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Elucidation of cow tick *Rhipicephalus microplus* (formerly *Boophilus microplus*) reproduction in general Santos City, Philippines

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Abstract

Ticks comprise one of the most significant groups of arthropods in terms of effects on animal health. They incapacitate the host by feeding on it. The cattle tick, economically impact cattle industry in tropical and subtropical regions of the world, is a cautiously serious external parasite affecting, primarily, cattle. These ticks are adapted to the advantages of specialising to feed on cattle and with all the feeding stages occurring on one individual host in a rapid sequence of reproduction. Cattle tick's reproduction and life cycle occurs on body of only one host. This stage takes approximately 21 days, during which the tick changes from a minute larva to a nymph and finally an adult. With the use of a thin-tipped tweezers or forceps with a steady even pressure, ticks were removed straight upward from different body parts of cattle. Ticks were identified to the species level based on their morphologic features under a dissecting microscope and their genus and species were identified under the stereo microscope in the laboratory. Several parameters were taken as to with its life cycle. As observed, the period of tick's life cycle varies due to some factors. This study aims to elucidate the reproduction process and life cycle of cattle ticks to serve as a guide in controlling and managing these parasitic creatures.

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Introduction

When it comes to terms of effects on animal health, ticks comprise one of the most significant groups of arthropods. They harm the host by feeding on it (Kaufman & Philips, 1973); they can cause paralysis (Murnaghan & O'Rourke, 1978) and immunological disorder (Rossi, 1990) through direct effects resulting from inoculation of their saliva; and they can also transmit high-morbidity pathogenic agents. Moreover, they can act as vectors between domestic animals, sylvatic animals, and humans (Hoogstraal, 1991). One of these ticks is the cattle tick, *Rhipicephalus (Boophilus) microplus*, a significant ectoparasite of cattle and other domestic animals (Merck Veterinary Manual, 1998).

The cattle tick, *Rhipicephalus (Boophilus) microplus*, is distributed in tropical and subtropical regions of the world (Estrada *et al*, 2006). Infestations with *R. microplus* economically impact cattle industry by reducing weight gain and milk production because large numbers of ticks will remove significant amounts of blood, protein and nutrients from infested cattle, affecting growth and productivity and they are also transmitting pathogens that cause babesiosis (*Babesia* and *B. bigemina*) and anaplasmosis (*Anaplasma marginale*) (Peter *et al*, 2005; de la Fuente *et al*, 2008). Heavy cattle-tick infestation causes loss of condition and even death because of tick-worry and blood loss. These ticks are adapted to the advantages of specialising to feed on cattle and with all the feeding stages occurring on one individual host in a rapid sequence of reproduction (Sonenshine, 2014).

Cattle tick's reproduction and life cycle occurs on body of only one host. This stage takes approximately 21 days, during which the tick changes from a minute larva to a nymph and finally an adult. Adult females feed slowly for about a week before rapidly filling with blood just prior to detachment. They then drop onto pasture, lay up to 3000 eggs and die. Eggs hatch to produce larvae which infest the pasture until picked up by a suitable host or they die. Mating by ticks in

the genera *Rhipicephalus* occurs on the host after feeding. Certain species of *Ixodes* often mate off the host before feeding, but may mate while on the host (Kiszewski *et al*, 2001). During the first 24 to 36 hours following attachment to the host, little or no ingestion of blood takes place (Sonenshine *et al*, 1991). During this period, ticks use their chelicerae to cut the epidermis and insert their hypostome, which contains backward directed spines. Following insertion of the hypostome, many ticks reinforce their attachment by secreting a cement-like substance from their salivary glands (Sonenshine *et al*, 2002); (Kaufman WR., 1989). Their reproduction process is quite unfamiliar to many people that is why controlling them is reasonably a hard job.

With the growing importance of biological control as an alternative solution to the unpleasant effects of tick's manifestation, it is necessary to survey and assess the reproduction process of ticks found in cattle because they are particularly vulnerable when they first encounter these ticks but develop a degree of resistance after repeated exposure. This study aims to elucidate the reproduction process and life cycle of cattle ticks to serve as a guide in controlling and managing these parasitic creatures. It limits only to the characteristics of ticks, nature of their reproduction and how they survive in their hosts. The expected output attests to be useful as a future reference since there are no researchers conducted their study in General Santos City, Philippines.

Materials and methods

Study area

The study was carried out from the last week of November up to December (2014) in Fatima, General Santos City (Fig.1). The study area provided excellent sites for studying animal relations because of the various domestic animals dwelling in the area. The study sites include different types of faunas: cats, dogs, cows and carabaos. The actual location of site was determined through GPS (Global Positioning System).

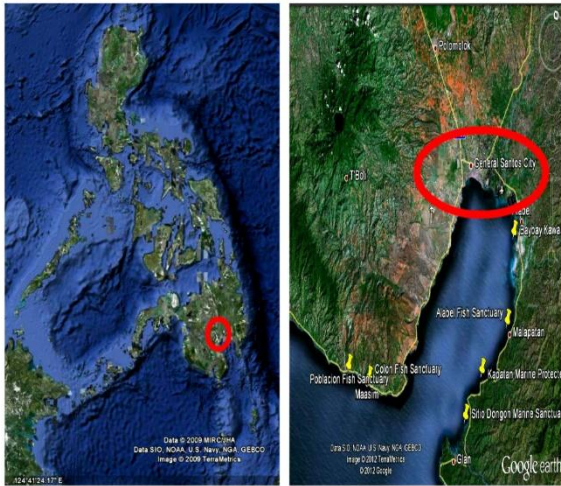


Fig. 1. Map of General Santos City, Philippines.

Tick removal

Three out of 30 cows were selected randomly from small holders of cows irrespective of their age, sex, breed, and examined for the presence of ticks and most likely associated risk factors in animal population according to the method adopted by (Thrusfield 2005). With the use of a thin-tipped tweezers or forceps with a steady even pressure, ticks were removed straight upward from different body parts of cattle (ears, around eyes etc.) The ticks were collected by three people on two trips last November 29-30, 2014, with roughly three hours dedicated to tick collection during each trip. Specific permissions were required to collect ticks from the site, and no endangered or protected species were involved in the fieldwork conducted. Additionally, the time points when the first and the last engorged females detached and fell to the ground were recorded.

Identification of tick species

Ticks were identified to the species level based on their morphologic features under a dissecting microscope (Furman and LooMis, 1984). The tick’s genus and species were identified under the stereo microscope in the laboratory and the half body tick counts were doubled to obtain whole body tick load according to (Keiser, 1987; Walker *et al*, 2003).

Ticks life cycle parameters

Ticks were observed daily to record the following parameters (Guglielmone *et al*, 1989): (i) the period elapsed between the detachment of the last engorged female and the oviposition (preoviposition time); (ii) the period during which the engorged female deposited eggs (oviposition time); (iii) the period between the beginning of oviposition and the eclosion of the first larvae (incubation time); (iv) the number of eggs deposited by each female; (v) the number of tick larvae that were borne from each female; (vi) the percentage of hatched larvae with respect to the total number of eggs deposited by each female (% eclosion).

Results and discussion

Engorged females collected from the cows were allowed to oviposit under controlled conditions of temperature and humidity. The timing of this process, as well as the number of deposited eggs and born larvae are shown in Table 1.

Table 1. Table showing the parameters measured in the life cycle of *Rhipicephalus microplus*

PRE-OVIPOSITION	3 Days
OVIPOSITION	4 Days
INCUBATION	21 Days
NUMBER OF EGGS	~3000/ Mother tick
NUMBER OF HATCHED LARVAE	~2600/ Mother tick
% OF EXCLOSION	86 %

In 30 cows selected randomly, *Rhipicephalus microplus* species of ticks was the only species dominated. The species was observed and its life cycle lasted for 40 days from the period the egg was laid by the engorged female to the period it became an adult.

It was recorded that the period elapsed between the detachment of the last engorged female and the period it deposited eggs took for 3 days. On the other hand, the period during which the engorged female deposited eggs lasted for 4 days. The incubation time, or the time elapsed between the beginning of

oviposition and the eclosion of the first larvae was recorded to be about 21 days. Out of approximately 3000 eggs laid by each female ticks, approximately 2600 of it hatched into larvae. From this information, the percentage of eclosion is said to be about 86%.

Table 2. Table showing the day by day observation on the life cycle of *Rhipicephalus microplus*.

Days	Stage
Day 1 –Day 20	Eggs
Day 21 – Day 24	Larvae (six-legged)
Day 25 –Day 32	Nymphs (eight-legged)
Day 33 –Day 40	Adult (eight-legged)

Ticks were monitored day by day in the laboratory with the aid of the stereomicroscope. The following observation were recorded and analyzed in Table 2.

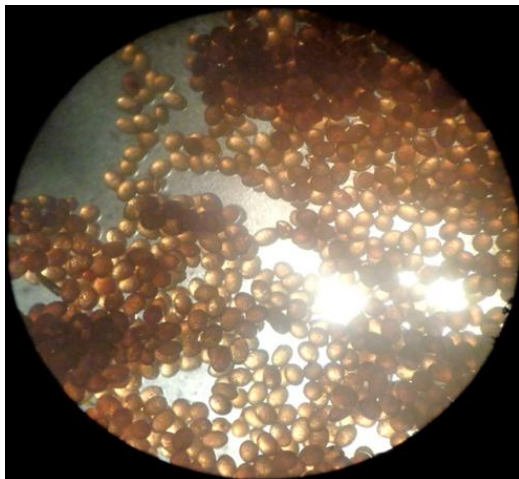


Fig. 2. Compound microscope image at 40X magnification showing the eggs of the *Rhipicephalus microplus* (Day 1- Day 20).

From the period when the female tick oviposited the eggs (Figure 2), they only hatched and turned into six- legged larvae after 20 days (Figure 3). Day after day, the ticks were monitored using a stereomicroscope and no particular changes observed until day 25, when the larvae then grew into eight-legged nymphs (Figure 4). Same observations were witnessed up to its 32nd day. On day 33, the test subject was then transformed into an adult having eight legs (Figure 5).

An adult has the same number of legs as to with the nymphs but these two differs on their body size. Adults are larger compared to nymphs.

The period of tick’s life cycle varies in respect to many factors. Factors including the availability of energy absorbed, time bare on the test organism and having a host as the cycle progresses were vital. Furthermore, tick’s life cycle depends on its environmental factors.

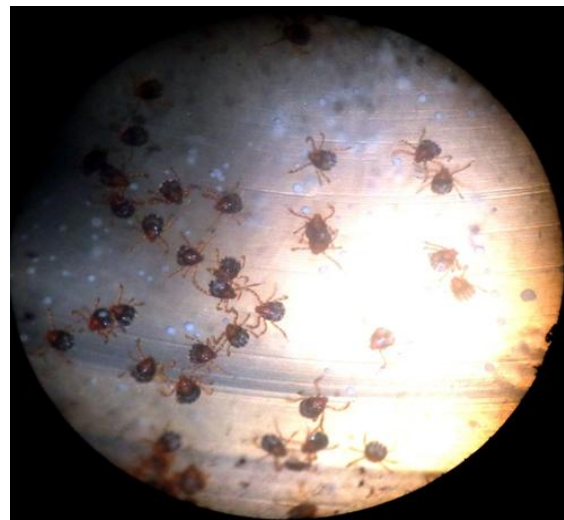


Fig. 3. Compound microscope image at 40X magnification showing the larvae of the *Rhipicephalus microplus* (Day 21-Day 24).



Fig. 4. Compound microscope image at 40X magnification showing the nymphs of the *Rhipicephalus microplus* (Day 25- Day 32).



Fig. 5. Compound microscope image at 40X magnification showing the adult *Rhipicephalus microplus* (Day 33- Day 40).

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