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Species composition and seasonal variation of *Anopheles* mosquitoes in Bihsud district, Nangarhar Afghanistan

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Abstract
Survey for the collection of Mosquitoes at district Bihsud was carried out from August 2017 to July 2018 in three targeted villages i.e. Malikbella, Belandghar and Daman, a total of 10175 Mosquitoes were collected from thirty sleeping rooms to determine *Anopheles* species. *Anopheles* Mosquitoes collection comprised by the species were *A. hyrcanus (15.67%)* as the most abundant mosquito species followed by *A. pulcherimus (15.28%), A. fluviatilis (14.80%), A. stephensi (14.68%), A. superpictus (14.63%,),A. culicifacies (13.53%),* and *A. subpictus (11.38%),* of the total collection. Seasonal variation of the *Anopheles* mosquito's population presented a spring dominant bimodal pattern. The highest density was observed during the month of October 2017. During winter months the population density was very low. A total of 3294 *Anopheles* species were collected at village Daman. *A hyrcanus* was (511, 15.51%) found to be the most abundant species then other species of *Anopheles* genus. While *A. culicifacies* was (429, 13.02%) comparatively least abundant species. A total of 3388 *Anopheles* species were collected in a survey at village Malik Bella. *A.hyrcanus* was (549, 16, 20%) found to be the most abundant species while *A. subpictus* was (390, 11.91) observed to be in a comparatively low abundance. A total of 3493 individuals belonging to various *Anopheles* species were collected in a survey at village Belandghar. *A. fluviatilis* was (530, 11.30%) found to be the most abundant species while *A. subpictus* was (402, 15.17%) the least abundant species.

Keywords: vector, *Anopheles*, bihsud, mosquitoes, malaria

Introduction
Mosquitoes one of the most distributed insects containing important disease vectors that infect humans and animals [9]. Mosquitoes have global distribution; they found trough out the hot and temperate region [2]. Mosquitoes extend their range northwards into the Arctic Circle [3].Mosquitoes belong to Order Dipteral, which are having two pairs of wings [5]. Both sexes' male and female mosquitoes can be simply divided by examination of antenna [5] Both sexes' male and female mosquitoes have different feeding behavior [5]. Males and non-reproductive females fed by on nectar and plant juice [10]. The female of some species that normally feed on blood or sometimes enable of ovarian maturation without blood feeding [7]. The speed for the digestion of the blood meals rely on the climate and a lot of tropical species takes only two and three days but in colder temperature region it can take up to 14 days [12]. The genus *Anopheles* contain five hundred twenty-two species worldwide [16] of which seventy-five are the vectors of malaria below normal condition but twenty-eight species are of major importance amid them [5, 6]. Besides malaria Mosquitoes as number one public enemy inflict human diseases like Dengue fever, Dengue hemorrhagic fever, Filarial fever, Chikungunya, Japanese encephalitis, Rift valley fever virus, Wuchereria Bancroft and West Nile virus [6, 15, 5, 11, 17]. worldwide. According to WHO calculation, there are at minimum 6 malaria vectors in Afghanistan, these are *An. Superpictus, An. Culicifacies, An. Hyrcanus, An. Pulcherrimus, An. Fluviatilis and An. Stephensi* [1]. In Afghanistan there are 24 *Anopheles* species [18], of which only two species, *A. Culicifacies* and *A. Stephensi* have been reported as confirmed malaria vectors [8]. The role of *A. Fluvitialis, A. Pulcherrimus,A. Maculates, A. Stephensi* and *A. Superpictius* is very essential and must be considered [16]. This research conducted to determine the species composition of *Anopheles* mosquitoes in district Bihsud, which will provide a base and make foundation for further studies. It also includes the analysis and identification of the *Anopheles* mosquito species in this part of the country.

Material and Methods
Flit method was used to catch the *Anopheles*mosquito's during Day time. The collection of *Anopheles* mosquitoes was performed for the period of 12 months from August 2017 till July 2018. The collection was from the human houses, mostly from 30 doweling at targeted villages Daman, Malik Bella and Belandghar. The collection was also done on monthly basis. Mosquitoes were collected on hourly basis starting at morning and evening during day time. The white cloth sheet was installed at the four corner of rooms it provides an appropriate cover over the normal area,the lower margins of all the four corners were raised about 8 meter above the ground then a cobra spray was sprayed in the rooms of targeted human doweling at the study area, after few hours Mosquitoes at knock-dawn on white cloth sheets. Specimens were collected after dawn for later use for species analysis and identification in laboratory, then preserved in silica gel.

Study area
This study was carried out to explore the species composition and seasonal variation of *Anopheles* mosquitoes in the different parts of the District Bihsud, Nanganar Province, Afghanistan. This district located on the

east part of Jalalabad city. Geographically position of this district through GIS are; Latitude is 34 27' 13" degrees and longitude is 70 27' 23" degrees. according to the 2010 expected survey, total population of the district is about 130,000 people. The climate of district Bihsud is very [19]. There are 3 spells of rainy season in the 12 months. the spring rainfall in the months of March and April and the other months in which the highest rainfall is in August. But overall the winter rainfall exceeds the summer rainfall [20]. Three targeted village's Malikbella, Belandghar and Daman were selected as focal points for the collection of *Anopheles* mosquitoes in district Bihsud. The selection as well as to fulfill the ecological requirements for such study recommended, the houses selected in each village contained permanent ground water breeding sites, adjacent agricultural fields and vegetation for outdoor resting mosquitoes, cattle sheds and houses suitable for indoor resting collection.

Results

Taxonomic study of *Anopheles* mosquitoes revealed that the whole collection belonged to seven species of subgenus *AnophelesA. stephensi (14.68%), A. culicifacies (13.53%), A. hyrcanus (15.67%) A. fluviatilis (14.80%), A. pulcherimus (15.28%), A. suspects (11.38%),* and *A. superpictus (14.63%).* A gradual increase in population was observed from March (761, 7.48%), the highest number of *Anopheles* mosquitoes were collected during October (1131) while the lowest number were observed in January (503, 4.94%). In village Daman,a total of 3294 *Anopheles* specimens were collected in this survey. *A. hyrcanus* was found to be the most abundant species (511, 15.51%). However, no drastic difference was observed in the number among different number of individuals and the percentage was almost same for all seven species (Table. 1, Fig. 1).

A total of 3388 *Anopheles* species were collected at village MalikBella. *A.hyrcanus* was found comparatively to be the most abundant species (549, 16. 20%) while *A. subpictus* was to be relatively less abundant species (390, 11.91). (Table 2, Fig. 2). Invillage Belandghar a total of 3493 *Anopheles* mosquitoes comprising species were collected in this survey. *A. fluviatilis* was found to be the most abundant species i.e (530) while *A. subpictus* was to be the least abundant species (402) as shown in (Table.3, Fig.3)

Table 1: Species composition of *Anopheles* mosquitoes at village Daman, district Bihsud

Months	*A. stephensi*	*A. hyrcans*	*A. cuilicifacies*	*A. superpictus*	*A. fluviatilis*	*A.pulchermus*	*A.subpectus*	*Total*
Aug	61	39	49	45	55	50	41	340
Sep	43	47	46	43	51	51	29	310
Oct	58	42	30	53	36	60	42	321
Nov	37	37	35	39	50	44	16	258
Dec	28	34	22	40	23	33	19	199
Jan	19	17	28	26	34	23	11	158
Feb	28	19	13	29	18	13	17	137
Mar	35	49	42	35	36	31	38	266
Apr	48	56	29	35	52	51	43	314
May	51	60	46	36	51	48	38	330
Jun	51	48	42	36	46	44	34	301
Jul	51	63	47	45	54	62	38	360
Total	510	511	429	462	506	510	366	3294
%	15.48	15.51	13.02	14.02	15.36	15.48	11.1	32.38

Table 2: Species composition of *Anopheles* mosquito at village MalikBella, district Bihsud.

Months	*A.stephensi*	*A.hyrcans*	*A.cuilicifacies*	*A.superpictus*	*A.fluviatilis*	*A.pulchermus*	*A.subpectus*	*Total*
Aug	51	61	47	50	39	47	27	322
Sep	51	47	49	51	51	50	36	335
Oct	67	49	49	63	63	54	66	411
Nov	34	32	34	26	30	45	44	245
Dec	34	39	43	55	27	52	21	271
Jan	26	44	38	18	25	23	26	200
Feb	16	27	22	34	16	29	32	176
Mar	20	44	35	31	48	21	32	231
Apr	31	49	48	41	36	39	32	276
May	51	49	38	42	65	52	32	329
Jun	75	49	48	55	65	52	32	376
Jul	45	44	47	46	65	52	22	321
Total	501	534	498	512	530	516	402	3493
%	14.34	15.2	14.25	14.65	15.17	14.77	11.50	34.34

Table 3: Species composition and seasonal variation of *Anopheles* mosquito at village Belandghar, district Bihsud

Months	*A.stephensi*	*A.hyrcans*	*A.cuilicifacies*	*A.superpictus*	*A.fluviatilis*	*A.pulchermus*	*A.subpectus*	*Total*
Aug	44	54	49	52	34	48	39	320
Sep	50	47	46	43	51	51	29	317
Oct	41	45	48	82	61	61	61	399
Nov	40	30	34	22	28	46	22	222
Dec	43	48	19	30	41	31	21	233
Jan	30	20	18	25	17	25	15	150

Feb	18	23	15	21	29	30	21	157
Mar	34	46	37	30	40	47	30	264
Apr	40	53	47	65	39	27	38	309
May	51	53	47	38	42	45	39	357
Jun	51	63	47	38	42	45	39	325
JUL	14	57	43	45	45	62	38	335
Total	487	549	450	514	470	528	390	3388
%	14.37	16.20	13.28	15.17	13.87	15.5	11.91	33.31

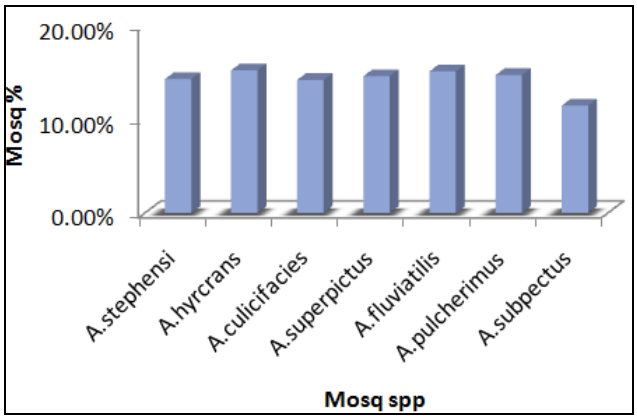

Fig 1: Species wise distribution of *Anopheles* mosquito species at village Daman, district Bihsud.

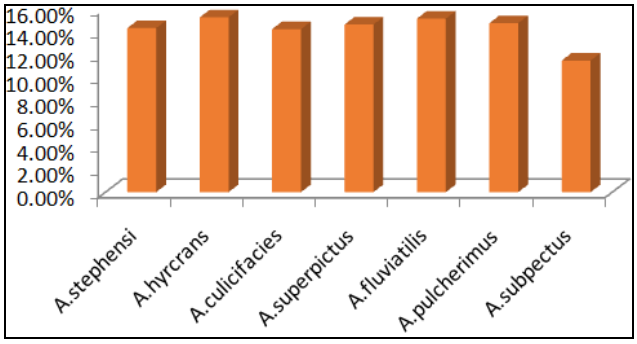

Fig 2: Species wise distribution of *Anopheles* mosquitos at village MalikBella, district Bihsud.

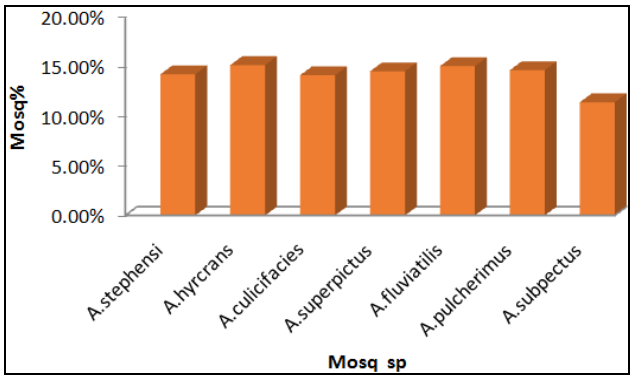

Fig 3: Species wise distribution of *Anopheles* mosquitos at village Belandghar, district Bihsud.

Discussion

The *Anopheles* mosquitoes survey of the district Bihsud yielded a total of 7 species, *A. hyrcanus (15.67%)* as the most abundant mosquito species followed by *pulcherimus (15.28%), A. fluviatilis (14.80%), A. stephensi (14.68%), A. superpictus (14.63%,), A. culicifacies (13.53%),* and *A. subpictus (11.38%).*

There was a slight difference in the breeding habitats of the area as Belandghar and Malikbella are very much wet area with plenty of water supply through rivers, while Daman is comparatively a dry village with small water channels fed from irrigation canals. Moreover, the major crops of the Belandghar and Malikbella were found to be the same but in Daman tobacco and rice was grown extensively during summer. The highest number of mosquitoes belonged to *A. hyrcanus* at the village of Daman and Malikbella as well as at village Belandghar. However, the difference from other species like *A. stephensi* and *A. fluviatilis* was very minute and we could not infer anything about the effect of the changing environment upon the species composition of each village. The effect of change in the habitat on species type of mosquitoes was studied by Rowland and Hewitt [13]. in the southern Afghanistan. They studied the malaria vector species composition relative to the varying environment. They reported that due to the large scale ecological changes there is a shift in species dominance.

Seasonal prevalence of the overall mosquito population in district Bashed showed an overall summer dominant pattern with mosquito population starting rising in spring and then continues till October. The lowest population number of mosquitoes was collected during late winter season when temperature was extremely decreased. Seasonal changes in the mosquito's population at all three villages followed almost similar pattern [14] conducted a study of *Anopheline* vectors in eastern Afghanistan area near to the present study area and found *Anopheline*. They reported eight *Anopheline* species found in the present study from the collection area. According to their findings *A. stephensi* was the most abundant species which comprised 82% of the whole *anopheline* collection, while other *anopheline* species contribution was *A.culicifacies* 5.0%, *A. fluviaitils* 4.3% and *A. pulcherrimus* 2.6%. *A. stephensi* and A. *pulcherrimus* were reported to be most abundant during July–August and *A.culicifacies* and *A. fluviaitils* during September and October. This trend was observed among all the species being the highest for *A. pulcherrimus, A. fluviaitilis* and *A. stephensi*. The present study shows that *A. subpictus* was low abundant species at district Bihsud, while six species show a bimodal monsoon dominant pattern, the possible reason was high humidity of the area because the place was inhabited by crop, rice field and trees.

Conclusion

As for in district Bihsud, the *Anopheles* fauna yielded seven species which included the major malaria vectors like *A. stephensi s, A. culicifacies, A. hyrcanus, A. pulcherrimus, A. fluviatilis* and *A. superpictus.* This research wasconducted during August 2017 to July 2018.This study performed at three villages (Belandghar, Daman and Malikbella)when rice, maize and tobacco were cultured on most area of these villages. Rice fields and connectedditches, ponds, pools (perennial and temporary), This will assist in understanding connection amid landscapemechanism and mosquito

density, which is a main concern in foreseeing the control of land-cover variation on malaria vectorhappening and in determining control strategies for the future. There were some limitations to this s study due to which not a thorough survey could be done to find out the maximum species diversity in the district Bihsud. the land cover and irrigation canals were not analyzed. Also the number of fed, unfed, gravid and non-gravid mosquitoes were not recorded. If the study area and parameters are extended than the data could be more useful for designing research and control strategies.

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