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DIVERSITY OF DIPTEROUS FORENSIC INSECTS FROM WESTERN MAHARASHTRA, INDIA

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ABSTRACT

Forensic insects help in solving the mysteries of a crime like murder and essential component of court of law. Therefore, diversity of forensic insects has been studied from Western Maharashtra (Kolhapur, Sangli & Satara), India. In all 25 insect species of forensic importance have been reported belonging to the families Culicidae, Calliphoridae, Sarcophagidae, Muscidae, Psychodidae, Tabanidae, Piophilidae, Syrphidae, Chioropidae, Ceratopogonidae, Shaeroceridae and Trichoceridae of order Diptera. The occurrence, association, distribution, life cycle and the forensic role of members of above families have been discussed.

KEY WORDS : Diversity, forensic insects, diptera, Western Maharashtra, India.

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INTRODUCTION

Insects have an important role in forensic science for solving problems related to murder mysteries. They provide the information on time of person death, the road used by the curlpit, the region or place of death, distance of dead body thrown in unknown place etc. However, early historical account of forensic insects is almost non-existent. Chinese first reported case of a man dying of wounds inflicted by sickle which was detected with the help of insects in 13th centuary. Later, Europeans used insects in forensic cases (Megnin, 1894). In past, Arutjunov (1963), Leclercq (1969), Nuorteva (1974, 1977), Beyer *et al*. (1980), Smith (1986), Crosskey & Lane (1993), Grassberger & Friedrich (2003), Amendt *et al*. (2004), Williams & Villet (2006), Sukontason *et al*., (2007) etc. worked on forensic insects. Review of literature indicates that there is no any published data on Indian forensic insects. Hence, the present work will add great relevance to the Indian forensic science as baseline data of the region.

MATERIALS AND METHODS

Diversity of forensic dipterous insects were studied by collecting insects from human habitats, on animals of forensic importance (pig, goat, horse etc.) and from actual forensic human cases from Western Maharashtra specially Kolhapur, Sangli and Satara at one week interval by one man one hour search/collection method during the years 2008 to 2011. The flies were also collected with the help of pig liver traps by one week interval. The flies were reared in the laboratory (30±1^{o}C, 70-75% and 12 hr photoperiod) on pis liver / goat liver in cages 25 x 25 x 25 cm for noting life cycles. The insects were also collected directly from dead bodies and or identified which were received for identification. The species were identified by consulting appropriate literature (Barroud, 1934; Lewis, 1973; Crosskey, 1973; Oldroyd, 1973; Pont 1973; Busvine, 1980; Sathe & Awate, 2009 and Sathe *et al*., 2011 etc.) and finally diversity index of the region have been prepared.

RESULTS AND DISCUSSION

Results recorded in table 1 indicates that there were 25 species of dipterous insects prevalent in Western Maharashtra specially from districts Kolhapur, Sangli and Satara. Out of 25 species recorded *E. scanaris, Culicoides* sp., *Piophila niqriceps* and *Trichocera saltator.* Comparatively short life cycles were recorded in mosquitoes, eyeflies, houseflies, biting midges, blue bottles, green bottles and cheese flies showing their potential of reproduction. Other forensic insects recorded in table-1 have relatively long life cycles. All insects were distributed in most of the districts covered from Western Maharashtra. Almost all, 25 species were abundant in mansoon season. Out of which 8 species were found breeding throughout the year from Western Maharashtra.Forensic insects are basically divided into two groups viz., those affecting live persons and those developing upon dead persons. They are also classified as Necrophages, Predators, Parasitoids and Cryptozoids.

Insects can tell the following things related to corpses.

1) When did the death take place i.e. time since dead.
2) Environmental conditions in which the death occurred.
3) Possible cause of death in suspected cases of suicides.
4) Route followed by a crime involved motor vehicle.
5) Whether the death occurred was due to poison of insect origin and
6) Whether the disfiguring of dead body was by insects or by other reasons.

The association and relationship of insects with dead body has also great importance in obtaining appropriate clues for detecting culprit of a crime. The earliest occurring species have shortest and lastly occurring have longest life cycles. In early stage of decomposition of dead body insect develop faster than later stages. Liquefaction of corpses becomes fast in presence of insects and by dissemination of bacteria. Insect

oviposition in flesh takes at specific temperature. Without insects dead body decay very slowly.According to Tomberlin *et al*., (2010) behavioural ecology of an forensic insect have four components namely, evolutionary underpinnings of effective foraging, carrion signaling characteristics, control modes of insect behavioural cascades, and mechanisms of host location and selection.The data collected for forensic purpose should meet the Daubert standard. Two phases of vertebrate decomposition process visualized are precolonization interval and post colonization interval and insect activity periods which refer to exposure, detection, location, colonization and dispersal.Insects were first used in a forensic context in thirteenth century in China (McKnight, 1981). Out of about one million insect species described, 400 species are found on a pig cadaver during its various stages of decay (Payne, 1965). At the beginning of the nineteenth century it was noted that flies were attracted towards corpses at a very early stage of decomposition (Mende, 1829). Orfila and Lesueur (1831) compiled a list of necrophagous insects including order diptera. Krahmer (1837) described the scope and problems associated with using insects for the estimation of the postmortem interval.The first evidence of insect in French courtroom was accepted in 1850 (Bergeret, 1855) when skeletonized remains of a child were found behind a chimney by workman during redecoration. According to Williams & Villet (2006) entomological forensic evidence has been used in Southern Africa for decades but explicity forensic research began in only 26 years ago. Several South African entomologists consulted medico-legal investigations and critically evaluated the forensic cases to South African police and Courts. The presence of blister beetles *Myllabris* spp., *Cyanolytta* spp. and *Decaptoma* spp. in postmortem examination revealed extensive internal bleeding resulting damage to oesophageal and gastric mucosa. In 2000, a murder case was solved by partial evidence by the insects, was the first South African case. In 2005 also, entomological evidence was provided in court in South Africa. Grassberger & Friedrich (2003) studied the blowfly *Chrysomya albiceps* (Wiedemann) (Diptera : Challiphoridae) as a new forensic indicator in Central Europe. They reported that *C. albiceps* was very common and abundant in Southern Europe, afrotropica, oriental and neotropical regions. It was also recorded from Western Maharashtra in India. A carrion succession study with pig cadavers conducted throughout the year 2001 along with six forensic entomological cases in Vienna revealed large numbers of *C. albiceps* larvae. Several traps from various places in lower Australia baited with decaying beef liver yielded large numbers of *C. albiceps* larvae throughout the summer of 2001.

Sukontason *et al*., (2007) discussed 30 cases of Cadavers that had been transferred for forensic entomology investigation from 2000 to 2006. Variable death scenes were determined. The flies obtained from corpses were mostly from the family Calliphoridae which refer to *Crysomya megacephala* (F.), *Chrysomya rufifacies* (Macquart) *Chrysomya villeneuvi* Patton, *Chrysomya nigripes* Aubertin, *Chrysomya bezziana* Villeneuve, *Chrysomya chain* Kurahashi, *Lucilia cuprina* (Wiedmann) and *Hemipyrellia ligurriens* (Wiedmann) and *Synthesiomyia nudiseta* (Wulp), from Piophilidae *Piophila casei* (L.), from Phoridae *Megaselia scalaris* (Loew), from Sarcophagidae *Parasarcophaga ruficornis* (F.) and from Stratiomyiidae *Sargus* sp. were also recorded on corpses in Thailand. *C. cephala* and *C. rufifacies* were the most common species found in the ecologically varied death scene habitats in Thailand while, *C. nigripes* were commonly found in forested areas. However, *S. nudiseta* was associated with corpses found in an indoor death scene. In the present study, from Western Maharashtra, India *C. albiceps* and *C. bezziana* were common. The life cycle from egg to adult in *C. albiceps* was completed within 8.5 to 19 days.at 35^{o}C and 20^{o}C respectively in Central Europe (Grassberger & Friedrich, 2003) while, from India, Western Maharashtra *C. albiceps* completed its life cycle within 10-12 days 30^{o}C and *C. bezziana* within 15-20 days at temperatures between

25°C to 30°C at field conditions. The key insect indicator species group is the blow flies which is used in the majority of death cases in the world. Therefore, more attention is needed on the survey and utility of this group from India for forensic purpose. Insect tell us when the victim died since they are very first organisms to colonize dead animals. Some species within the blow fly group can be found on a dead body within seconds to minutes after the individual died. The insects also tell the origin and the road used for transportation of dead body. Carrion insects can be used to identify areas of trauma on badly decomposed remains when major changes have taken place in the appearance of the soft tissue on the body. The maggots of flies initially enter into the body only through nine openings and through trauma/ wound on the body if any. Skin of dead body becomes main barrier to maggots to get entry into the body to feed on soft tissue. Hence, blow flies prefer places such as face, eyes, nose, mouth, etc. Many times trauma of pelvic region of female dead body attracts for early oviposition but, without trauma this region is used latter.Parasitoid host selection processes are illustrated by Vinson (1976), Sathe & Margaj (2001) etc. Broadly, same processes are observed in forensic models. Visual, audio and chemical clues play an important role in detecting human bodies by flies. The maggots may be used to determine the presence or absence of drugs or toxicants from human dead body tissues. According to Haskell (2002) chitin is a protein like substance that is arranged in a molecular matrix pattern that appears to be ideal for trapping and locking chemical substances within the molecular structure. Insects can provide considerable information in cases of elderly neglect or child abuse. Climatological data such as temperatures, rainfall, fog conditions, cloudcover, sunrise, sunset, etc play very important role in establishing the relation of insects, dead body and time of death. Changing life style of humans create several problems related to criminology and becoming more difficult to solve with the existing sources. Therefore, there is need to initiate basic and applied research in India on forensic entomology, specially, aquatic insects, succession of carrion insects from geographic areas, host parasite interactions, comparison of human virus pig carrion, fly DNA cataloging, human DNA in insects, cataloguing the insects and court cases etc. Techniques for analyzing molecular DNA structures of insects for species identification and the human DNA in insects that feed on humans have recently been developed (Wells & Sperling, 2001), should be used on large extent in forensic entomology.

Table 1
Diversity of dipterous forensic insects from Western Maharashtra

Sr. No.	Species	Family	Life cycle duration	Occurrence	Association	Distribution*
1.	*Simulium* sp. (80 sp. oriental)	Simuliidae	6 weeks	Rich in mountain areas, Western Maharashtra	Man, Domestic animals	KP, SG, ST
	Mosquitoes					
2.	*Anopheles*	Culiidae	1 week	Throughout year Hot weather	Man, D.A.	KP, SG, ST
3.	*Culex*	Culiidae	1 week	1-2 weeks - (Mansoon)	Man, D.A.	KP, SG, ST
4.	*Aedes*	Culiidae	1 week	-- "" -- Throughout year	Man, D.A.	KP, SG, ST
	Drone fly					
5.	*Eristalis tenax*	Syrphidae	1 week	Throughout year	Man/ Vegetation	KP, SG, ST
6.	*Surphus*	Syrphidae	1 week	Throughout year	Man/ Intestinal myiasis man	KP, SG, ST
	House fly					
7.	*Musca domestica*	Muscidae	12-14 days cold region	Throughout year	Man	KP, SG, ST
8.	*M. nebulo*	Muscidae	10-12 days hot region	Throughout year	Man	KP, SG, ST
	Eye fly					
9.	*Siphunculina funicola*	Chioropidae	10-20 days	May & June	Man, Vegetation aphids	KP, SG, ST
	Sand fly					
10.	*Phlebotomus minutes* (All India)	Phlebotomidae	2 months	Throughout year	Man, Kala Azar, 3 days fever tropical	KP, SG, ST
11.	*P. argentipes* (Bengal Assam)			Abundant in Mansoon	ulcer, Dermal	KP, SG, ST
12.	*P. papatasii* (North)			season	leishmaniasis	KP, SG, ST
	Latrine fly					
13.	*Fannia scalaris*	Muscidae	1 month	Throughout year	Man, urinogenital or intestinal myiasis	KP
	Biting midge					
14.	*Culicoides sp.*	Ceratopogonidae	13-80 days	Mansoon	Man, Rodents domestic animals	KP
	Horse fly					
15.	*Tabanus rubidus*	Tabanidae	1-2 months	Mansoon / Throughout year	Man, Horse dogs	KP, SG, ST
	Horse fly					
16.	*T. macer*	Tabanidae	1-2 months	Mansoon / Throughout year	Man, Horse dogs	KP, SG, ST
	Dung fly					
17.	*Leptocera caenosa*	Sphaeroceridae	1-2 months	Throughout year	Man, Horse dogs	KP, SG, ST
18.	*Muscina stabulans*	Muscidae	1 month	Mansoon	Man	KP
	Blow fly (Blue bottle)					
19.	*Calliphora eurythrocephala*	Calliphoridae	11-12 days	Mansoon	Man	KP, SG, ST
	Screw worm					
20.	*Chrysomyia bezziana*	Calliphoridae	15-20 days	Mansoon	Man	KP, SG, ST
21.	*C. albiceps*	Calliphoridae	10-12 days	Mansoon	Man	KP, SG, ST
	Green bottle					
22.	*Lucilia sericata* (Bronze green)	Calliphoridae	8-10 days	Mansoon	Man	KP, SG, ST
	Flesh fly					
23.	*Sacrophaga* sp.	Sarcophagidae	--	Mansoon / Intestinal	Man	KP.
24.	Cheese skipper *Piophila niariceps*	Piophilidae Trichoceridae	1-2 weeks	myliasis Mansoon / throughout year	Man, dead animals, fish protein, cheese)	KP
25.	Winter gnat *Trichocera saltator*		1-2 weeks	Mansoon	Man	KP

**** = KP - Kolhapur, SG - Sangli and ST - Satara***

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