Zimbabwe Journal of Science & Technology pp 123-130 Vol.14 [2019] e-ISSN 2409-0360
Zimbabwej.sci.techno

Helminth Parasites in imported Botswana cattle: a comparison with Cattle in Zimbabwe

M. Sibula and S. Dube

National University of Science and Technology, Department of Applied Biology and Biochemistry, Bulawayo, Zimbabwe.

E mail: madeleine.sibula@nust.ac.zw

ABSTRACT

Importing live animals has the potential of moving parasites across borders that may result in spread and emergence of new and virulent strains of parasites of zoonotic importance. A thousand live cattle imported to Zimbabwe from Botswana and those from Zimbabwe were examined for the presence of helminths during the period 2011-2013. This was done by handpicking those parasites that could be seen, in the liver, rumen, reticulum and small intestine. The parasites were preserved in normal saline for further examination. Physical examination for hydatid cysts was done on the abdominal cavity and in the muscles for *Taenia saginata*. The results showed that 22.4% of the one thousand Botswana cattle were infected by helminths whilst 29% of the cattle from Zimbabwe were infected. These helminth infections included *Stilesia hepatica*, *Fasciola gigantica*, *Monezia benedeni*, *Thysaniezia* and *Setaria* that were collected from different organs. Paramphistome infections with low to high burdens of the worms for cattle from both countries were recorded. Two genera of paramphistomes, Camyerius and Calicophoron were recovered from Botswana cattle whilst only one genus, *Calicophoron* was recovered from Zimbabwean cattle. *Taenia saginata* was observed as *Cysticercus bovis* in active muscles of Botswana cattle whilst *Echinococcus granulosus* was recovered from the abdominal cavity as hydatid cysts. There was a higher prevalence of *Taenia saginata* in Botswana cattle with recordings of 2.65% whilst only 1.04% was recorded in cattle from Zimbabwe. The presence of parasites of zoonotic importance in Botswana cattle shows that there is a possibility of introducing different genotypes of these parasites into the ecosystem resulting in possible outbreaks. There is also a high possibility that with increase in trade between Zimbabwe and Botswana, a new species of paramphistome, *Camyerius dollfusi*, which has not been recorded in Zimbabwean cattle, might be introduced and become established in this country.

Key Words: Zoonosis, Trematodes, Cestodes, Cattle, Import.
Received: 20.11.19 **Accepted:** 31.07.20

1. INTRODUCTION

Botswana and Zimbabwe share a common border stretching approximately 400 km. Both countries used to export beef to Europe but rarely between themselves. Recently Zimbabwe started importing live cattle from Botswana. Importing live animals has the potential of moving parasites across borders in particular, helminths. Studies on helminths of cattle of Zimbabwe have been carried out but the situation in Botswana has not received extensive attention. Although most of Botswana is drier than Zimbabwe it has extensive swamps in the Okovango delta and water holes making it prone to water borne diseases. Swamps are suitable habitats for aquatic snails some of which are intermediate hosts for parasitic trematodes such as paramphistomes, schistosomes and fasciola among others. The following aquatic snails in Botswana Bulinus, Biomphalaria, and Lymnea all which are capable of playing host to trematodes have been reported (Brown et al., 1992). In Zimbabwe, studies show that snails transmit three types of important trematode parasites: namely Fasciola spp., Schistosome spp and Paramphistomes

The following snails, *Bulinus reticulatus*, *Bulinus tropicus*, *Bulinus globosus*, *Bulinus trancatus* and *Bulinus forskali,* transmit *Schistosoma bovis* which infects cattle, sheep and goats in the circulatory system around the urinogenital region (Brown, 1994; Abrous et al., 1996; Brown and Kristensen, 1989; Frandsen and McCullough, 1980). *Bulinus reticulatus* also transmits *Schistosoma mattheei* another blood fluke, which infects cattle, sheep and goats in the circulatory system around the alimentary region (Brown, 1994). *Bulinus tropicus* is also involved in the transmission of *Calicophoron* *microbothrium* and *Calicophoron calicophorum* both stomach flukes which infect cattle, sheep and goats (Brown and Kristensen, 1989). *Bulinus tropicus* and *Bulinus natalensis* transmit *Schistosoma margrebowiei*, which occurs in the blood vessels of the alimentary canal of cattle (Brown and Kristensen, 1989). *Lymnea natalensis* and *Lymnea collumella* transmit *Fasciola gigantica*, which occurs in the liver of cattle, sheep and goats (Brown, 1994; Abrouse et al., 1996). *Biomphalaria pfeifferi* on the other hand transmits *Calicophoron sukari* another stomach flukes, which infect cattle, sheep and goats (Dinnik and Dinnik, 1957). The following aquatic snails in Zimbabwe Melanoides, Physa, Bulinus, Biomphalaria, and Lymnea most which are capable of playing host to various trematodes have also reported (Dube et al., 2002; Chingwena et al., 2002). In Zimbabwe *Cotylophoron cotylophorum, Carmyerius spotiosus* and *Carmyerius bubalis* were recovered from the stomachs of *Alcelaphus* spp., *Tragelaphus spekei* and *Tragelaphus stresiceros* in Zimbabwe (Eduardo, 1982b). *Calicophoron raja* was recovered from *Connochaetes taurinus* while *Calicophoron microbothrium* (syn. *Paramphistomum microbothrium)* was recovered from *Aepyceros melampus, Kobus leche* and *Taurotragus oryx* (Eduardo, 1983). A number of paramphistomes and other cattle parasites in Zimbabwe have been documented (Eduardo, 1983; Dube *et al*., 2002; Dube *et al*., 2004; Dube *et al*., 2010). Losses due to parasite infection associated with parasite infection include reduced fertility of the brood cow herd, lighter calves at weaning, slower growth of replacement heifers, light weight cull cows, poor hides, reduction in milk production in dairy cattle, and dairy replacement heifers that take long to reach breeding age (Marcharnd, 1984; Dube *et al*., 2002). Anorexia and oxidative stress could be other consequences of parasitic infections. The aim of this study was to determine the identity and incident parasites that occur in cattle imported from Botswana and compare them with those sourced from Zimbabwe.

2 MATERIALS AND METHODS

Examination for parasites incidents was done in the gastro intestinal tracts of 1000 cattle from Botswana and Zimbabwe slaughtered in Abattoirs in Bulawayo. The parasites were handpicked into normal saline solution. The reticulum and rumen were examined for paramphistomes. Some parasite specimens were flattened dorsoventrally between microscope slides held by rubber bands to facilitate examining diagnostic features. Some were preserved in formal saline or 70% ethanol for anatomical studies. Cattle had their livers examined by palpating, making three cuts on the liver and checking for Fasciola and *Stilesia hepatica*. Coporological examination for eggs from parasites not readily visible to the naked eye were also made by taking contents of the rectum. Physical examination for hydatid cysts (*Echinococcus granulosus*) and *Setaria* sp. was done in the abdominal cavity and that of Cysticercus bovis (*Taenia saginata*) in the active muscles. Tape worms were examined for during washing of the small intestines and in this way these and other nematodes were recovered. The incidents and degree of infection with parasites were recorded. The number of cattle infected was expressed as a percentage of the total number of cattle examined. For identification of amphistomes, the keys according to (Nasmark, 1937) were used. Statistical analyses were done using SPSS v27 and significance values computed using one way ANOVA.

3 RESULTS

On average 25% of the 1000 Botswana cattle and 19% of the Zimbabwe cattle examined were infected with parasites. In the rumen and reticulum two paramphistome species from and one paramphistome species from Zimbabwean cattle were identified using given keys (Nasmark, 1937; Gretillat, 1960; Eduardo, 1983). These were *Calicophoron microbothrium* (syn. *Paramphistomum* *microbothrium)* (Fig. 1D, K, L, M) and *Carmyerius dollfusi* (Fig. 1C, E, F, G, H, I, J). There were no externally observable symptoms distinguishing the infected cattle from those not infected and were no preferential infections based on breed of cattle or their age. Nests of paramphistome numbering between 20 and 1500 were found in the folds of the rumen and between papillae in the reticulum, where they adhered to knobbed parts of the mucosa (Fig. 1A and B). Occasionally the worms nipped off the mucosa sucked into the acetabulum leading to slightly hardened areas devoid of rugae and papillae due to necrosis. *Fasciola gigantica* (Fig. 1N and O) and *Stilesia hepatica* (Fig. 2 E and F) were recovered from the livers of 5 and 10% of the cattle respectively. *Monezia benedeni* (Fig. 2C and D) and *Thysaniezia* (Fig. 2G) were recovered from the small intestines. *Echinococcus granulosus* was recovered as hydatid cysts whilst *Taenia saginata* cystecircus bovis was recovered from active muscles. A *Setaria* species was recovered from the abdominal cavity and is shown on Fig. 2A and B.

As shown on Fig. 3, the number of cattle observed to have helminths was recorded and comparison was made for both countries. There generally were a higher number of cattle with helminths from Zimbabwe cattle compared to the ones imported from Botswana. *Camyerius* sp. was only recorded from the Botswana cattle and none in cattle from Zimbabwe. However, more cattle from Zimbabwe had Calicophoron sp. and Fasciola compared to the ones from Botswana. Stilesia and *Taenia saginatta* were more prevalent in Botswana cattle as shown on Fig. 3. The number of cattle from both countries that had other parasites like Monezia sp., Thysaniezia sp. and Seratia sp. were more or less the same.

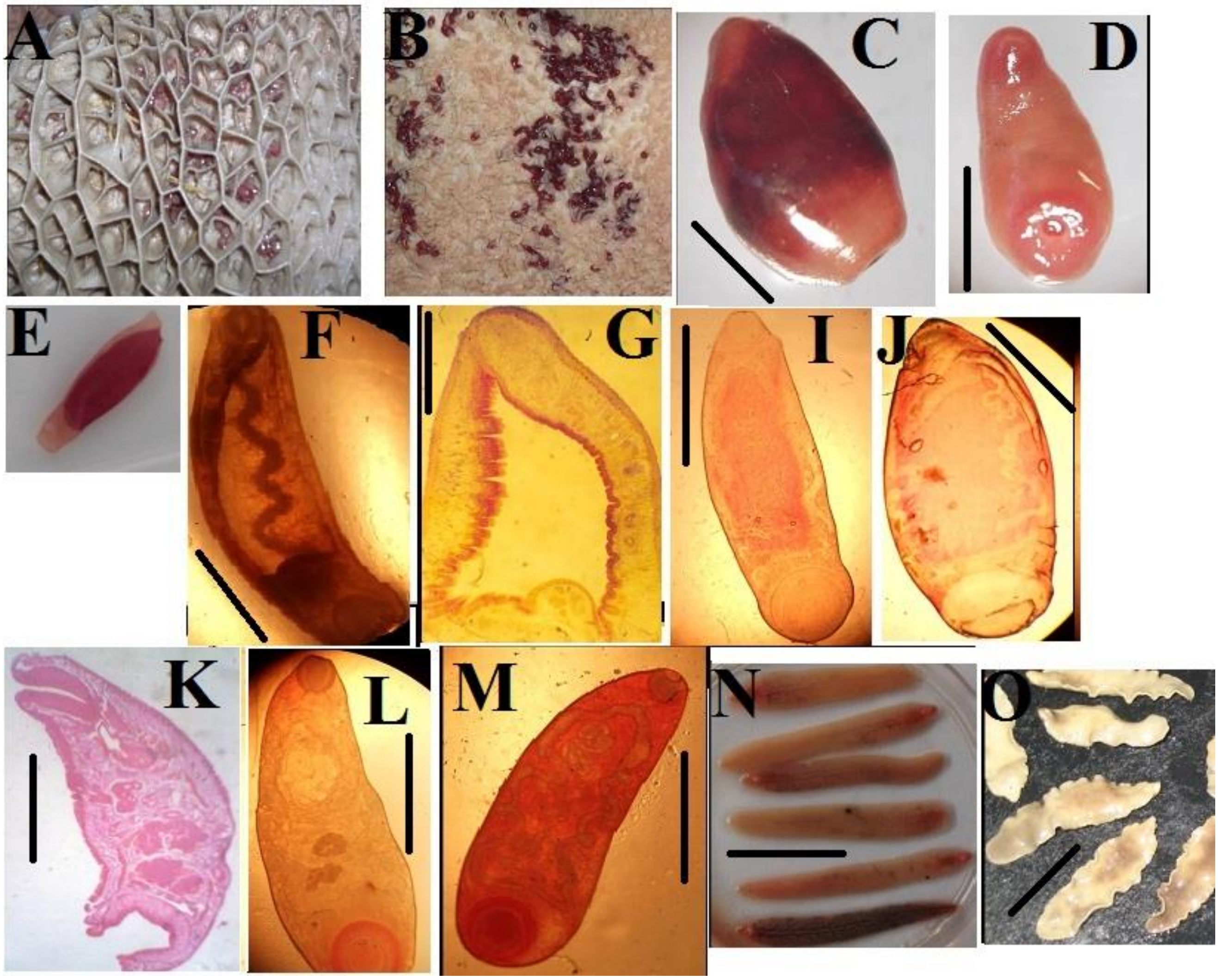

Figure 1: Some trematodes recovered from Botswana Cattle slaughtered in local abattoirs: A) Paramphistomes on reticulum of a cow. B) Paramphistomes on rumen of a cow. C) *Camyerius* whole mount (scale bar = 1 cm) D) *Calicophoron* whole mount (scale bar = 1 cm) E) *Camyerius* flattened (scale bar = 1 cm) F) *Camyerius* specimen dissected in half (scale bar = 1cm) G) Transverse section in sagital area of *Camyerius* . I) Flattened *Camyerius* showing caeca reaching to the acetabulum and the pouch (scale bar = 1 cm) J) a variant of flattened *Camyerius*. K) *Calicophoron* in the median sagital section (scale bar = 2000 µm). L) Flattened *Calicophoron* specimen showing testes oblique and caeca reaching the acetabulum. M) Flattened whole mount of *Calicophoron* showing the internal parts without staining (scale bar = 1cm) N) Freshly collected *Fasciola gigantica* whole mount showing caeca. (scale bar = 3 cm) O) *Fasciola gigantica* preserved in ethanol. (scale bar = 2.5 cm).

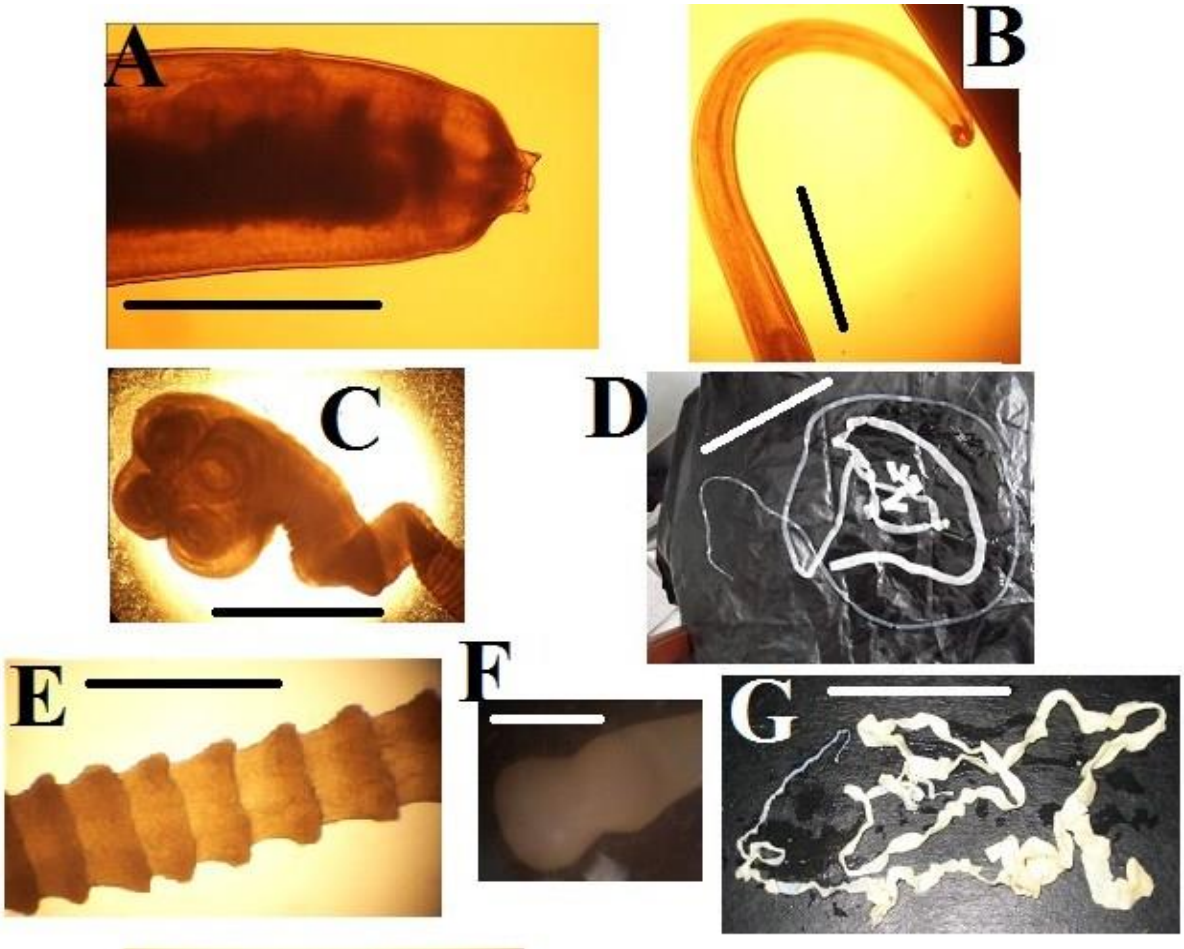

Figure 2: Some cestodes recovered from Botswana Cattle slaughtered in a local abattoir: A. Posterior region of *Setaria* sp. from abdomen (scale bar = 1000µm) B) Anterior region of *Setaria* sp. from abdomen (scale bar = 1cm) C) Scolex of *Monezia benedeni* (scale bar = 1000µm) D) *Monezia benedeni* (scale bar = 3cm) E) Segments of *Stylesia hepatica* (scale bar = 2000µm). F) Scolex of *Stylesia hepatica* (scale bar = 2cm). G) *Thysaniezia* (scale bar = 3cm).

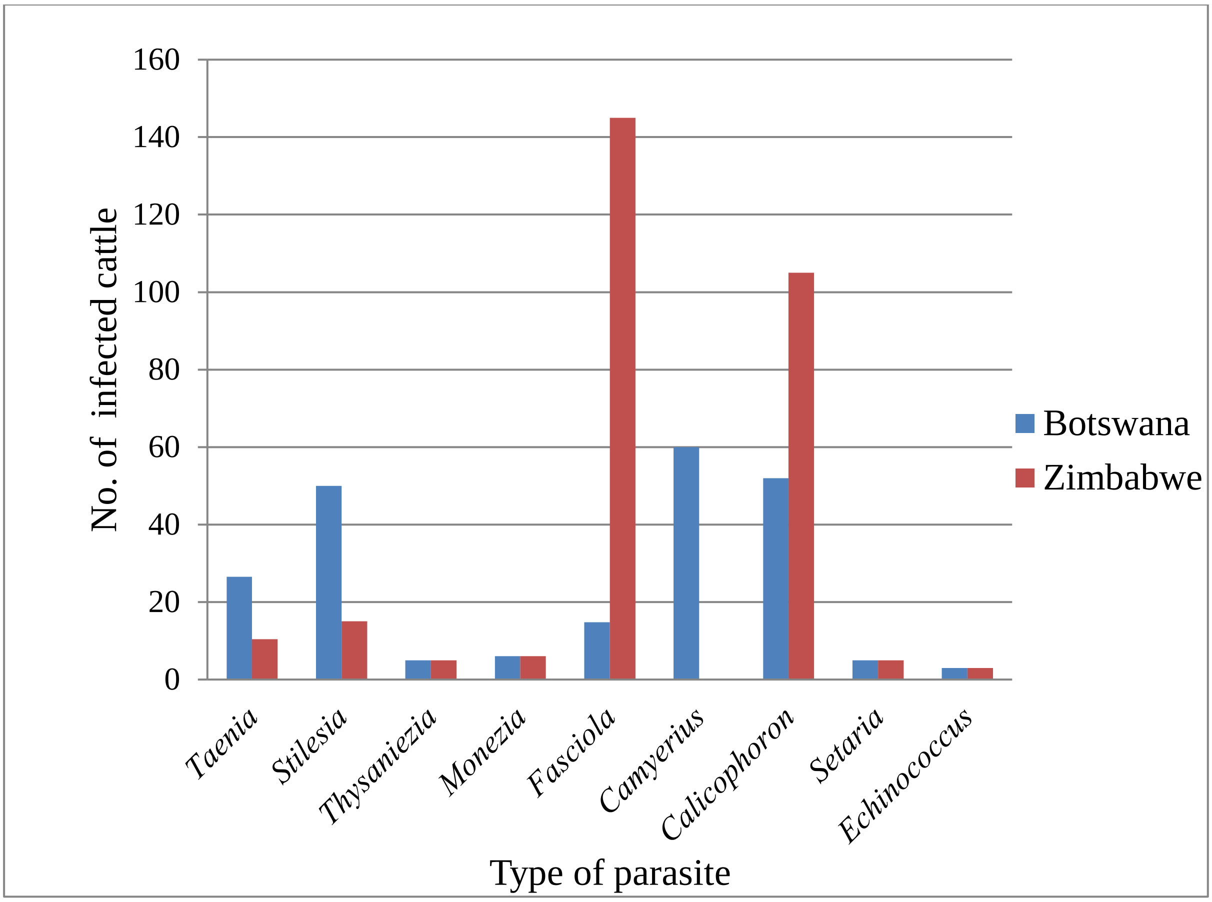

Figure 3: A comparison of the parasites obtained from the Botswana and Zimbabwe Cattle during the time of study showing the number of cattle infected by the particular parasites. The significance level computed using SPSS was 0.02 showing that the infection rates were significantly different for the two countries.

4 DISCUSSION

Movement of animals across borders for trade has been known to have significant risks of disease transmission and transfer of vectors to recipient populations (Kock et al., 2010). This has resulted in many countries importing beef rather than live animals. In a study conducted on trade animals from Nigeria and surrounding countries at an international trade market, the most prevalent disease conditions in cattle were caused by helminths (Mubi et al., 2011). Similarly, in our current study, helminths were the most prevalent in both countries although higher figures were recorded from Zimbabwe. Presence of helminth parasites may be due to the fact that although Botswana is generally dry, the Okavango delta and some stagnant water bodies provide sustenance for animal life. An assessment of the Okavango Delta revealed the presence of molluscs such as Bulinus sp, Lymnea sp. and Biomphalaria sp. all of which are intermediate hosts for some helminths showing how these conditions could have resulted (Alonso et al., 2003).

However, of particular concern was the presence of *Camyerius dollfusi/mancupatus*, a Gastrothylacinae. So far there has been no record of this species in Zimbabwean cattle; it has also been recorded in domestic ruminants in countries like Kenya (Laidetmitt et al., 2017). There may be a number of reasons for the presence of Camyerius sp. in Botswana and amongst them includes the wildlife/ livestock interface (Bengis et al., 2002) where domestic animals and wildlife interact at some point. In Botswana both

wildlife and domestic animals may share the scarce water resources of the Okavango Delta and pastures. Trans frontier parks like the Kgalagadi Trans frontier Park stretching across the Botswana and South Africa boarders may also be the main reservoirs of parasites across boundaries resulting in introduction of new parasites to domestic animals. Although the pathogenicity of Camyerius sp. has not been documented, introduction of the same in high burdens may result in lowered productivity in cattle. There is a possibility with increase in trade between these two countries that this particular species could be introduced to Zimbabwean cattle. This might provide substantial opportunity for introduction of this new strain into Zimbabwe, which might be difficult to manage once fully established (Mubi et al., 2011). There are a number of routes through which parasitic diseases might be spread, and these include (i) spread with faecal matter which is left in the destination country during movement of the animals from one location to another (ii) the cleaning process at the slaughter house which generally leaves some parasites and other eggs of trematodes still attached thus increasing the potential of spreading and (iii) lodging of eggs between the hooves of imported cattle. Prevalence of *Fasciola gigantica* however, is a cause for concern in Zimbabwe as it was extremely high compared to the cattle from Botswana as this is confirmed by an the overall significance level was 0.02 which is high. In a study done by Pfukenyi and Mukaratirwa, 2004, prevalence of fasciolasis in abattoir studies in some regions of Zimbabwe was relatively high. This could be due to the presence of a lot of water bodies that harbour a lot of snails resulting in transmission of *Fasciola gigantica*. The cattle from Botswana had a very low prevalence of fasciolasis and this is consistent with findings by Monchakana and Robertson, 2016 showing that this could be due to animal husbandry practices that are different from those in Zimbabwe.
Even with meticulous inspection of animals before slaughter, conditions such as Cysticercus bovis, *Stilesia* and Hydatid cysts may not be detected by coprorological methods. This needs proper inspection to be done on muscles and organs. *Taenia saginata* and *Echinococcus granulosus* were recovered from Botswana cattle showing that these conditions could have been difficult to detect prior to exportation. The presence of echinococcosis in cattle may result in cross infection to humans, which is a serious health problem. The source of infection of echinococcus could be contaminated pastures from dog faecal matter or poor husbandry practices.

5 CONCLUSION

Although movement of both domestic and wild animals is restricted across borders, trade in this global village is inevitable. Movement of animals has the disadvantage of introducing new parasites or even new strains of species that may be difficult to manage and control once they are established (Mubi et al., 2011). Thorough inspection and proper parasite control needs to be done before exportation of animals during trading. Detection of parasites of zoonotic importance could also be a cause for concern seeing that this may have implications on public health issues.

ACKNOWLEDGEMENTS: We would like to thank the National University of Science and Technology for their support and the Research Board for in funding the project.

REFERENCES

Abrous, M., Rondelaud, D. and Dreyfuss, G. (1996) *Paramphistomum daubneyi* and *Fasciola heptica*: The Effect of Dual infection on Prevalence and Cercarial Shedding in Preadult *Lymmaea glabra*. *The International Journal of Parasitology* **82 (6)**: 1026-1029.

Alonso, L.E. and Nordin L. (2003). A rapid biological assessment of the aquatic ecosystems of the Okavango Delta, Botswana: High Water Survey. RAP Bulletin of Biological Assessment 27. Conservation International, Washington, DC. pp. 58-68.

Bengis, R.G., Kock, R.A. and Fischer, J. (2002). Infectious animal diseases, the Wildlife /livestock interface. In: Infectious Diseases of Wildlife: Detection, Diagnosis and Management. O.I.E. *Scientific and Technical Revue* **21**: 53-65.

Brown, D. S., Curtis, B. A., Buthune, S. and Appleton C.C. (1992). Fresh water snails of East Caprivi and the lower okovango river basin in Namibia and Botswana.*Hydrobiologia* **246**:9-40.

Brown, D. S. (1994) Freshwater snails of Africa and their medical importance. Taylor and Francis Ltd 2nd Edition. pp. 154-389.Brown, D. S. and Kristensen, T. K. (1989). A field guide to African fresh water snails. Danish Bilharziasis Laboratory. Chalottenlund 54. pp. 8.

Chingwena, G., Mukaratirwa, Chimbari, M.S. and Kristensen, T.K. (2002). Larval trematode infections in freshwater snails from the highveld and lowveld areas of Zimbabwe. *Journal of Helminthology* **76**:283–293.

Dinnik, J.A. and Dinnik, N. N. (1957) Development of *Paramphistomum sukari* Dinnik1954 (Trematoda Paramphistomideae) in snail host. *Parasitology* **1** (**2**): 209-216Frandsen, F and McCullough, F. (1980) Practical guide to the identification of African fresh water snails. pp. 12. Danish Bilharziasis Laboratory. Denmark.

Dube, S., Dlamini, N. R., Masanganise, K. E., Dube, C. (2004). Abattoir Studies on Paramphistomes Recovered from Cattle in Masvingo and Manicaland Provinces of Zimbabwe. *Folia Veterinaria* **48** (**3**): 123-129.

Dube, S., Masanganise, K.E. and Dube, C. (2010). Studies on Paramphistomes Infecting Goats and Sheep from Gwanda District. *Zimbabwe Journal of Science and Technology* **5**:55-64.

Dube, S., Siwela, A.H., Dube, C and Masanganise, K.E. (2002). Prevalence of Paramphistomes in Mashonaland West, Central, and East, and Midlands Provinces, Zimbabwe. *Acta Zoologica Taiwanica* **13**:39-52.

Eduardo, S. L. (1982b). The taxonomy of the family Paramphistomidae Fischoeder,
1901 morphology of species occurring in ruminants. General considerations.Fischoeder, 1901. *Systematic Parasitology* **4**:189-238.

Eduardo, S. L. (1983). The taxonomy of the family Paramphistomidae Fischioeder, 1901 with special reference to the morphology of species occurring in ruminants. III. Revision of the genus *Calicophoron* Nasmark.1937. *Systematic Parasitology* **5***: 25-79.*

Gretillat, S. (1960). Amphistomes (Trematodes) des ruminants demestiques dela Republique du Tchad description d'un Gastrothylacidas nouveau *Carmyeriusgraberi* n. sp. *Ann. Parasit. Hum*. *Com*. **35** (**4**): 509 – 527.

Kock, R.A., Woodford, M.H. and Rossiter, P.B. (2010). Disease risks associated with translocation of wildlife.*Revue Scientifique et technique* **29** (**2**): 329-361.

Laidemitt, M.R., Zawadzki, E.T., Brant, S.V., Mutuku, M.W., Mikoji, G.M. and Loker, E.S. (2017). Loads of trematodes: Discovering hidden diversity of paramphistomoids in Kenyan ruminants. *Parasitology* **144**, 131–147.

Marchand, A. (1984) Economic effects of the main parasitosis of cattle. *Revue de Medecine Veterinaire* **135** (**5**): 299-3302.

Mubi, A.A., Muhammad, Michika, S.A. and. Midau, A**. (**2011).Threaten Health Challenges of Trade Animals in International Livestock Market, Mubi, Nigeria. *Global Veterinaria* **7** (**6**): 596-600.

Nasmark, K.E. (1937). A revision of the tramatode family Paramphimidae. *Zool. Bidr. Uppsala*. **16**: 301 - 565.

Mochankana, M.E. and Robertson, I.D. (2016). A retrospective study of the prevalence of bovine fasciolosis at major abattoirs in Botswana. *Onderstepoort Journal of Veterinary Research* 83(1), a1015. http://dx.doi.org/10.4102/ ojvr.v83i1.1015.

Pfukenyi, D.S. and Mukaratirwa, S. (2004). 'A retrospective study of the prevalence and seasonal variation of *Fasciola gigantica* in cattle slaughtered in the major abattoirs of Zimbabwe between 1990 and 1999'. *Onderstepoort Journal of Veterinary Research* 71: 181–187.