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Pitout JDD, Church DL, Gregson DB, Chow BL, McCracken M, Mulvey M, Laupland KB (2007). Molecular epidemiology of CTXM-producing Escherichia coli in the Calgary Health Region: emergence of CTX-M-15-producing isolates. Antimicrob. Agents Chemother. 51: 1281-1286.

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Full Length Research Paper

Cockroach and rodents infestation in Benue State University students' hostel in Makurdi and their epidemiological implications

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Adverse housing conditions in homes and hostels are strongly associated with increased odds of both rodent and cockroach infestation. This study was designed to determine the species of rodents and cockroaches infesting university hostels, the extent of infestation and the methods of control practiced by students. Cockroaches and rodents were trapped using the Hercules mouse glue board. An average of 1.72 rats per room was collected. The number of rats caught from boys' hostel (Unity campus) and girls' hostel (Technical block) were significantly higher than those caught from the other hostel blocks (χ^2 = 39.3, df = 4, P < 0.05). Three species of rodents were identified, *Mus musculus* (24.1%), *Rattus norvegicus* (34.0%) and *Rattus rattus* (41.9%). 502 cockroaches were caught from 142 (54.6%) of the hostel rooms inspected, and an average 3.53 cockroaches were caught from a room. Girls' hostel technical block accounted for the highest cockroach infestation rate (32.3%) and this differs significantly from the other hostel blocks (χ^2 = 11.4, df = 4, P < 0.05). This study shows that overcrowding, cooking in the hostel and refuse accumulation provide conducive breeding ground for cockroaches and rodents. The severe health implications arising from cockroach and rodent infestation justify the need to provide hygiene education to both students and hostel management staff to be able to link cockroach and rodent infestation to health and disease.

Key words: Cockroach, rodents, infestation, university hostels, Makurdi, Nigeria.

INTRODUCTION

Pest infestation is a recognized residential hazard that has been associated with higher risk of asthma symptoms in the case of cockroach (Wang et al., 2008; Sarinho et al., 2004) and Lassa fever, in the case of rodents (Bonner et al., 2007; Bradman et al., 2005). Due to inadequate hostel accommodation for students and the lack of adequate maintenance of existing facilities, a disproportionately high incidence of pest infestation occurs, arising from poor hygiene and improper storage and disposal of waste (Bradman et al., 2005; Wang et al., 2008; Bamigboye, 2006). Poor housing conditions resulting to overcrowding of limited hostel facilities in many Nigerian Universities, provide ample habourage for pest infestation due to unsanitary stacking of food items, as well as congestion of rooms with varieties of articles (Majekodunmi et al., 2002; Onyido et al., 2009). The high incidence of cockroaches in public housing apartments poses numerous public health risks, including exposure to allergens through the air and via food contamination, resulting in an increased incidence of health problems, mainly asthma (Wang et al., 2008; Lwebuga-Mukasa et al., 2002). Cockroaches are also capable of transmitting many pathogens including bacteria, viruses, fungi, protozoa and pathogenic helminthes that threaten human

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health (Tawatsin et al., 2001; Mlso et al., 2005; Pai et al., 2004; Ghosh and Gayen, 2006). Rodents infestation on the other hand has long been associated with risk of Lassa fever epidemics and the transmission of many serious diseases including plague, hantavirus pulmonary syndrome, murine typhus, rat bite fever, salmonella and leptospirosis (Fisher and Miller, 2003; Bonner et al., 2007; Bradman et al., 2005). Lassa fever is endemic in West Africa and has been reported from Sierra Leone, Guinea, Liberia, and Nigeria. Some studies indicate that 300,000 to 500,000 cases of Lassa fever and 5000 deaths, occur yearly across West Africa (Ogbua et al., 2007). The synergistic health and economic consequences of rodents and cockroach infestation is resulting to the use of home pesticide for their control, a situation that increases indoor pesticide residue (Arlian, 2002).

That adverse housing condition in homes and hostels is strongly associated with increased odds of both rodent and cockroach infestation is not in doubt.

The extent of infestation, destruction caused to property, the species involved and their perceived importance, is yet to attract the required research interest in Nigeria. The objectives of this study therefore, were to determine the extent of rodents and cockroach infestation in a University hostel, species of these pests involved and methods of control practiced by the students. The findings of this study will be used to design and develop pest control strategies that will involve education and students' participation.

MATERIALS AND METHODS

Description of study area

The study was conducted at the Benue State University (BSU), Makurdi, between October, 2009 and March, 2010. Makurdi is the capital of Benue State in Nigeria; the State covers an area of about 34,059 square kilometers with a population of over 4.2 million people (National Population Commission, 2006). Benue State has two seasons called the rainy and dry season, as rainfall is the real climatic variable.

The rainy season is from April to October (7 months, with 800 to 1,100 mm of rain) while the dry season runs from November to March (5 months, with 200 to 400 mm of rain). Temperature ranges from 26 to 29.5°C in the dry season and 19.5 to 24°C in the rainy season, with mean relative humidity of 78%.

The town lies between latitude 7° 30' to 8° 00' N and longitude 8° 30' to 9° 00' E and situated in the guinea savanna vegetative region in Nigeria. The University was established 17 years ago and has 13 halls of residence, each averaging about 48 rooms to serve a student population of about 18,000. Each room was originally designed for 2 students but now officially has between 3 to 4 students per room due to large increase in student admission without corresponding increase in hostel facilities. A common feature of most Nigerian university hostels is the stocking of foodstuffs by individual students inside their rooms, especially under their beds and inside the wardrobe (Bamigboye, 2006). Significant among the problems created by cooking in the hostel are the increased volume of garbage generated and poor strategies for disposal and hygiene.

Selection of rooms and participants

Twenty (20) rooms were randomly selected in each hall of residence, and in each of the selected rooms the first occupant was identified to provide information on students' attitude and practices towards cockroach and rodent infestation. Advocacy visits were made to each of the selected rooms to solicit occupants' cooperation and participation throughout the period of the study. A semi-structured questionnaire was administered to the room occupants. The questions investigated activities of cockroaches and rodents in the rooms and methods of control employed by students.

Methods of trapping cockroaches and rodents

Cockroaches and rodents were trapped using the Hercules mouse glue board, measuring 30 cm in length and 20 cm in width. After thorough visual inspection of the room to identify cockroach and rodents' tracks, droppings and eggs, the glue board was then placed on the path. Pieces of crayfish or smoked fish were placed in the middle of the board as bait. The glue board was left overnight and trapped cockroaches and rodents were collected in the morning and taken to the Zoology laboratory for preservation and identification. While rodents were identified using keys provided in Fisher and Miller (2003), the cockroaches were identified using identification keys in Runstrum and Bennet (1990).

Data analysis

Data was analyzed using percentages and frequencies while chi-square was used to test for significance of infestation rates in the different halls of residence.

RESULTS

The study inspected 260 students' hostel rooms for rodents and cockroach infestation, and a total of 203 rats were caught from 118 (45.5%) rooms (an average of 1.72 rats per room). The number of rats caught from Boys' hostel on the unity campus and girls' hostel Technical block were significantly higher than those caught from the other hostel blocks (χ^2 = 39.3, df = 4, P < 0.05). Three species of rodents were identified, *Mus musculus* (24.1%), *Rattus norvegicus* (34.0%) and *Rattus rattus* (41.9%) (Table 1). On the other hand, 502 cockroaches were caught from 142 (54.6%) of the hostel rooms inspected, and an average 3.53 cockroaches were caught from a room. Girls' hostel Technical block accounted for the highest cockroach infestation rate (32.3%) and this differs significantly from the other hostel blocks (χ^2 = 11.4, df = 4, P < 0.05) (Table 2). The American cockroach, *Periplaneta americana* was the most predominant cockroach species encountered, accounting for 50.6% of total cockroaches caught. Other species were the German cockroach, *Blattala germanica* (34.7%) and *Supella longipalpa* (14.7%).Students reported several evidences of rat infestation in their rooms, the three most reported evidences were rat runs noticed in room corners (24.6%), rat droppings in wardrobes (18.5%) and rat burrows in boxes and cupboards (15.8%)

Table 1. Common species of rodents trapped from BSU students' hostels in Makurdi, Nigeria.

Hostel	Number of room inspected	Number of rooms with rodents (%)	Number of rodents caught	*Mus musculus*	*Rattus norvegicus*	*Rathus rattus*
Boys' hostel main campus	20	7 (35.0)	16 (7.9)	2 (12.5)	6 (37.5)	8 (50.0)
Girls' hostel main campus	40	17 (42.5)	26 (12.8)	6 (23.0)	8 (30.8)	12 (46.2)
Boys' hostel unity campus	60	38 (63.3)	62 (30.5)	14 (22.5)	28 (45.2)	20 (32.3)
Girls' hostel unity campus	80	21 (26.3)	28 (13.8)	16 (57.1)	11(39.3)	1 (3.6)
Girls' hostel technical block	60	35 (58.3)	71 (35.0)	11 (15.5)	16 (22.5)	44 (62.0)
Total	260	118 (45.4)	203	49 (24.1)	69 (34.0)	85 (41.9)

(X^2 = 39.3, df = 4, P < 0.05).

Table 2. Common species of cockroach trapped from BSU students' hostels in Makurdi, Nigeria.

Hostel	Number of room inspected	Number of rooms with cockroach (%)	Number of cockroaches caught	*Periplaneta americana*	*Blattela germanica*	*Supella longipalpa*
Boys' hostel main campus	20	18 (90.0)	125 (25.0)	79 (63.2)	41 (92.8)	5 (4.0)
Girls' hostel main campus	40	19 (47.5)	58 (11.6)	23 (39.6)	29 (50.0)	6 (10.4)
Boys' hostel unity campus	60	28 (46.7)	84 (16.7)	46 (54.8)	21 (25.0)	17 (20.2)
Girls' hostel unity campus	80	35 (43.8)	73 (14.5)	31 (42.5)	22 (30.1)	20 (27.4)
Girls' hostel technical block	60	42 (70.0)	162 (32.3)	75 (46.3)	61 (37.7)	26 (16.0)
Total	260	142 (54.6)	502	257 (50.6)	174 (34.7)	74 (14.7)

(X^2 = 11.4, df = 4, P< 0.05).

Table 3. Respondents' noticeable evidence of rodents' infestation in BSU hostels in Makurdi, Nigeria.

Indicators of rodents infestation	Frequency	Percentage
Rat runs noticed in corners of rooms	64	24.6
Rate droppings found on floor and in wardrobes	48	18.5
Hole/burrow in wardrobes/cupboards	41	15.8
Live rats often sighted inside cupboards/wardrobes	26	10.0
Reduction in amount of food stuff	24	9.2
Rat noise heard	21	8.1
No evidence of rat infestation	36	13.8
Total	260	100

(Table 3). Some of these noticeable evidences of rat infestation were reported even in rooms where rats were not caught. The three most reported evidences of cockroach infestation were sighting live cockroaches (38.8%), cockroach body parts seen in wardrobes/ cupboard (27.3%) and cockroach odour perceived in cupboards (13.5%) (Table 4). Respondents were more concerned with rat infestation than cockroach infestation; 64.7% of respondents' preferred cockroach infestation to rats.

The most commonly reported damages to properties resulting from cockroach and rat infestation were contamination and consumption of food stuff (29.6%), books (21.1%) and bags (9.6%) (Table 5).

Students in the hostels have resorted to a wide range of activities targeted at controlling cockroaches and rats. The most commonly used method is the use of insecticides for cockroach (44.6%) and a variety of rodenticides popularly known as rat killers (26.1%). This usually combined with physical killing for both rats and cockroaches (Table 6).

The findings from this study demonstrate that students in the hostel have to cope with both physical health risks and the nuisance of cockroach and rat infestation. Both rodents and cockroaches were caught from 20.7% of the rooms inspected; this combined infestation could have additional consequences.

Table 4. Respondents' noticeable evidence of cockroach infestation in BSU hostels in Makurdi, Nigeria.

Indicator of cockroach infestation	Frequency	Percentage (%)
Live cockroach often sighted in room/cupboard	104	38.8
Cockroach body parts seen in wardrobes/cupboard	71	27.3
Cockroach odour perceived in wardrobes/cupboards	35	13.5
Cockroach eggs seen in cupboards/wardrobes	28	10.8
cockroach droppings seen in cupboards	9	3.5
Cockroach noise heard in room	3	1.1
No evidence of cockroach infestation	13	5.0
Total	260	100

Table 5. Damage to items caused by rodents and cockroaches in BSU students hostels in Makurdi, Nigeria.

Item	Frequency	Percentage
Food stuff	77	29.6
Books	55	21.1
Bags/ boxes	25	9.6
Textiles	27	8.5
Shoes	21	8.1
Carpets rugs	16	6.2
Mattresses/pillows	11	4.2
No item damaged	33	12.7
Total	260	100

DISCUSSION

The incidence of cockroaches and rodents in students' hostels poses numerous public health risks. The outcome of this study indicates that overcrowding, cooking in the hostel and low level sanitation and hygiene encourage the breeding of rodents and cockroaches. Species of cockroaches and rodents encountered in university hostels in this study seem to be widespread. *R. rattus* and *R. norvegicus* have been frequently reported in residential buildings in both urban and rural areas in many parts of the world (Stojcevic et al., 2004; Bradman et al., 2005; Omudu and Ati, 2009). The American cockroach, *P. americana* and the German cockroach, *B. germanica,* on the other hand are the commonest roaches infesting buildings worldwide (Tawatsin et al., 2001; Sarinho et al., 2004; Mlso et al., 2005; Bradman et al., 2005; Omudu and Eyumah, 2008). These species of rodent and cockroaches are known to reproduce faster and thrive in habitats with availability and abundance of diverse food materials, suitable refuge, and lack of comprehensive control efforts.

Several studies have linked adverse housing conditions in residential apartments to an increased odds of both rodent and cockroach infestations (Bradman et al., 2005; Bonner et al., 2007; Wang et al., 2008). Our finding corroborates earlier studies in university hostels and residential apartments in Nigeria (Mbanong et al., 2002; Bamigboye, 2006; Omudu and Eyumah, 2008; Omudu and Ati, 2009). In addition to poor sanitation and lack of proper maintenance, Nigerian universities are known to be largely overcrowded, with more than twice the number of students expected to occupy the rooms. Also contributing is the fact that many students cook in the hostel, these factors substantially provide a wide range of food items, increase the amount of waste generated and escalate the breeding of rodents and cockroaches (Bamigboye 2006; Wang et al., 2008; Onyido et al., 2009).

Poor sanitary conditions in the hostel and overcrowding provide enabling environment for cockroach and rodent infestations, both of which are allergenic and can carry infectious diseases. A large number of microorganisms have been isolated from cockroaches captured, either from residential apartments, hospitals or other buildings. Recent studies in Iran reported a high percentage of test cockroaches (98%) carrying various microorganisms (bacteria, fungi and parasites) in and on their bodies, some of them of medical importance (Salehzadeha et al., 2007).Exposure to cockroach allergens through air and via food contamination results to an increased incidence of health problem, mainly asthma and cockroaches are potential to vector dysentery and gastroenteritis (Bradman et al., 2005; Wang et al., 2008). Studies have reported robust association between cockroach infestation and development of asthma as relevant allergens have been identified in the body and secretions from cockroach's body (Sarinho et al., 2004). On the other hand, rodent infestation is associated with the occurrence of Lassa fever. Evidences of rodent infestation like rodent burrows have been strongly associated with Lassa fever incidence in homes (Davis et al., 2005; Bonner et al., 2007). Other health implications of rodent infestation are that they are reservoirs for a variety of zoonotic diseases like *Toxoplasma goondi* (Stojcevic et al., 2004; Murphy et al., 2007). The involvement of rodent and cockroaches in transmission of life-threatening infections is epidemiologically significant and could be responsible for increasing incidence of emerging infectious diseases. Refuse disposal and food handling practices in many Nigerian

Table 6. Respondents' methods of rodent/cockroach control in BSU hostels in Makurdi, Nigeria.

Adopted control methods	Frequency	Percentage
Rodents		
Physical killing	96	37.0
Rat poison	68	26.1
Use of traps (glue board, snap trap)	44	17.0
blockage of burrows and tracks	17	6.5
Proper storage of food stuff	10	3.8
Never did anything	25	9.6
Total	260	100
Cockroaches		
Use of insecticides (Chlorpyrifos DDVP, Permethrin, Dichlorvos)	116	44.6
Physical killing	93	35.8
Use of adhesive gum	18	70
Proper storage of food stuff	9	3.5
Never did anything	24	9.2
Total	260	100

universities hostels provide ideal habitats for cockroaches and rodents to breed. The Girls' hostel technical block and the boys' hostel Unity campus are surrounded by open fields overgrown with weeds providing a mosaic of agricultural and village areas. These may be the reason for the significantly high infestation rates recorded in these hostel blocks. It has been reported that human environment, such as shrubs and refuse dumps, attract rodents for shelter and refuge (Onyido et al., 2009). Poor external hygiene may act as a risk factor for rodent and cockroach infestation of residential homes and transmission of lassa virus and precipitation of asthmatic attacks (Sarinho et al., 2004; Bonner et al., 2007).

Additional health consequences of rodent and cockroach infestation are the resultant increase in use of pesticides. Frequent pesticide use results in environmental pollution and poor air quality within rooms. The high percentage of student resorting to rodenticides and insecticide to control infestation could cause accidental contamination of foods stuff inside students' rooms and increase indoor pesticide residue (Majekodumi et al., 2002; Bamigboye, 2006; Wang et al., 2008). Control strategies should therefore be directed to emphasis of knowledge of the biology and ecology of target rodent and cockroaches, improvement in sanitation and hygiene and limited pesticide use.

Conclusion

This study shows that overcrowding, cooking in the hostel and accumulating refuse provide conducive breeding ground for cockroaches and rodents. The severe health implications arising from cockroach and rodent infestation justify the need to provide hygiene education to link cockroach and rodent infestation to health and disease.

Controlling pest infestation in hostel settings will require a comprehensive approach targeted at reducing overcrowding of rooms, improvement of hygiene and sanitation, and general maintenance of hostel facilities on campus.

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Full Length Research Paper

Seasonal prevalence of *Oestrus ovis* L. (Diptera: Oestridae) larvae in infested sheep in Jazan Region, Saudi Arabia

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***Oestrus ovis* L. (*O. ovis*) (Diptera: Oestridae) is a cosmopolitan agent of myiasis in sheep and goats. Sneezing and nasal discharges are the major clinical signs in infested animals. The present study was carried out to estimate the annual abundance of *O. ovis* in randomly selected male sheep heads in Jazan region. Survey conducted weekly for *O. ovis* during the period from November, 2010 to October, 2011, from Slaughterhouses in Jazan and the ecological data including, temperature, relative humidity, were obtained from the Department of Meteorology, Jazan. The study investigated 480 sheep heads. The collected larval specimens were identified by British Museum (Natural History), London. Results indicated that 257 (53.54%) of the total examined sheep heads showed positive infestation. Infestation recorded four peaks at January, May, July and October. The highest infestation was detected at January (82.5%), while the lowest was at August (25.00%). Also, the first, second and third larval instars represented 3.02, 20.35, and 76.63% from the total collected larvae, respectively. The data represented mean larval monthly number per sheep head. The study suggested the cold seasonal related *O. ovis* infestation in Jazan region.**

Key words: Jazan, *Oestrus ovis*, sheep, seasonal prevalence, abundance.

INTRODUCTION

The present study continues the planned series of studies that aim to detect the prevalence and abundance of the dipterous insects associated with sheep in Jazan region. These studies were started by Bosly (2010), who recorded twelve dipterous species within eight genera, belonging to seven families: Calliphoridae, Sarcophagidae, Muscidae, Ceratopogonidae, Ulidiidae, Sphaeroceridae, Chloropidae on sheep in Abu Arish, Alquayiyah, (Eastern Jazan); Duhaygah and Mihliyah (Northern Jazan); Mizhirah and Industrial City (Southern Jazan). The present study focuses on the nasal botfly *Oestrus ovis*, Linnaeus 1761 (Diptera: Oestridae).

O. ovis is the almost cosmopolitan and well known myiasis causing dipterous insect species which affects the health of sheep and goats in many parts of the world (Zumpt, 1965; Nacapunchai et al., 1998; Gracía et al., 2006). The parasitic phase of *O. ovis* begins after adult females deposit first larval stage larvae into the nostrils of hosts; these larvae develop into second and third larval stages in the nasopharyngeal cavities and frontal sinuses (Zumpt, 1965). Sneezing and nasal discharges are the major clinical signs in infected animals (Angulo-Valadez et al., 2011). Sometimes, the larvae are present in human eyes, classified as ophthalmomyiasis externa if it is on

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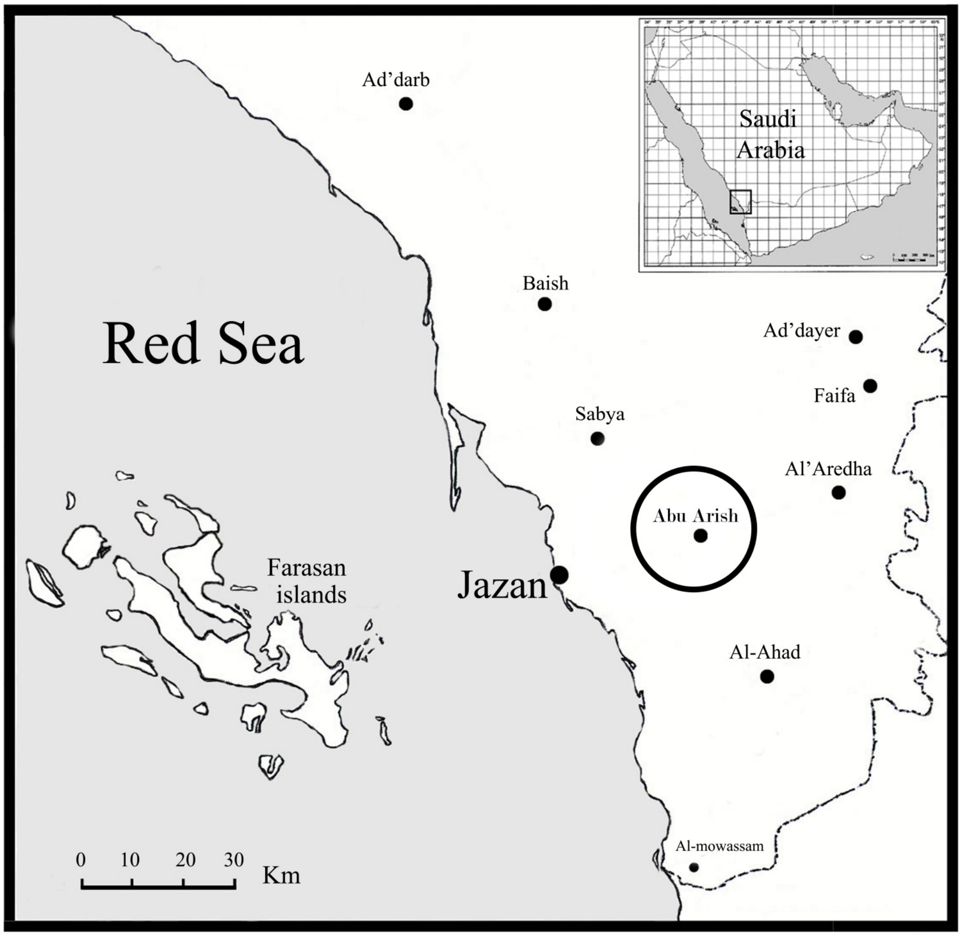

Figure 1. Map showing the location of the study area.

the conjunctiva and ophthalmomyiasis interna when there is intraocular penetration of larvae (Gregory et al., 2004; Dunbar et al., 2008; Khurana et al., 2010; Parikh et al., 2011). McGarry et al. (2012) observed infestation of dogs with first-stage larvae deposited by an adult fly the previous autumn in a farm in the Cotswolds, UK. Abundance of *O. ovis* larvae were done in many localities in central region of Saudi Arabia by Alahmed (2000). Despite the veterinary and medical importance of the nasal botfly in Saudi Arabia, little is known about its distribution and abundance in Jazan region. Accordingly, the present work aimed to detect the annual abundance of *O. ovis* on sheep in Jazan during the period from November, 2010 to October, 2011.

MATERIALS AND METHODS

The study area

The present study was carried out in Abu Arish area (Eastern Jazan), southern Saudi Arabi, (16° 58'N to 42° 47'E) (Figure 1).

Animals

The survey of *O. ovis* was conducted weekly during the period from November, 2010 to October, 2011 from Slaughterhouses in Jazan. A total of 480 randomly selected male sheep heads were examined for infestation.

Examination procedures

Heads were detached and opened from nose to the base by an electric saw. Larvae of the different instars were found alive inside heads; these larvae were picked up by forceps and preserved in 70% ethanol. Identification of specimens was performed by using keys of Zumpt (1965), Ferrar (1987) and Smith (1989), moreover some specimens were sent to British Museum (Natural History), London to confirm identification.

Weather data

Ecological data including the mean annual temperature, relative humidity and the received rainfall per annum were obtained from Meteorological Agency, Jazan.

Table 1. Monthly temperature, relative humidity and number of infested sheep head by *Oestrus ovis* in Jazan, Saudi Arabia.

Month	Temperature		Relative humidity (%)	No. of infested heads*	Percentage of infestation
	Max. Mean	Mean	Mean		
November, 2010	34.0	24.8	67	19	47.5
December	30.9	22.9	73	28	70.0
January, 2011	29.9	22.2	75	33	82.5
February	30.9	22.8	72	32	80.0
March	32.1	24.1	70	26	65.0
April	34.8	26.8	66	20	50.0
May	37.2	28.8	65	20	50.0
June	37.6	31.2	64	14	35.0
July	38.4	32.1	60	15	37.5
August	38.2	30.6	64	10	25.0
September	37.7	30.0	65	20	50.0
October	36.4	26.9	68	20	50.0
Total*	-	-	-	257	53.5

*Monthly examined 40 sheep head. *Total examined 480 sheep head during the study period.

Statistical analysis

The percentage of sheep head infestation (%) was calculated by the equation:

(Number of Infested heads / Total number of examined heads) × 100

The percentage of each *O. ovis* larval instar per infested sheep head was calculated by the equation:

(Number of larval instar / Total number of larvae) × 100

The mean larvae number per sheep head was calculated by the equation:

Number of monthly instar larval / Total monthly number of Infested sheep heads.

RESULTS AND DISCUSSION

Data in Table 1 and Figure 2 represent the monthly temperature, relative humidity and number of infested sheep heads by *O. ovis* larvae during the study period started in November, 2010 in Gizan region. Generally, the examination of 480 sheep heads revealed that 257 (53.5%) heads were infested with different larval instars of *O. ovis* (Table 1). Alahmed (2000) reported that during a period 12 months, 544 sheep heads were examined for infestation with *O. ovis* larvae in Riyadh abattoir, with recorded prevalence of infestation at 5.9%. The data reported that the lowest infestation percentage of sheep heads in August, 2011 was 25%, where temperature and relative humidity were 38°C and 64%, respectively. However, the percentage of infested heads in the present study increased to a peak abundance in January, 2011 (82.5%), followed by simple decline in February (80.0%). The results clearly showed the weather relation to the insect abundance because in Jazan region, the winter months are the best time of the year, with low temperature and high humidity while the decline in the flies' activity in most of the year was probably due to the heat and weather (http://en.wikipedia.org/wiki/Jizan). These results are in line with Alahmed (2000) who recorded the peak of infestation with *O. ovis* larvae in Riyadh as 23.3% in March (low temperature and humidity). Also, Dorchies et al. (2000) reported that the prevalence rate of *O. ovis* larvae in sheep and goats (in France) varied from 14.3% in February to 65% in October and Shoorijeh et al. (2009) found that prevalence of *O. ovis* larvae at the fairs abattoris in (Iran) ranged from 23.3% in spring to 80% in Winter.Datas in Table 2 and Figure 3 represent a total of 860 larvae of all three instars of *O. ovis* which were collected. The infestation percentages were 3, 20.4 and 76.6% of the first (L1), second (L2) and third instars (L3) larvae, respectively. The data in Table 3 showed the mean monthly number of larvae per sheep head (L/S). The L1 expressed two peaks, one in April (0.4 L/S) and the second in May (0.7 L/S) and L2 peaked in May (1.9 L/S) and in June (1.6 L/S) while L3 peaked only in August (8.4 L/S). In general, L2 and L3 instar larvae behaved in a similar trend throughout the experimental period as the fly had only one generation per year which started in November. Also data in Table 3 indicated that the mean monthly total number of all three instars had two peaks of abundance in August (8.7 L/S) and in May (6.3L/S). As regard to the predicted lower mean of the first instar larvae, Tabouret et al. (2001) previously reported that rapid larval development occurs in summer whereas L1

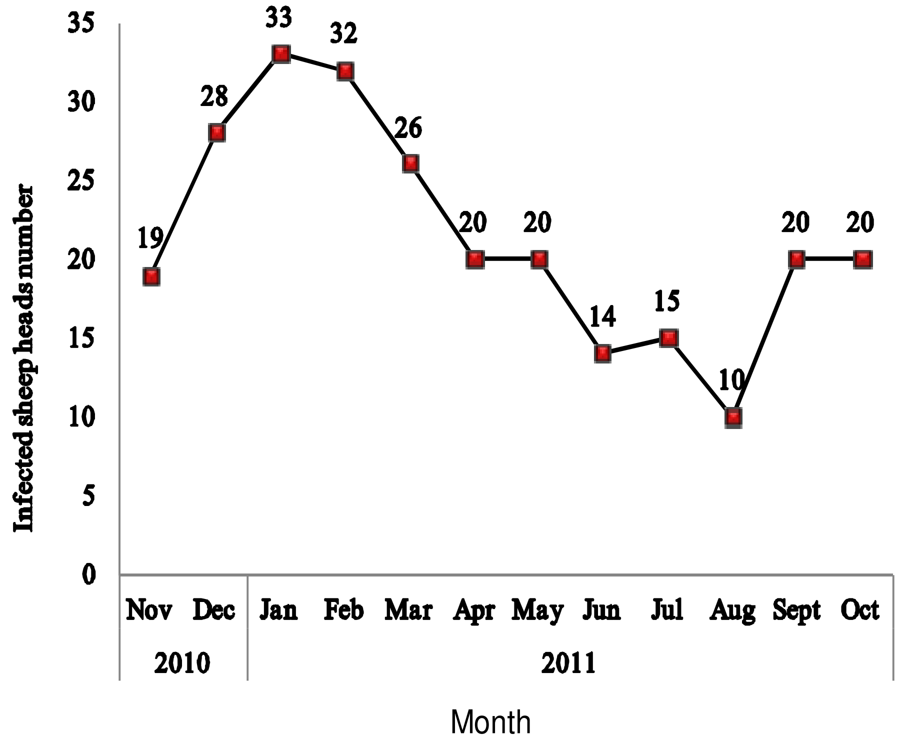

Figure 2. Monthly number of Infected Sheep Heads of *Oestrus ovis* Abu Arish area (Eastern Jazan), south Saudi Arabia.

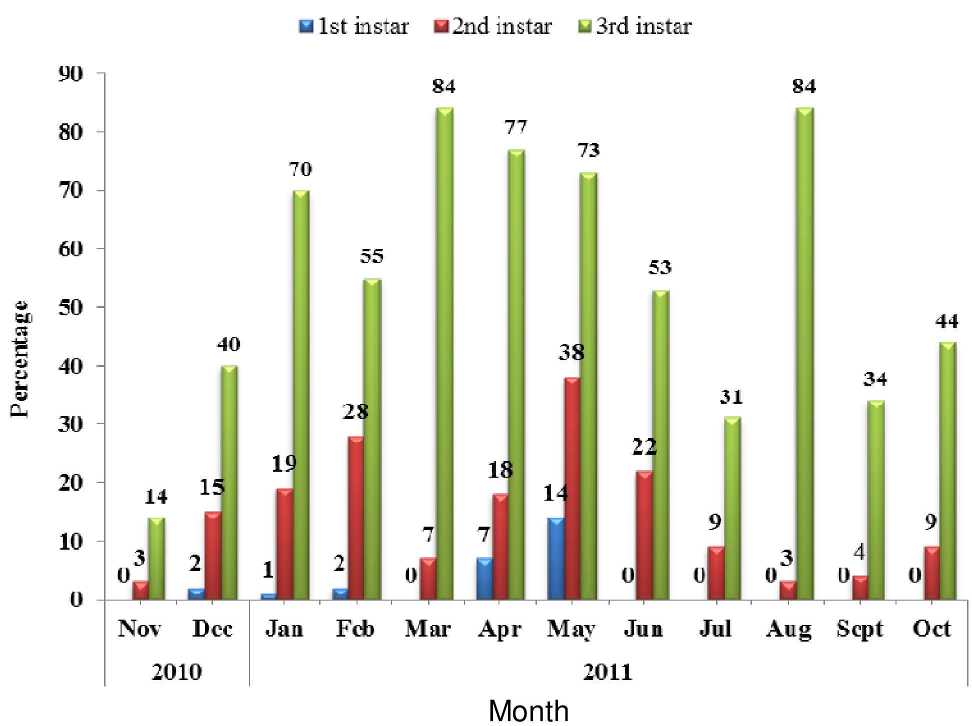

Figure 3. Monthly number intensity of *O. ovis* infection in sheep of different instars.

Table 2. Number of the three instars of *Oestrus ovis* larvae and number of each larval instar.

Month	Total No. of larvae	Larval instar					
		L1	%	L2	%	L3	%
November, 2010	17	0	0	3	17.7	14	82.35
December	57	2	3.51	15	26.3	40	70.18
January, 2011	90	1	1.11	19	21.11	70	77.78
February	85	2	2.35	28	32.9	55	64.71
March	91	0	0	7	7.7	84	92.31
April	102	7	6.86	18	17.7	77	75.49
May	125	14	11.20	38	30.4	73	58.40
June	75	0	0	22	29.3	53	70.67
July	40	0	0	9	22.5	31	77.50
August	87	0	0	3	3.5	84	96.55
September	38	0	0	4	10.53	34	89.47
October	53	0	0	9	16.98	44	83.002
Total	860	26		175		659	
Percentage		3.0		20.4		76.6	

Table 3. Monthly mean of first, second and third instars larvae *O. ovis* per sheep head (L/S).

Month	Mean larvae per sheep head (L/S)			
	1st instar	2nd instar	3rd instar	Mean total
November, 2010	0	0.2	0.7	0.9
December	0.1	0.5	1.4	2.0
January, 2011	0.03	0.6	2.1	2.7
February	0.1	0.9	1.7	2.7
March	0	0.3	3.2	3.5
April	0.4	0.9	3.9	5.2
May	0.7	1.9	3.7	6.3
June	0	1.6	3.8	5.4
July	0	0.6	2.1	2.7
August	0	0.3	8.4	8.7
September	0	0.2	1.7	1.9
October	0	0.5	2.2	2.7

whereas L1 hypobiosis takes place in the late autumn and winter. In southern Mediterranean countries (Morocco, Tunisia, etc.), the hypobiosis period is shorter and in humid tropical countries, adult fly activity and larval development occur all around the year. Also, Angulo-Valadez et al. (2010) discussed that *O. ovis* life cycle development is closely related to local climate and geographical location. Previous reported observations indicate that the range of L1 establishment rate is 0 to 48% in sheep (Dorchies et al., 1998; Frugére et al., 2000) and the L1 stage lasts from less than 10 days to more than 25 days under favorable temperatures (Cepeda-Palacios and Scholl, 2000).

Badawi (1994) previously mentioned that under Saudi Arabia conditions, the larvae spend about 9 months in sheep head before falling for pupation. Amin et al. (1997) pointed out that *O. ovis* larvae were found all over the year in sheep heads in Cairo and has one generation. Alahmed (2000) reported that the highest mean number of larvae per infested sheep head in L1, L2 and L3 were 5, 7 and 5.3, respectively in spring months. Alahmed (2004) stated that the myiasis incidences were highest during March to May (60%) and September to November (31.5%), where temperature and relative humidity are optimum. Arslan et al. (2009) found that the prevalence of sheep nasal myiasis in Turkey was 54.3% in spring, 41%

in summer and 38.9% in winter. Shoorijeh et al. (2009) indicated that prevalence of *O. ovis* in sheep head in Iran ranged from 23.3% in spring to 80% in winter. Also, Gracia et al. (2010) determined the prevalence of *O. ovis* larvae in sheep heads monthly for one year in Spain and reported that *O. ovis* recorded slower larval maturation in winter. Paredes-Esquivel et al. (2012) found that 46.03% of animals were infested in a 13-month period in the island of Majorca (Spain) and significant differences in oestrosis prevalences in winter and autumn. Silva et al. (2012) suggested that evolution and development of *O. ovis* practically occurs throughout the entire year, with larval infestation especially frequent during the spring and summer months.

This study suggested the risk of *O. ovis* larvae according to the abundance in Jazan region and the impact of climate on the infestation. Hence, the importance of controlling the sheep infestation which should be in the beginning of the winter season and for complete prevention, a seasonal treatment in April, is suggested, and every effort should be made to control them by sanitary measures and tools for the pest management. The results of this survey proved that the high infestation of sheep with *O. ovis* was monitored on January, 2011, and also revealed that this fly is becoming a serious pest in Gizan region. The prevention of myiasis is mainly achieved by treating the infested hosts. All efforts should be made to control this fly and the Ministry of Agriculture efforts should be intensified in the winter season to restrict and control the infection level.

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UPCOMING CONFERENCES

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