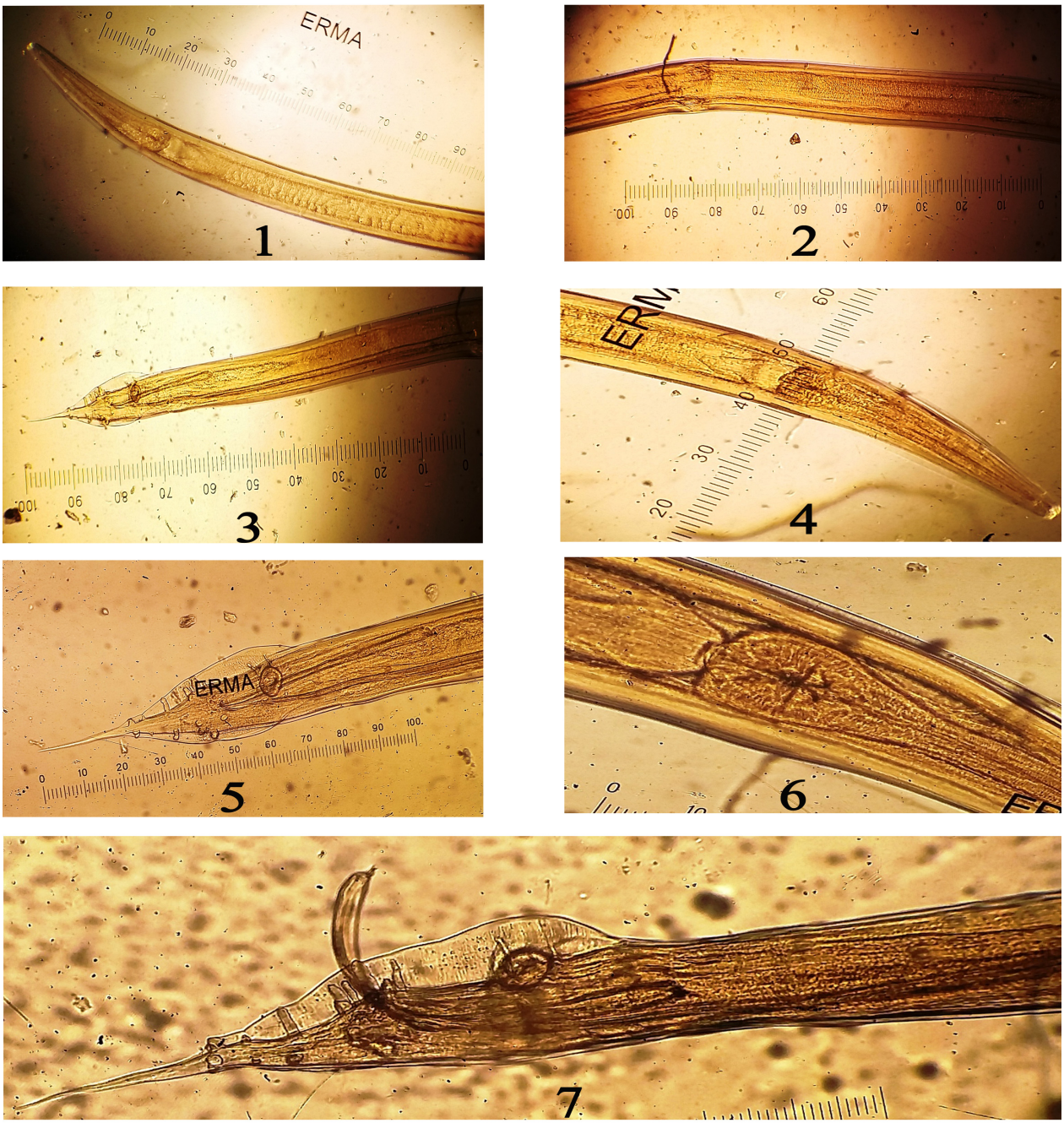

Plate I- *Heterakis* sp Male: Photo 1-Anterior part (10X x 4X), Photo2- Middle part (10X x 4X), Photo-3 Posterior part (10X x 4X), Photo-4 Oesophagus (10X x 4X), Photo-5 Tail (10X x 10X), Photo-6 Oesophagus Bulb (10X x 10X), and Photo-7 Caudal alae (10X x 10X)

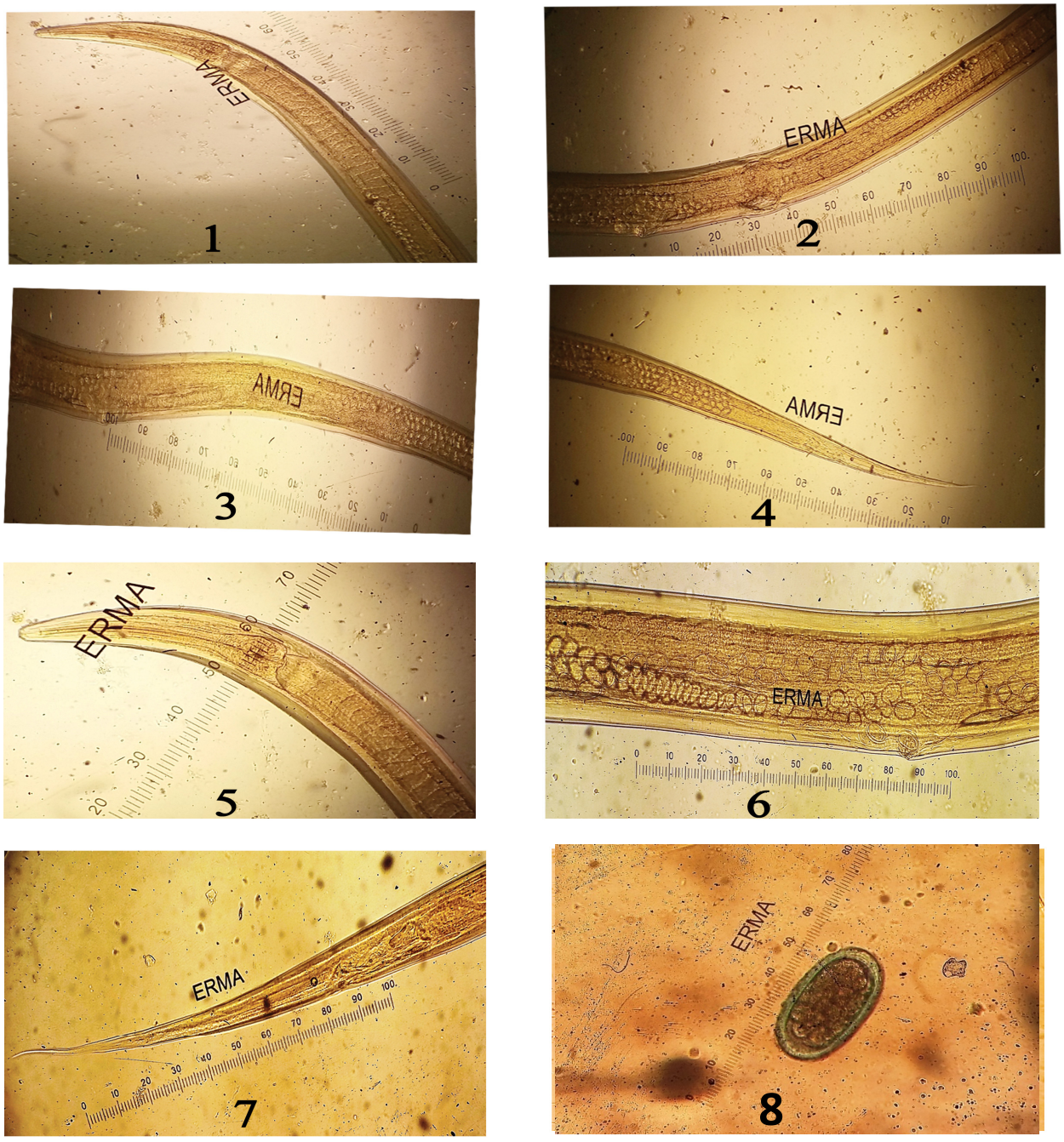

Plate II- *Heterakis* sp Female: Photo 1-Anterior part (10X x 4X), Photo2,3- Middle part (10X x 4X), Photo-4 Posterior part (10X x 4X), Photo-5 Oesophagus (10X x 4X), Photo-6 Vulva (10X x 10X), Photo-7 Tail (10X x 10X) and Photo-8 Egg (10X x 40X)

Table2: Prevalence of adult parasites of duck in Chitwan

Municipalities	*Heterakis* Prevalence	χ^2	P-Value
Ratnanagar Municipality (N=60)	5%	1.071	0.583
Khairahani Municipality (N=40)	10%		
Rapti Municipality (N=20)	5%		

Heterakis sp. of nematode parasites seems to be predominant parasites of ducks in Chitwan. Post mortem examination of local ducks brought from three municipalities of Chitwan at eight different hotels of Sauraha showed maximum prevalence of *Heterakis* sp. among the ducks of Khairahani compared to Ratnanagar and Rapti municipalities. Although the adult parasitic prevalence was high in ducks of Khairahani, statistically the distribution of parasites was showed insignificant.

4.2 Prevalence of gastrointestinal helminth parasites of ducks in Chitwan.

Out of 120 samples examined revealed 90 (75%) prevalence of endoparasites in ducks. Maximum number of ducks microscopically were found to be infected from nematode parasites compared to cestode and trematode parasites. Statistically, distribution of helminth parasites showed insignificance (χ^2=16, df=2, p-value=0.449).

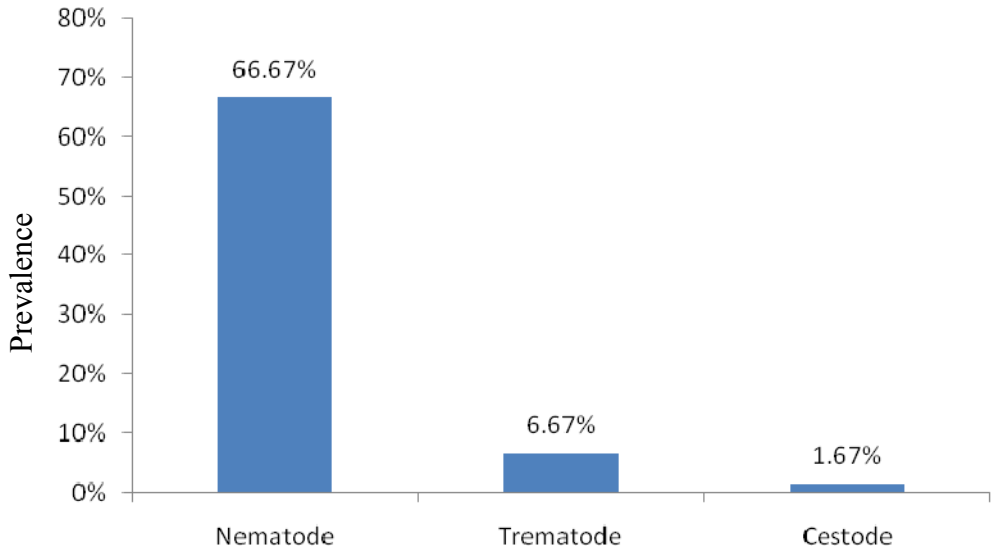

Fig 2: Prevalence of helminth parasites of duck in Chitwan

Out of 90 sample infected, almost all the samples were found to be infected by different nematode parasites while 2.33% of samples were found to be infected by cestode and 8.89% of samples by trematode parasites. *Ascaridia* sp. of nematode parasites seems to be dominant parasites followed by *heterakis* sp., *Echinuria* sp., *Amidostomum* sp., *Strongyloides* sp., *Trichostrongylus* sp., *Dromaestrongylus* sp. and *Capillaria* sp. Besides nematode parasites *Echinostoma* sp. and *Raillietina* sp. belonging to the trematode and cestode parasites respectively were also found to be infected in the ducks. (Fig 2).

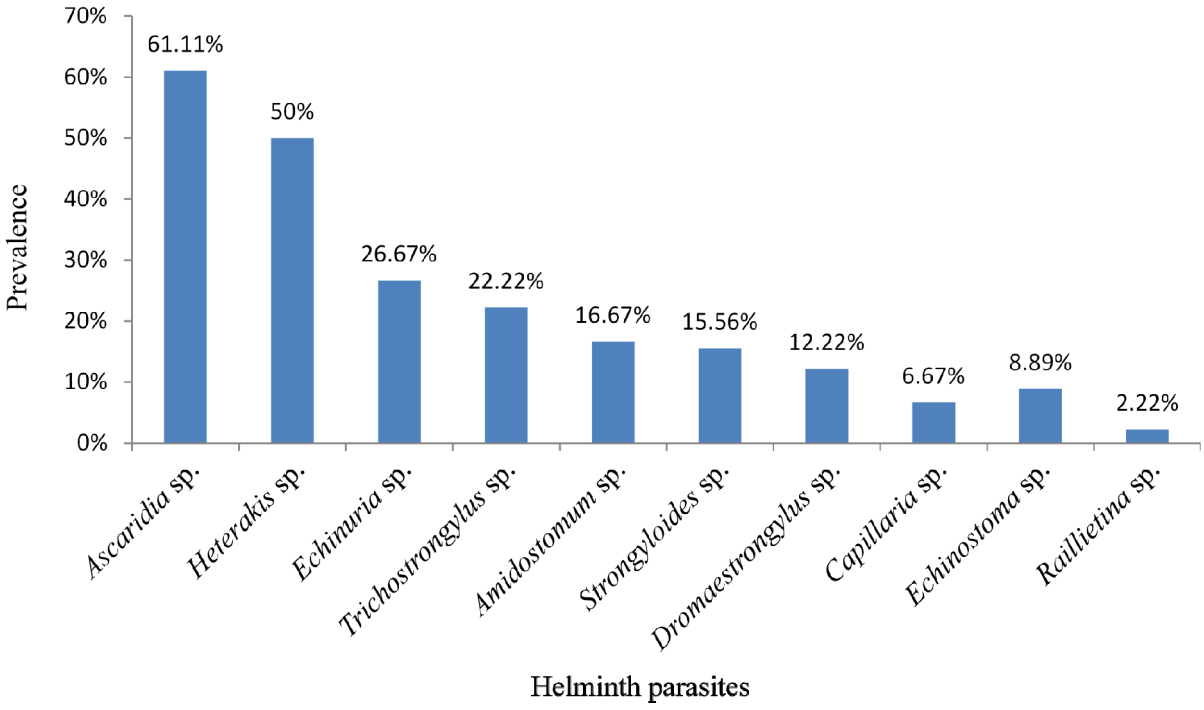

Fig 3: Prevalene of specific helminth parasites of ducks in Chitwan

4.3 Municipality wise prevalence of intestinal helminth parasites of ducks in Chitwan

Table 3: Municipality wise prevalence of helminth parasites of ducks in Chitwan

Parasites	Municipalities		
	Ratnanagar (N=60)	**Khairahani(N=40)**	**Rapti (N=20)**
Nematodes			
Ascaridia sp.	45%	42.5%	55%
Heterakis sp.	33.33%	45%	35%
Amidostomum sp.	15%	5%	20%
Strongyloides sp.	13.33%	7.5%	15%
Trichostrongylus sp.	18.33%	10%	25%
Dromaestrongylus sp.	11.67%	10%	-
Capillaria sp.	6.67%	2.5%	5%
Echinuria sp.	25%	7.5%	30%
Trematode			
Echinostoma sp.	8.33%	2.5%	10%
Cestode			
Raillietina sp.	1.67%	2.5%	-

Municipality wise distribution of helminth parasites showed that the highest prevalence of nematode was reveled in ducks of Rapti municipality followed by Ratnanagar municipality and Khairahani municipality. *Ascaridia* sp., *Amidostomum* sp., *Trichostrogylus* sp., and Echinuria sp., of nematodes showed maximum prevalence in ducks of Rapti municipality than Khairahani and Ratnanagar municipalities. Whereas *Heterakis* sp. and *Dromaestrongylus* sp. were found to be most prevalence in Khairahani municipality and Ratnanagar municipality respectively. High prevalence of trematode parasites was found in Rapti and Ratnanagar compared to Khairahani while cestode parasite was not found in Rapti. (Table3).

Table4: Type of helminth parasitic infection in ducks

Type of Infection	Municipalities			χ^2	P-Value
	Ratnanagar (N=60)	Khairahani (N=40)	Rapti (N=20)		
Single	23.33%	32.5%	15%	2.355	0.308
Double	30%	42.5%	20%	3.418	0.181
Multiple	21.67%	5%	30%	7.215	**0.027**

The study showed that ducks from three different municipalities were infected with either single or double or multiple helminthes parasites. Double infection was found highly prevalent in ducks of Khairahani whereas least in Rapti. Single infection was maximum prevalent in ducks of Khairahani and minimum in Rapti. Likewise high prevalence of multiple infections was found in ducks of Rapti. Statistically, single and double types of helminth parasitic infection among different municipalities (chi=2.335, df=2, p=0.308 for single, chi=3.41, df=2, p=0.18 for double) showed insignificant but multiple types of helminth parasitic infection among different municipalities (chi=7.21, df=2, p=0.027) was showed significant. Ducks of Rapti and Ratnanagar municipalities were found significantly high infection with multiple parasites compared to Khairahani.

Eggs of intestinal helminth parasites in ducks under 10X x 40X electric microscope

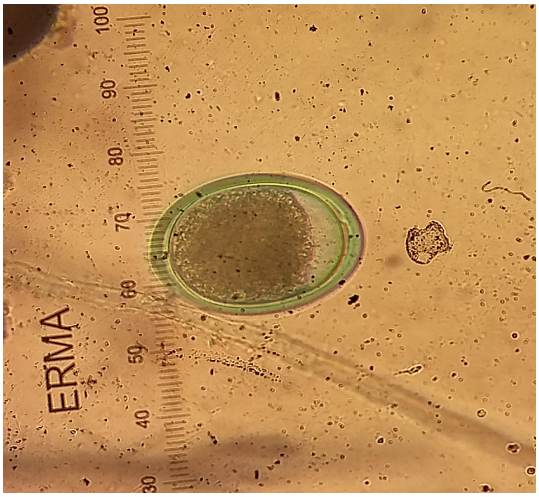

Photo7: *Ascaridia* sp. egg
(72µm x 52.8µm)

Photo8: *Capillaria* sp.egg
(55.2µm x 24µm)

Photo9: *Amidostomum* sp. egg
(115.2µm x 60µm)

Photo10: *Dromaestrongylus* sp. egg
(132µm x 74.4µm)

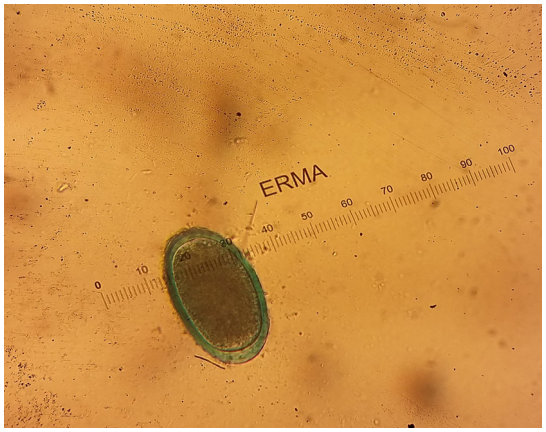

Photo11: *Heterakis* sp. egg
(76.8µm x 48µm)

Photo12: *Echinuria* sp. egg
(48µm x 21.6µm)

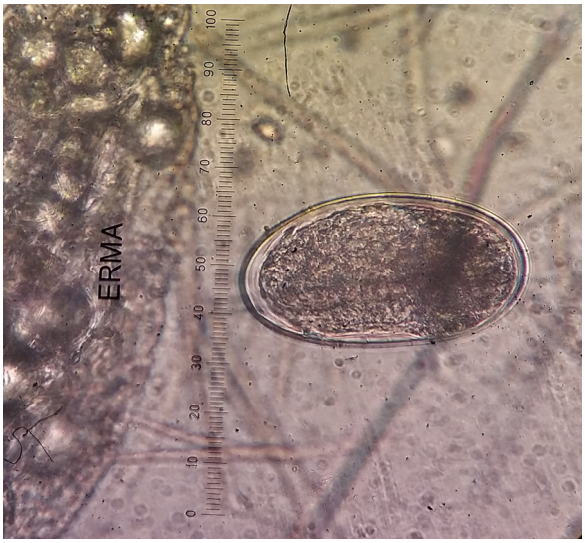

Photo13: *Trichostrongylus* sp. egg
(117.6µm x 60µm)

Photo14: *Strongyloides* sp. larva

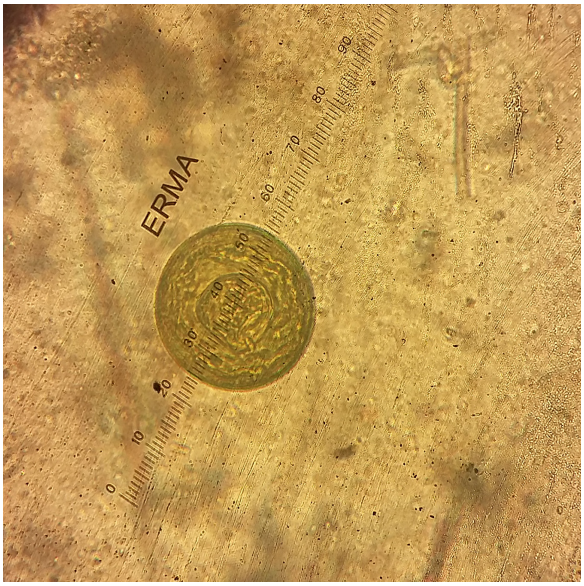

Photo15: *Raillietina* sp. egg
(72µm)

Photo16: *Echinostoma* sp. egg
(108µm x 67.2µm)

5 DISCUSSION

Many domestic ducks are found loss every year worldwide due to different kinds of diseases such as Bacterial diseases, viral diseases, neoplastic diseases, parasitic diseases, mycoses and other deficiency diseases. Among the parasitic infection, helminth parasites are key threat to the domestic ducks. The common helminth parasites includes nematodes (*Ascaridia* sp., *Heterakis* sp., *Echinuria* sp., *Trichostrongylus* sp., *Amidostomum* sp., *Strongyloides* sp., *Capillaria* sp. etc), cestodes (*Hymenolepis* sp., *Fimriaria fasciolaris, Diorchis nyrocae, cotugnia fastiga*, *Raillietina* sp. etc) and trematodes (*Echinostoma revolutum, Hypoderaeum conoideum, prosthogonimus* sp. etc). During the study period, 120 ducks were examined among them 6.67% ducks were found to be infected with adult nematode parasites. In this investigation, both male and female nematode parasites were found. Taxonomically presently reported nematodes were found similar with order Ascaridia and family Heterakidae. Family heterakidae includes four reported genus *heterakis*, *odonterakis*, *subulurina* and *spinapidodera*. The body length of male nematode reported in this study was found 10.08mm which was similar to 10.09 mm (Tanveer, 1989) and the body length of female nematode parasite reported in this study was 10.9mm which was similar to 10.9mm (Sheich *et al*, 2016) In case of male, lateral flanges were found short which was similar to genus *Heterakis* but lateral flanges was found extending throughout the body in genus *odontoterakis* under family Heterakidae. Similarly caudal alae well developed in genus *Hetetakis* but caudal alae was differentiated into three portion by transverse groove in genus *spinapidodera* and absent in genus *subulurina,* though all three genera are under family Heterakidae. In case of female valve was found near the middle body similar with genus *Heterakis* but behind the middle body in *Spinapidodera* and valva anterior to mid body in genus *Subulurina*. Similarly pointed tail was recorded in the species found in this study which is similar to the female of *Heterakis* but tail tapering in genus *Subulurina* of family Heterakidae. Most of the taxonomically important organs and position of organs of species found in this investigation were almost similar to the genus *Heterakis* so, species found in this study was confirmed as genus *Heterakis* under family Heterakidae (Yamaguti, 1961).

The prevalence of adult *Heterakis* sp. was found (6.67%) which was higher than 1.81% (Aboulaila *et al.,* 2011) reported in Egypt but lower than 9.1% (Michael and Kocan, 1980) from ducks of Nigeria. High prevalence might be due to post mortem investigation of whole GI tract though only intestinal portion of alimentary canal was macroscopically examined in the present study.

A total of 120 fecal samples of ducks were collected directly from intestine of ducks during the postmortem examination for detection of eggs of helminth parasites. Out of them 75% of ducks were found to be positive for one or more helminth parasites. Although the samples were collected from Sauraha, tourist area of Chitwan, the ducks usually brought from surrounding three municipalities namely Ratnanagar municipality,

Khairahani municipality and Rapti municipality. The prevalence rate of parasites was found low as compared to 95.4% (Adejinmi and oke 2011) from Nigeria and 96.7% (Farjana *et al*., 2004) from Bangladesh but the prevalence rate was higher than 47.5% (Al-Labban *et al*., 2013) from Iraq and 52% (Muhairwa *et al*., 2007) from Tanzania. The result 70.50%, 79%, 77.3% and 73% reported by Farias and Canaris (1986) from Mexico, Yousufi *et al*. (2014) from North Iran, Kevastka *et al*. (2012) from Poland and Chaudhary, (2017) in parsa Nepal somehow coincides with the result of present study. The difference in the prevalence of helinth parasites might be due to variation in methodology, climatic condition feeding and rearing practices. Statistically distribution of helminth parasites showed insignificance (χ^2=16, df=2, p-value=0.449). It might be due to similar climatic condition, food resources and environment among three municipalities of eastern Chitwan. Endoparasitic diversity of water birds may be related to many bioclimatic and physical factors, which may include home range, temperature, size and roosting habit of the host (Begum and Sehrin, 2012). During this study, the overall prevalence of nematodes was reported 66.67% which was higher than previous study 20.7% (Negwa *et al*., 2013) in Egypt 26.1%, (Michael and kocan, 1980) in central Okalahoma 5% (Utpal and Biswas, 1997) in west Bengal India. Likewise prevalence of trematode in this study was found to be 6.67%, which was higher than 1.7% (Negwa *et al*., 2013) in Egypt, but lower than 47.8% (Michael and Kocan, 1980) in central Oklahoma, 26% (Uptal and Biswas, 1997) in west Bengal India and 32% (Chaudhary, 2017) in Nepal. In case of cestodes parasites 1.67% was found in Eastern Chitwan which was much lower than result obtained from previous study, 7.6% (Negwa*et.al*., 2013) in Egypt, 72.4% (Michael and Kocan, 1980) in central Oklahoma, 9% (Uptal and Biswas, 1997) and 32.8% (Paul *et.al*., 2015) in Nigeria.

Nematode parasitic eggs isolated and identified in present study includes *Ascaridia*sp., *Heterakis* sp., *Echinuria* sp., *Trichostrongylus* sp., *Amidostomum* sp., *Strongyloides* sp., *Dramaestrongylus* sp. and *Capillaria* sp. Among ten identified helminth parasites, in present study the prevalence rate of *Ascaridia* sp. was 61.1% which was highest compared to other parasites. The prevalence rate of *Ascaridia* was higher than 46.8% (Adejnmi and Oke, 2011) in south western Nigeria, 23.4% (Muhairwa *et al*., 2007) in Tanzania, 14% (Hoque *et al*., 2014) from Bangladesh, 6.9% (Aboulaila *et al*., 2011) in Egypt and 30% (Chaudhary, 2017) in Nepal. The prevalence rate in this was lower as compared with 88% and 85.67% reported in previous study John and Donald, (1972) from Washington and Paul *et al*. (2015) from Gombe respetively. The possible migration of *Ascaridia* sp. to liver, trachea and lungs for development also suggest low prevalence (Michel, 1974) and even difference in ecology or they may be in their juvenile stage. The prevalence rate of *Heterakis* sp. 50% was consistence with the finding 51.7% and 56.8% of Youshino *et al*. (2009) and John and Donald, (1972) but this results contracts with 23.4%, 7.3%, 18% and 8% observed in study of Adejnmi *et al*. (2011) from Nigeria, Muhairwa *et al*. (2007), Chaudhary (2017) and Hoque *et al*., (2014) from Tanzania respectively. The results of present study concur with *Heterakis gallinarum* of Muhairwa *et al*. (2007). Some other species like *Heterakis dispar* (0.5%) and *Heterakis isolanche*

(2.6%) were also reported in study of Muhairwa *et al*. (2007) in Tanzania. The low prevalence rate might be due to different in sampling methods, study method and study was not possible upto species level only on the basis of morphology of eggs. *Heterakis* sp. is found less in winter season in temperate region (permin and Hansen, 1998). *Heterakis gallinarum* is non-pathogenic, but a vector for *Histomonas melagridis* which is highly pathogenic etiological agent of Black-head disease lethal to chickens, ducks, turkeys, pheasants and other fowls (Chang, 1973). In present investigation, the infection of *Echinuria* sp. was found 26.67% which was higher than 7.5% (Farjana *et al*., 2008) in Bangladesh 7.89% (Kavetska *et al*., 2012) and 6.3% (Jaime *et al*., 1986). The highest prevalence in this study might be due to rearing practice and feeding practices. In the present study, the rate of *Trichostrongylus* sp. Infection 22.22% low in comparison to 29.64% and 41.7% observed in study of Yousuf *et al*. (2009) and Muhairwa *et al*. (2007) but prevalence rate was highest than 9.64% and 11.7 % in previous study of Flowler, (1996) and Farias and Canaris, (1986). The prevalence of *Amidostomum* sp. (16.67%) in this study was higher than 12.64% (Kavetska *et al*., 2012) in Western Poland, 4.2% (Yousuf *et al*., 2009) in Bangladesh and 3% (Chaudhary, 2017) in Nepal but lower than 20.75% (Donald *et al*., 1994) in Sourthern Florida. The prevalence difference might be due to difference study methods and rearing practices. The infection of *Strongyloides* sp. (15.56%) in this study which was higher than 10% (Donald *et al*., 1994) but lower than 35% (John and Donald, 1972) in Washington. Prevalence difference was might be due to traditional free range management system and difference methods of study. In present study, the infection of *Dromaestrongylus* sp. 12.22%, this is the first record of this parasite in duck. This parasite was frequently recorded in other birds in tropical and subtropical area (Permin and Hansen, 1998) and Khatri (2016). The gastrointestinal parasites encountered in water birds are common parasites of ducks Fowler (1996). Muhairwa *et al*. (2007) this parasite might be from other birds due to free range of ducks farming practices in Nepal.

The prevalence rate of *Capillaria* sp. 6.67% was consistence with 8% and 7.3% observed in study of Hoque *et al*. (2014) and Muhairwa *et al*. (2007) from Tanzania but differ with the finding 21.7%, 20% and 36.83%of Adjenmi and Oke, (2011), Chaudhary, (2017) and Paul *et al*. (2015). The larva of *Capillaria* sp. develops insides the earthworm and become infective within two to four weeks and can survive inside it for years (Davis *et al*., 1971). There was not much difference in prevalence rate of *Capillari*a sp. among three municipalities due to same geographical area and ecology. Different species of *Capillaria* i.e *Capillaria anatis* (0.5%), *Capillaria annulata* (3.1%) and *Capillaria contorta* (7.3%) were reported by Muhairwa *et al*. (2007) from Tanzania, similarly *Capillaria contorta* (36.83%) and *Capillaria annulata* (21.83%) were observed in previous study of Paul *et al*. (2015) from Gombe but present study was done up to genus level only because identification to species level is impossible without genetic sequencing or access to the adult worms.

The Trematode species identified in the fecal and post mortem examination of domestic and wild ducks are *Dietziella egregria, Neohematotrephus brasilianum*, *Psilocollaris* sp.,

Stromitrma sp., *Michajlovia migrate*, *Ptychogonimus megastoma*, and *Hypoderaeum conoideum* from sourhern Iraq (Jaffar, 2016) in maxico and the U.S. (Farias and Canaris, 1986), in Thailand (Saijuntha *et al*., 2013). *Notocotylus attenuates* and *prosthogonimus cuneatus* in maxico and the U.S. (Farias and Canaris, 1986), from North Iran in green winged teal (Youssefi *et al.,* 2014). *Zygotylelunata* in maxico and the United state (Farias and Canaris, 1986). *Echinoparyphium recurvatum* was reported in Thailand (Saijuntha *et al*., 2013). *Echinoparyphium paroulum* and *Echinoparyphium recurvatum* were reported in Egypt (Aboulaila *et al*., 2011). *Tracheophilus cymbium* in Nigeria (Adejinmi and Oke, 2011). *Echinostoma* sp. Farias and Canaris (1986) in Mexico and United State, in Thailand (Saijuntha *et al*., 2013) and Dhaka (Musa *et al*, 2012). However, in the present study only *Echinostoma* sp. has been observed. Among trematode, *Echinostoma* sp. and *Prosthogonimus* sp. have been reported in duck (Permin and Hansen, 1998). *Echinostoma* sp. was found with 8.89% of prevalence rate in present study which was lower than 30% (Musa *et al*., 2013) and 23% (Chaudhary, 2017) It is similar to 10.8% (Farias and Canaris, 1986). *Echinostoma* sp. has three hosts in their life cycle first intermediates host (snail spp.), second intermediate host (tadpoles and small freshwater fish) and a definitive host duck (Huffman and Fried, 2012). The high prevalence of *Echinostoma* sp. might be due to the availability of snail intermediate hosts as they are set free to graze in paddy field and nearby water resources.

In the present study single species of cestode, *Raillietina* sp. was reported. The prevalence of *Raillietina* sp. (2.22%) which was lower than 4.23% (Muhairwa *et al*., 2007), 3.92% (Ritchie *et al*., 1997) in Bangladesh. The prevalence was somehow similar, to 2.10% (Farias and Canaris, 1986) and 1.92% (Adejinmi and Oke, 2011).

In the present investigation, three types of infection i.e. single, double and multiple infections were observed. Among study area single infection 32.5% and double infection 42.5% was reported high in Khairahani municipality but multiple infections was observed high in Rapti municipality. In this study double parasitic infections 32.5% were recorded maximum which contradicts the finding of Muhairwa *et al*., (2007) in Tanzania, Yousuf *et al*. (2009), Adejinmi and Oke, (2011) in Nigeria and Chaudhary, (2017) in Parsa ,Nepal where single infections were recorded high. But this study agrees with the study of Paul *et al*. (2015) in Gombe where mixed infection was recorded high. Kennedy, (1975) argued that food preference at a particular time may determine the establishment of single or mixed infections and older birds have strong immune system.

In general the nematode parasitic infection recorded in the present study were almost coincide with the earlier reported infection in ducks of different countries such as Bangladesh, Maxico, Egypt, Tenzania, Iraq etc. Whereas cestodes and trematodes found in this investigation were very limited than early reported infection in domestic duck In general, the ducks of Eastern Chitwan which were brought for meat purpose in Sauraha, touristics place were found to be highly infected with different types of nematode, cestode and trematode parasites.

6 CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

From the present investigation, it is clear that intestinal helminth parasites are highly prevalent (75%) in domestic ducks of three municipalities of Eastern Chitwan i.e, Ratnanagar municipality, Khairahani municipality and Rapti municipality. In this study single species of adult nematodes i.e. *Heterakis* sp. was reported from all three municipalities. High prevalence of *Heterakis* sp was found in Khairahani municipalitiy (10%) and prevalence rate was found equal in Rapti and Ratnanagar municipalities (5%). Finding of this study showed that nematodes parasites were more prevalent than trematodes and cestodes in different study areas. Ten different parasitic genera were identified in duck of different municipalities such as *Ascaridia* sp. (61.11%), *Heterakis* sp. (50%), *Echinuria sp. (*26.67%), *Amidostomum* sp. (16.67%), *Strongyloides* sp. *(15.56%), Trichostrongyle* sp. (22.22%), *Dromaestrongylus* sp. *(*12.22%), *Capillaria* sp. (6.67%), *Echinostoma* sp. (8.89%), *Raillietina* sp. (2.22%) from Eastern Chitwan. The higher prevalence of helminth parasites were recorded in Rapti municipality followed by Ratnanagar municipality and lowest was in Khairahani municipality. Single infection was least prevalent in all three municipalities. Double infection was more prevalent in Ratnanagar municipality (30%) and Khairahani (42.5%) while multiple infections were observed more in Rapti municipality (30%). Among identified nematodes, *Ascaridia* sp. was found to be most prevalent in all study areas. This result highlights most farmer were unaware about duck diseases and their symptoms.

6.2 Recommendations

Based on the result of this study, the following recommendations have been derived.

- Season wise study and further study to identify on species level of parasites need to be carried out.
- For the sustainable management of disease in ducks regular and detailed investigation of gastrointestinal parasites of ducks need to be carried out.

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