

Notes on Biting Midges of the Genus *Culicoides* from South Korea

—with special reference to unrecorded species and distribution—

Hu-Cha Cho and Chun-Sik Chong

5th Preventive Medicine Unit of the U.S. Army

INTRODUCTION

In Korea, little attention has been given to the study of biting midges of the Genus *Culicoides*. The authors have conducted this survey in conjunction with adult mosquito surveillance throughout South Korea. The survey was performed from 1965 through 1973 to discover unrecored species and their geographical distribution in connection with diseases of man and domestic animals. For many years biting midge data have been collected, but unfortunately all the data of 1969 and some data from other years were destroyed due to the fire which occured at the laboratory of the 5th Preventive Medicine Unit in October 1971. Few specimens were salvaged.

It is hoped that the information obtained will be of use for reference in future endeavors of study in the field of biting midges (*Culicoides*) in Korea.

HISTORICAL REVIEW

Kinoshita (1918) was responsible for the first record of *Culicoides miharai* found in Korea: he described the specimen collected from Mokpo, Korea, in Dobutsugakuzasshi, 1918 (in Japanese). Fujito (1939, 1942) reported the biology of *Culicoides miharai*. To-

kunaga (1943) reported in Medical Entomology, part II, that *C. arakawae* was collected in Korea. Tokunaga (1955) collected one specimen in Sokcho and described it under the name of *C. nipponense*. In the same year Tokunaga recorded one female *C. odibilis* and one female *C. odiatus* collected from Youngsung, Kyongsangpuk-do. Barnett and Toshioka (1951) reported that *C. pulicaris* and *C. schultzei* were present in Korea. Barnett, Toshioka (1951) and Tokunaga (1942) observed the biting habits of *C. arakawae*.

Arnaud (1956) described a new species, *C. koreensis* in the vicinity of Seoul. In the same year, he reported that *C. obsoletus*, *C. circumscriptus*, *C. oxystoma*, *C. peregrinus* and *C. pictimargo* were collected near Kwangnung, Kangwondo.

Bullock and Akiyama (1959) described a new species, *C. reesi*, based on specimens collected from Honshu, Japan and Seoul, Korea but *C. reesi* Bullock and Akiyama (1959) is synonymous with *C. dendrophilus* Amosova (1957). Lien (1969) reported on two species, *C. homotomus* (1-4 September Shintaein, Chollapuk-do) and *C. amamiensis* (18 Sept. Sogwipo, Cheju-do). Wirth (1961) discovered that *C. nipponensis* was misidentified as *C. peregrinus* in Microentomology(1956)

by Arnaud. He also claimed that *C. oxystoma* was synonymous with *C. schultzei*, and that *C. kibunensis* was actually *C. ponkikiri*.

MATERIALS AND METHODS

The midges were collected chiefly with New Jersey light traps equipped with 40 or 60 watt bulbs. Members of the Preventive Medicine Unit selected sites for light traps on appropriate Army compounds. The traps were either wired to the night security systems or set with timing mechanisms. Traps set with security lights were turned on and off daily at dusk and dawn, respectively. Timing devices were less frequently used.

Designated local personnel routinely collected specimens from cyanide killing jars affixed to the traps. Specimens were sent to the Medical Zoology Laboratory where they were sorted and identified, and then the data was tabulated. The total number of each species in each trap collection was counted when numbers were small, but estimated by a sampling method when numbers were large.

Fifty-nine trap stations have been established since 1965 when the biting midges survey project was initiated. Location of the light trap stations and the light trap number are in Fig. 1. The years during which each station was active are given in Table 1. The geographical location of all traps are shown in Fig. 2.

RESULTS AND DISCUSSION

1) Unrecorded species in South Korea

Hitherto 14 species of biting midges of the Genus *Culicoides* were recorded from Korea. The authors collected one new species and 16 unrecorded species of biting midges in South Korea during the period from 1965 to 1973. Therefore, a total of 31 species of *Culicoides*

are now known to present in South Korea. The unrecorded species are as follows:

1. *C. amamiensis ohmorii* Takahashi, 1958
2. *C. clavipalpis* Mukerji, 1931
3. *C. dubius* Arnaud, 1956
4. *C. erairai* Kono and Takahashi, 1940
5. *C. japonicus* Arnaud, 1956
6. *C. laciocola* Arnaud, 1956
7. *C. longidens* Arnaud, 1956
8. *C. matsuzawai* Tokunaga, 1950
9. *C. nagahanai* Tokunaga, 1956
10. *C. okumensis* Arnaud, 1956
11. *C. omogensis* Arnaud, 1956
12. *C. ponkikiri* Kono and Takahashi, 1940
13. *C. sasinense* Tokunaga, 1956
14. *C. sigaensis* Tokunaga, 1937
15. *C. sinanoensis* Tokunaga, 1937
16. *C. toyamaruae* Arnaud, 1956

Detailed data about the unrecorded species are given in the geographical distribution section.

2) Seasonal succession

Table 2 through 8 show the number of biting midges by species and month. Due to the failure of regular collection and the irregular number of light traps, it is difficult to compare the number of biting midges by month. However, biting midges generally appeared from April to October. The peak of population was reached from May through September and the number of biting midges decreased gradually in October. *Culicoides arakawae*, *C. circumscriptus*, *C. homotomus*, *C. nipponense*, *C. odibilis* and *C. pulicaris* appeared earlier than other species. We hope the study of seasonal succession will continue in the future.

3) Geographical distribution

Kinoshita (1918) was the first to report the presence of *Culicoides* in South Korea.

Table 1. Distribution of light trap locations by province by year.

Year	1965	1966	1967	1969	1970	1972	1973
Province	Trap No.	Trap No.	Trap No.	Trap. No.	Trap No.	Trap No.	Trap No.
Seoul	12, 14,	12, 14,	12, 13,	12, 13, 14,			13, 14,
	15, 16,	15, 16,	14, 15,	15, 17,	12, 14,		15, 23,
	17,	17,	16, 17,				17,
KKD	1, 2, 3,	1, 5, 7,	1, 4, 5,	1, 6, 9,	1, 6, 10,	9, 10,	2, 2, 5
	4, 5, 6,	10, 19,	6, 7, 8,	10, 19,	19, 20,	22, 32,	8, 9, 10,
	7, 8, 9,	20, 21,	9, 10,	49, 64,	32, 49,	59,	22, 26,
	10, 18,	25, 28,	11, 19,		59, 64,		27,
	19, 20,	32, 47,	20, 21,				
	21, 24,	49, 59,	32, 47,				
	32, 47,		49, 59,				
49, 59,							
KWD		29, 30,	29, 30,	31, 48, 57,		48,	
	29, 57,	31, 48,	31, 57,	62,	31, 48,	62,	29,
		57,					
CND	34, 35,						
	46,	35, 46,	33, 35,	35, 46,			
			46, 51,				
KPD	36, 37,	36, 37,	36, 37,	36, 37,	36, 37,		
	56,	56,	56,	56,	56,		56,
KND	38, 40,	40, 41,	39, 40,				
	41, 42,	42, 43,	41, 43,			40, 43,	40, 43,
	43,		44,			44,	
CPD			52	52		52	
CND	45		45, 60,				
CJD					61	61	
KKD: Kyongki-Do		KND: Kyongsangnam-Do		KWD: Kangwon-Do			
CPD: Chollapuk-Do		CND: Chungchongnam-Do		CND: Chollanam-Do			
KPD: Kyongsangpuk-Do		CJD: Cheju-Do					

Tokunaga (1943, 1955), Barnett (1951), and Arnaud (1956) also reported the distribution of *Culicoides* species in South Korea.

The South Korea Peninsula is bordered to the north by the DMZ along 38° parallel and to the west by the Yellow Sea. Topographically, Korea is primarily mountainous with

a continuous mountain chain extending down the east with numerous auxilliary mountain chains extending to the southwest. Restriction of light trap stations to military compounds limited the authors' choice of collecting sites. A wider choice of sites would have given a more complete picture of the species distribu-

Fig. 1. Biting midge species collected by geographical

Province	Seoul												Kyongki-Do												
	Location from which collected												Trap number												
Species	Mojin Dong	Yong san	Yong san	Yong san	Hwakok Dong	Unchon Ni	Chonsan Ni	Chaijon Ni	Tongduchon	Bongilchon Ni	Munsan	Munsan	Bobwon Ni	Songsan Ni	Nambang Ni	Kangwha Island	Sungnam	Kwangju	Bupyong	Bupyong	Bupyong	Bupyong	Kwangnung	Unchon Ni	Kimpo
	12	15	16	17	23	2	3	4	5	6	7	49	8	9	10	11	13	14	18	19	20	21	22	1	24
<i>C. amamiensis ohmorii</i>																									●
<i>C. arakawae</i>	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
<i>C. clavipalpis</i>																									●
<i>C. circumscriptus</i>	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●			●		●	●		●	●	
<i>C. dendrophilus</i>															●			▲						▲	
<i>C. dubius</i>															●									●	
<i>C. erairai</i>	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●
<i>C. homotomus</i>	●	●		●	●	●	●		●	●		●	●	●	●		●	●		●	●			●	●
<i>C. japonicus</i>	●	●			●																	●			
<i>C. koreensis</i>	●				●	●	●	●		●			●	●	●		●						●	●	
<i>C. laciocola</i>							●		●					●	●									●	
<i>C. longidens</i>																									
<i>C. matsuzawai</i>															●									●	
<i>C. miharai</i>																									
<i>C. nagahanai</i>	●								●				●	●	●		●	●					●		
<i>C. nipponense</i>	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
<i>C. obsoletus</i>															●										
<i>C. odibilis</i>	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●		●	●		●	●		●	●
<i>C. okumensis</i>																									
<i>C. omogensis</i>																									
<i>C. ponkikiri</i>	●			●	●				●	●			●	●	●		●	●		●			●	●	●
<i>C. pulicaris</i>	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●		●	●		●	●	
<i>C. saninense</i>																									
<i>C. schultzei</i>	●	●	●			●									●			●		●				●	
<i>C. sigaensis</i>	●							●					●	●	●		●	●		●			●		
<i>C. sinanoensis</i>	●					●	●	●	●		●			●	●		●			●			●	●	
<i>C. toyamaruae</i>															●	●									
<i>C. sp.</i>	●	●	●	●	●			●	●	●		●	●	●	●		●	●		●	●	●	●	●	

*1: Chollapuk-do *2: Chollanam-do

Table 2. Species and number of biting midges collected in month of 1965.

Month	MAY		JUN		JUL		OCT		SEP		AUG		Total									
	F	M	F	M	F	M	F	M	F	M	F	M										
No. of traps operated	19	42	26	76	23	65	23	65	16	49	8	16										
No. of coll rec'd																						
Species	F	M	T	F	M	T	F	M	T	F	M	T	F	M	T							
<i>C. arakanae</i>	856	200	1056	2358	618	2976	3315	980	4295	4330	1686	6016	3554	934	4488	837	259	1096	15250	4677	19927	
<i>C. circumscriptus</i>	21	6	27	97	20	117	127	42	169	64	16	80	14	2	16	5	4	9	328	90	418	
<i>C. dubius</i>																						
<i>C. saninense</i>																						
<i>C. evairai</i>				36	13	49	109	20	129	116	6	122	2	2					263	39	302	
<i>C. homotomus</i>	189	68	257	513	115	628	453	150	603	25	14	39	18	3	21	2		2	1200	350	1550	
<i>C. japonicus</i>				22	3	25													22	3	25	
<i>C. korensis</i>	1		1	3	1	4													4	1	5	
<i>C. longidens</i>																						
<i>C. laticola</i>																						
<i>C. matsuzawai</i>																						
<i>C. miharai</i>				2	1	3																
<i>C. nagaharai</i>							71	23	94	352	104	456	117	41	158	2		2	542	163	710	
<i>C. nipponense</i>	806	146	952	1417	392	1809	1793	675	2468	2270	791	3061	1305	446	1751	3		3	7594	2450	10044	
<i>C. obsoletus</i>																						
<i>C. odibitis</i>	30	9	39	38	6	44	32	8	40	54	3	57	112	16	128	8		8	274	42	316	
<i>C. ponkikiri</i>	9		9	13	1	14	49	10	59	39	11	50	14	1	15				124	23	147	
<i>C. pulicaris</i>	52	15	67	265	94	359	315	97	412	265	70	335	210	49	259	122		40	162	1229	365	1594
<i>C. dendrophilus</i>																						
<i>C. schultzei</i>	8	1	9	13	4	17	69	28	97	1079	347	1426	653	206	859	148		46	194	1970	632	2602
<i>C. sigaensis</i>	18	2	20	8	4	12																
<i>C. sinanoensis</i>				2		2	33	8	41	56	2	58	2	2	2					93	10	103
<i>C. sp.*</i>				188	31	219	145	11	156	6	6	6	1	1	2	2		2	342	43	385	
Total	1990	447	2437	4975	1303	6278	6511	2052	8563	8675	3051	11726	6002	1699	7701	1131		349	1480	29284	8901	38185

* This is a new species to be described in a later paper. F:Female, M:Male, T:Total.

Table 3. Species and number of biting midges collected by month in 1966.

Month	APR			MAY			JUN			JUL			AUG			Total		
	F	M	T	F	M	T	F	M	T	F	M	T	F	M	T			
No. of traps operated		6			19			23			16			21				
No. of coll rec'd		24			66			98			75			69				
Species	F	M	T	F	M	T	F	M	T	F	M	T	F	M	T			
<i>C. arakawae</i>	42	20	62	593	153	746	2121	755	2876	1229	348	1577	2282	667	2949	6267	1943	8210
<i>C. circumscriptus</i>	74	14	88	277	64	341	653	166	819	224	35	259	101	22	123	1329	301	1630
<i>C. dubius</i>	1		1	3		3				1		1				5		5
<i>C. saninense</i>																		
<i>C. erairai</i>				8	2	10	873	149	1022	313	69	382	127	22	149	1321	242	1563
<i>C. homotomus</i>	1	2	3	20	7	27	214	39	253	249	90	339	57	20	77	541	158	699
<i>C. japonicus</i>																		
<i>C. koreensis</i>	1		1	16		17										17		18
<i>C. longidens</i>																		
<i>C. laticola</i>							1		1		4	4	18	15	33	23	15	38
<i>C. matsuzawai</i>				2		2				2		2				4		4
<i>C. miharai</i>				1		1			1							2		2
<i>C. nagahanai</i>				10	1	11	5	1	6	113	23	136	24		24	152	25	177
<i>C. nipponense</i>	1	1	2	259	54	313	1817	449	2266	1531	527	2058	2542	1396	3938	6150	2427	8577
<i>C. obsoletus</i>							1		1							1		1
<i>C. odibilis</i>	2		2	280	57	337	224	33	257	66	6	72	31	2	33	603	98	701
<i>C. pontikiri</i>				15	1	16	60	12	72	22	3	25	175	17	192	272	33	305
<i>C. pulicaris</i>				871	189	1060	1689	491	2180	788	239	1027	566	161	727	3914	1081	4995
<i>C. dendrophilus</i>																		
<i>C. schultzei</i>							24	5	29	30	12	42	410	134	544	464	151	615
<i>C. sigaensis</i>				1		1	6	2	8	12	3	15	1	4	5	20	9	29
<i>C. sinanoensis</i>				93	17	110	95	5	100	400	47	447	19	8	27	607	77	684
<i>C. sp.</i>	32	12	44	336	27	363	318	41	359	123	29	152	1		1	810	109	919
Total	154	50	204	2785	573	3358	8102	2148	10250	5107	1431	6338	6354	2468	8822	22502	6670	29172

Table 4. Species and number of biting

Month	APR			MAY			JUN		
No. of traps operated	8			29			22		
No. of coll rec'd	17			92			50		
Species	F	M	T	F	M	T	F	M	T
<i>C. arakawe</i>	22	4	26	1551	541	2092	785	413	1198
<i>C. circumscriptus</i>	11	1	12	424	113	537	443	144	587
<i>C. dubius</i>									
<i>C. saninense</i>									
<i>C. erairai</i>							174	43	217
<i>C. homotomus</i>		1	1	128	37	165	200	99	299
<i>C. japonicus</i>				4		4	2	1	3
<i>C. koreensis</i>				17	7	24			
<i>C. longidens</i>									
<i>C. laticola</i>									
<i>C. matsuzawai</i>									
<i>C. miharai</i>							1		1
<i>C. nagahanai</i>				6		6			
<i>C. nipponense</i>	4		4	1970	610	2580	1244	545	1789
<i>C. obsoletus</i>									
<i>C. odibilis</i>	3		3	709	219	928	27	5	32
<i>C. ponkikiri</i>				99	23	122	99	15	114
<i>C. pulicaris</i>	29	8	37	3072	1150	4222	313	126	439
<i>C. dendrophilus</i>									
<i>C. schultzei</i>				24	10	34	30	9	39
<i>C. sigaensis</i>				9	2	11	3		3
<i>C. sinanoensis</i>				37	17	54	146	25	171
<i>C. sp.</i>				504	60	564	73	13	86
Total	69	14	83	8554	2789	11343	3540	1438	4978

Table 5. Species and number of biting midges collected by month in 1969.

Month	MAY			JUN			JUL			AUG			SEP			OCT			Total			
	F	M	T	F	M	T	F	M	T	F	M	T	F	M	T	F	M	T				
No. of traps operated	8			17			11			10			3			4						
No. of coll rec'd	15			49			39			20			5			13						
Species	F	M	T	F	M	T	F	M	T	F	M	T	F	M	T	F	M	T	F	M	T	
<i>C. arakawae</i>	139	63	202	956	322	1278	630	197	827	523	116	639	73	48	121	123	85	208	2444	831	3275	
<i>C. circumscriptus</i>	52	27	79	255	83	338	27	7	34	11	3	14				3		3	348	120	463	
<i>C. dubius</i>																						
<i>C. saninense</i>							5		5	5		5							10		10	
<i>C. erairai</i>				1504	374	1878	143	32	175	158	21	179							1805	427	2232	
<i>C. homotomus</i>	6	2	8	9		9	5	1	6	7	5	12						1	1	27	9	36
<i>C. japonicus</i>																						
<i>C. koreensis</i>	2		2	1		1	1		1										4		4	
<i>C. longidens</i>																						
<i>C. laticola</i>				4		3	7												4		4	
<i>C. matsuzawai</i>																						
<i>C. miharai</i>																						
<i>C. nagahanai</i>				22		22		1	1	30	10	40							52	11	63	
<i>C. nipponense</i>	1550	482	2032	1425	354	1779	1577	425	2002	1276	221	1497	71	32	103	52	23	75	5951	1537	7488	
<i>C. obsoletus</i>																						
<i>C. odibilis</i>	85	38	123	140	43	183	49	11	60	60	14	74	14	9	23	12	6	18	360	121	481	
<i>C. pontikiri</i>	3		3	8	1	9	3	1	4	4	2	6	2		2				1	1	20	5
<i>C. pulicaris</i>	237	100	337	833	290	1123	311	94	405	759	181	940	50	40	90	27	18	45	2217	723	2940	
<i>C. dendrophilus</i>																						
<i>C. schultzei</i>	3		3	3		3	82	15	97	42	5	47							130	20	150	
<i>C. sigaensis</i>							10		10	7	1	8							17	1	18	
<i>C. sinanoensis</i>	1	1	1	11	2	13	7	1	8	5	2	7							23	6	29	
<i>C. sp.</i>	20	4	24	106	16	122	13	1	14	4	3	7	6	15	6	15	15	15	164	24	188	
Total	2097	717	2814	5285	1488	6773	2863	786	3649	2891	584	3475	216	129	345	232	134	366	13576	3838	17414	

Table 6. Species and number of biting midges collected by month in 1970.

Month operated	APR		MAY		JUN		JUL		AUG		OCT		Total							
	F	M	F	M	F	M	F	M	F	M	F	M								
No. of traps operated	1		10		12		11		9		3									
No. of coll rec'd	1		34		64		65		24		4									
Species	F	M	F	M	F	M	F	M	F	M	F	M	T							
<i>C. arakawae</i>	1	1	128	70	198	628	342	970	1887	834	2721	855	375	1230	87	58	145	3585	1680	5265
<i>C. circumscriptus</i>	1	1	53	39	92	747	275	1022	1233	346	1579	115	39	154	2		2	2150	700	2850
<i>C. dubius</i>									4		4							4		4
<i>C. saninense</i>			1		1	26		26	114	13	127	16	2	18				157	15	172
<i>C. erairai</i>						60	15	75	1326	225	1551	403	112	515				1789	352	2141
<i>C. homotomus</i>	1	1	30	19	49	64	23	87	87	26	113	39	8	47				220	77	297
<i>C. japonicus</i>						2		2	21	9	30							23	9	32
<i>C. koreensis</i>			11	6	17													11	6	17
<i>C. longidens</i>			2		2	19		19										21		21
<i>C. laticola</i>																				
<i>C. matsuzawai</i>																				
<i>C. miharai</i>						9		9										9		9
<i>C. nagahanai</i>						5	1	6	5	1	6							10	2	12
<i>C. nipponense</i>			567	276	843	3886	1204	5090	14143	5609	19752	3845	1719	5564	1	6	7	22442	8814	31256
<i>C. obsoletus</i>						2		2										2		2
<i>C. odibilis</i>			67	22	89	188	68	256	285	89	374	32	14	46	6	1	7	578	194	772
<i>C. ponkikiri</i>			2		2	178	60	238	34	2	36	20	7	27	1	1	2	235	170	305
<i>C. pulicaris</i>			295	116	411	2521	1022	3543	4762	1900	6662	1805	1173	2978	94	37	131	9477	4248	13725
<i>C. dendrophilus</i>																				
<i>C. schultzei</i>						2		2	3	1	4							5	1	6
<i>C. sigaensis</i>									5	1	6	46	8	54	1		1	52	9	61
<i>C. sinoensis</i>						16	3	19	4	4								20	3	23
<i>C. sp.</i>			11	4	15	241	26	267	89	14	103	8	8	13			13	362	44	406
Total	3	3	1167	552	1719	8592	3039	11631	24002	9070	33072	7184	3457	10641	205	103	308	41152	16221	57373

Table 7. Species and number of biting midges

Month	APR			MAY			JUN		
	1			10			6		
No. of traps operated									
No. of coll rec'd	17			34			39		
Species	F	M	T	F	M	T	F	M	T
<i>C. amamiensis ohmorii</i>							58	11	69
<i>C. arakawae</i>	2		2	175	51	226	1830	577	2407
<i>C. clevipalpis</i>							2		2
<i>C. circumscriptus</i>	2		2	17	7	24	148	22	170
<i>C. dendrophilus</i>									
<i>C. dubius</i>							13	1	14
<i>C. erairai</i>				7	1	8	206	42	248
<i>C. homotomus</i>				3	1	4			
<i>C. japonicus</i>							1		1
<i>C. koreensis</i>	2	1	3	4	1	5	7	3	10
<i>C. laciocola</i>				1	1	2	9	2	11
<i>C. longidens</i>									
<i>C. matsuzawai</i>									
<i>C. miharai</i>									
<i>C. nagahanai</i>		1	1						
<i>C. nipponense</i>	1		1	799	139	938	700	183	883
<i>C. odibilis</i>				68	213	281	1200	311	1511
<i>C. okumensis</i>									
<i>C. omogensis</i>									
<i>C. ponkikiri</i>				1007	38	1045	726	125	851
<i>C. pulicaris</i>	1		1	139	172	311	1610	259	1869
<i>C. saninense</i>				1		1	135	7	142
<i>C. schultzei</i>									
<i>C. sigaensis</i>				468	94	562	448	102	550
<i>C. sinanoensis</i>				140	347	487	3002	714	3716
<i>C. toyamaruae</i>				2		2	1		1
<i>C. sp.</i>				14	1	15	29	7	36
Total	8	2	10	2843	1066	3909	10125	2366	12491

collected in month of 1972.

JUL			AUG			SEP			OCT			Total		
5			5			3			3					
38			23			14			11					
F	M	T	F	M	T	F	M	T	F	M	T	F	M	T
45	5	50	99	18	117	22	6	28	1		1	225	40	265
1948	779	2727	1512	484	1996	390	164	554	128	41	169	5985	2096	8081
2		2	16		16	4		4	1		1	25		25
33	8	41	1		1	5		5	1		1	208	37	245
20	8	28	28	2	30							61	11	72
62	15	77	12	1	13	6		6	2		2	295	59	354
3		3				3		3				9	1	10
												1		1
												13	5	18
30	6	36				1		1	1		1	42	9	51
4		4	14	3	17							17	4	21
3		3	2		2							5	1	6
275	76	351	642	124	766	144	39	183	19	5	24	2580	536	3146
580	203	783	99	35	134	126	39	165	37	9	46	2110	810	2920
2		2										2		2
322	77	399	177	37	214	22	2	24	7		7	2201	279	2540
919	178	1097	462	78	480	87	23	110	121	13	134	3279	723	4002
41	7	48										177	14	191
			1		1							1		1
596	92	688	306	52	358	106	18	124	94	26	120	2018	384	2402
1112	272	1384	188	38	226	2		2	6		6	4450	1371	5821
2		2										5		5
12	3	15	2		2	6	1	7				63	12	75
6009	1729	7738	3501	872	4373	924	292	1216	418	94	512	23833	6421	30454

Table 8. Species and number of biting

Month	APR			MAY			JUN		
No. of traps operated	16			16			16		
No. of coll rec'd	60			84			101		
Species	F	M	T	F	M	T	F	M	T
<i>C. amamiensis ohmorii</i>							9	1	10
<i>C. arakawae</i>	162	95	257	2494	1303	3797	3176	1214	4390
<i>C. clavipalpis</i>									
<i>C. circumscriptus</i>	37	35	72	186	72	258	740	271	1011
<i>C. dendrophilus</i>				1		1	1		1
<i>C. dubius</i>	1		1				7	3	10
<i>C. erairai</i>							618	200	818
<i>C. homotomus</i>	3		3	38	11	49	91	36	127
<i>C. japonicus</i>				1		1	1		1
<i>C. koreensis</i>	33	14	47	56	10	66			
<i>C. laciocola</i>				16	10	26	2		2
<i>C. longidens</i>									
<i>C. matsuzawai</i>									
<i>C. miharai</i>									
<i>C. nagahanai</i>	4		4				8	2	10
<i>C. nipponense</i>	2	1	3	526	211	737	2503	868	3371
<i>C. odibilis</i>	23	4	27	1629	1155	2784	357	99	456
<i>C. okumensis</i>				1		1			
<i>C. omogensis</i>				1		1			
<i>C. ponkikiri</i>	4		4	200	144	344	508	151	659
<i>C. pulicaris</i>	54	15	69	1523	801	2324	1715	526	2241
<i>C. saninense</i>							1		1
<i>C. schultzei</i>				1		1			
<i>C. sigaensis</i>	6	3	9	98	23	121	40	4	44
<i>C. sinanoensis</i>	3		3	31	17	48	21	2	23
<i>C. toyamaruae</i>							1		1
<i>C. sp.</i>	13	5	18	166	41	207	1127	197	1324
Total	345	172	517	6968	3798	10766	10926	3574	14500

midges collected in month of 1973.

JUL			AUG			SEP			OCT			Total		
11			13			7			4					
84			78			43			20					
F	M	T	F	M	T	F	M	T	F	M	T	F	M	T
7		7												
3623	937	4560	1533	625	2158	753	251	1004	162	72	234	11903	4497	16400
2		2										2		2
2254	38	292	57	10	67	15	2	17				1289	428	1717
												2		2
6		6										14	3	17
1373	316	1689	104	7	111	3	1	4				2098	524	2622
74	10	84	9		9	3		3	2		2	220	57	277
												2		2
												89	24	113
1		1	1		1							20	10	30
			1		1							1		1
1		1	1		1	8		8				22	2	24
3556	589	4415	1859	776	1635	879	361	1240	19		19	9344	3076	12420
163	31	194	83	5	88	92	11	103	3		3	2350	1305	3655
												1		1
												1		1
191	32	223	111	7	118	72	8	80	2		2	1088	342	1430
1561	421	1982	691	191	882	311	100	411	198	40	238	6053	2094	8147
			1		1							2		2
3	1	4	6		6	3	1	4				13	2	15
32	12	44	10	1	11				3	1	4	189	44	233
14		14										69	19	88
												1		1
143	12	155	51	6	57	18		18				1518	261	1779
11004	2669	13673	4518	1628	6146	2157	735	2892	389	113	502	36307	12639	44996

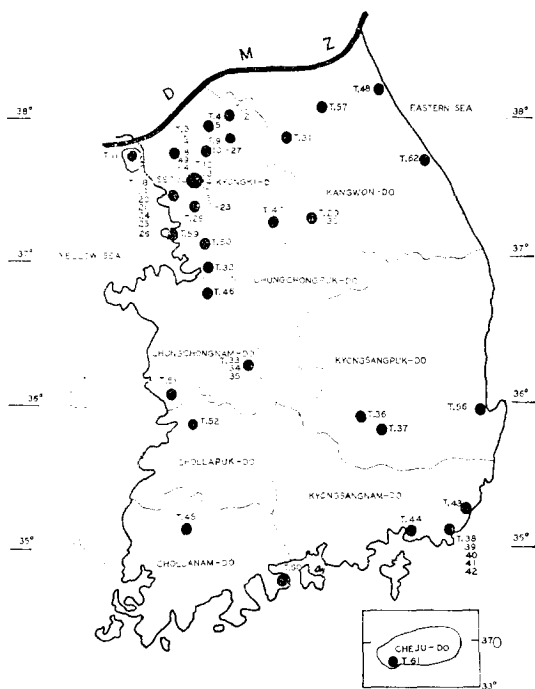


Fig. 2. Distribution of light trap stations throughout South Korea.

tion and the influences affecting it. Future research will attempt to correlate midge distribution with geographical and climatological factors.

It has been reported in foreign countries that *Culicoides* sp. are the vectors of various diseases. It is very important to find out their distribution for the prevention of those diseases and the control of biting midges. Fig. 1 shows the species according to location.

4) Comments on individual species

Although the preceding tables do not yield statistically significant population density data on the species level, the general population density of biting midges. In the following, comments are made on the species collected.

Culicoides amamiensis amamiensis Tokunaga

Culicoides amamiensis Tokunaga, 1937, Tenthredo 1(3): 325-327 (Ryukyu Islands)

Culicoides amamiensis Arnaud, 1956, Microent. 21(3): 90-91

Culicoides amamiensis Lien, 1969, WHO VBC, 175:17

DISTRIBUTION: Korea, Japan, Manchuria, Taiwan, Indonesia, India, New Britain, New Ireland,

Remarks: Lien (1969) collected one male and four females on Cheju Island but none was collected during our survey period. See Map 1.

Culicoides amamiensis ohmorii Takahashi

Culicoides amamiensis ohmorii Takahashi, 1958, Acta Medica et Biologica 6(2): 113-115 Fig. 1 Phot. 1.2. (Niigata, Japan)

Culicoides amamiensis Tokunaga, 1937, Tenthredo 1(3): 325-327

Culicoides amamiensis Arnaud, 1956, Microent. 21(3): 90-91

DISTRIBUTION: Korea, Japan.

NEW KOREA RECORDS: Kwangnung, Kyongki-do, Jun-Oct. 1972, 30♂ 155♀; Jun-Jul. 1973, 1♂ 16♀; Sorak Mt. Kangwon-do, Jun-Jul. 1972, 10♂ 70♀.

Remarks: We collected this species in forested and mountainous areas. See Map 2.

Culicoides arakawae (Arakawa)

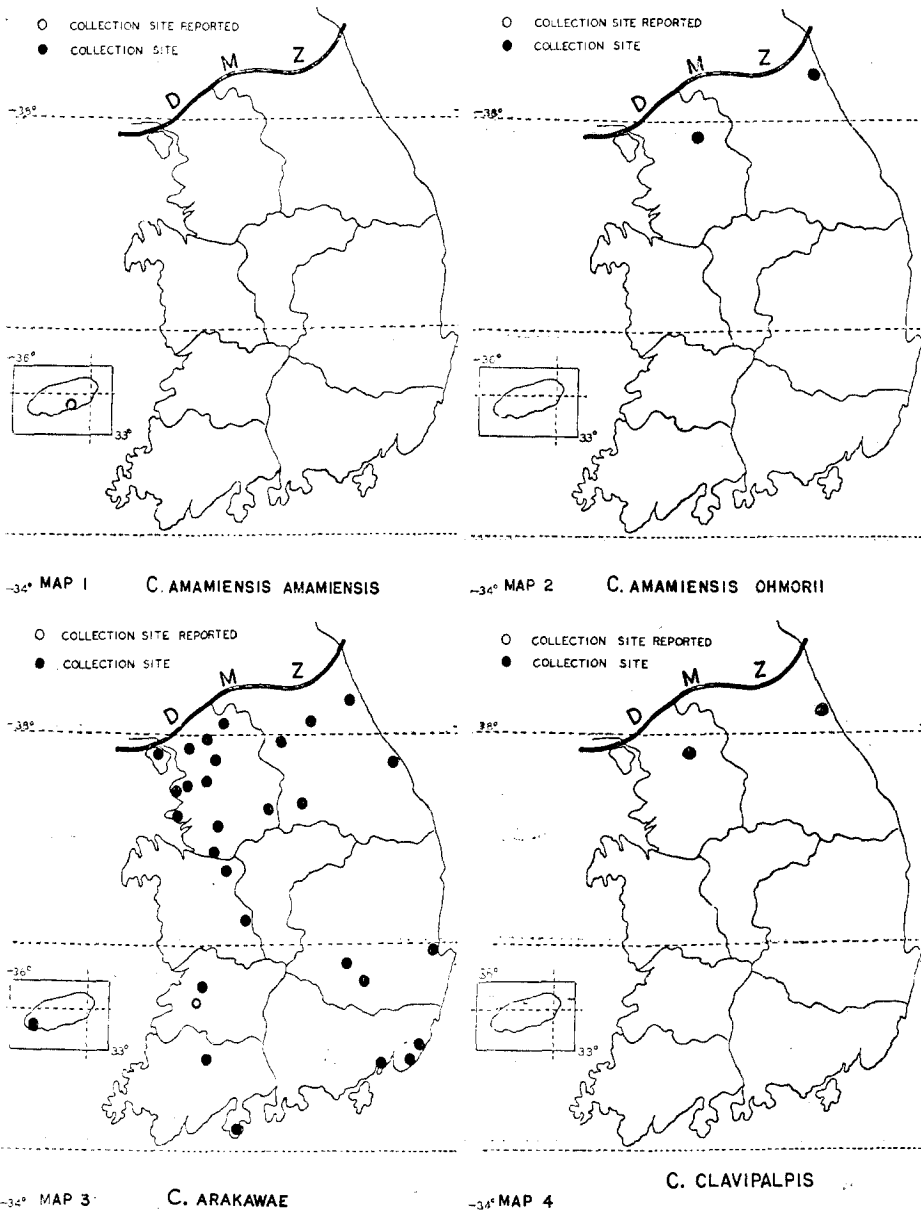
Culicoides arakawae Arakawa, 1910, Insect World, 14:411-414 (Japan)

Culicoides sugimotoensis Shiraki, 1913, Taiwan Sotokufu Nojishikenjo Tokubetsu Hokoku 8:287-290

Culicoides arakawae Barnett and Tosioka, 1951, The Bloodsucking Insects, Mites and Ticks of Korea and Their Relation to disease transmission. page 9.

Culicoides arakawae Arnaud, 1956, Micro-

DISTRIBUTION OF CULICOIDES



ent. 21 (3):92-95

DISTRIBUTION: Korea, Japan, Manchuria, Taiwan, Ussuri, Indonesia, New Guinea, India.

Remarks: This species is very common and widely spread throughout South Korea. See Map 3.

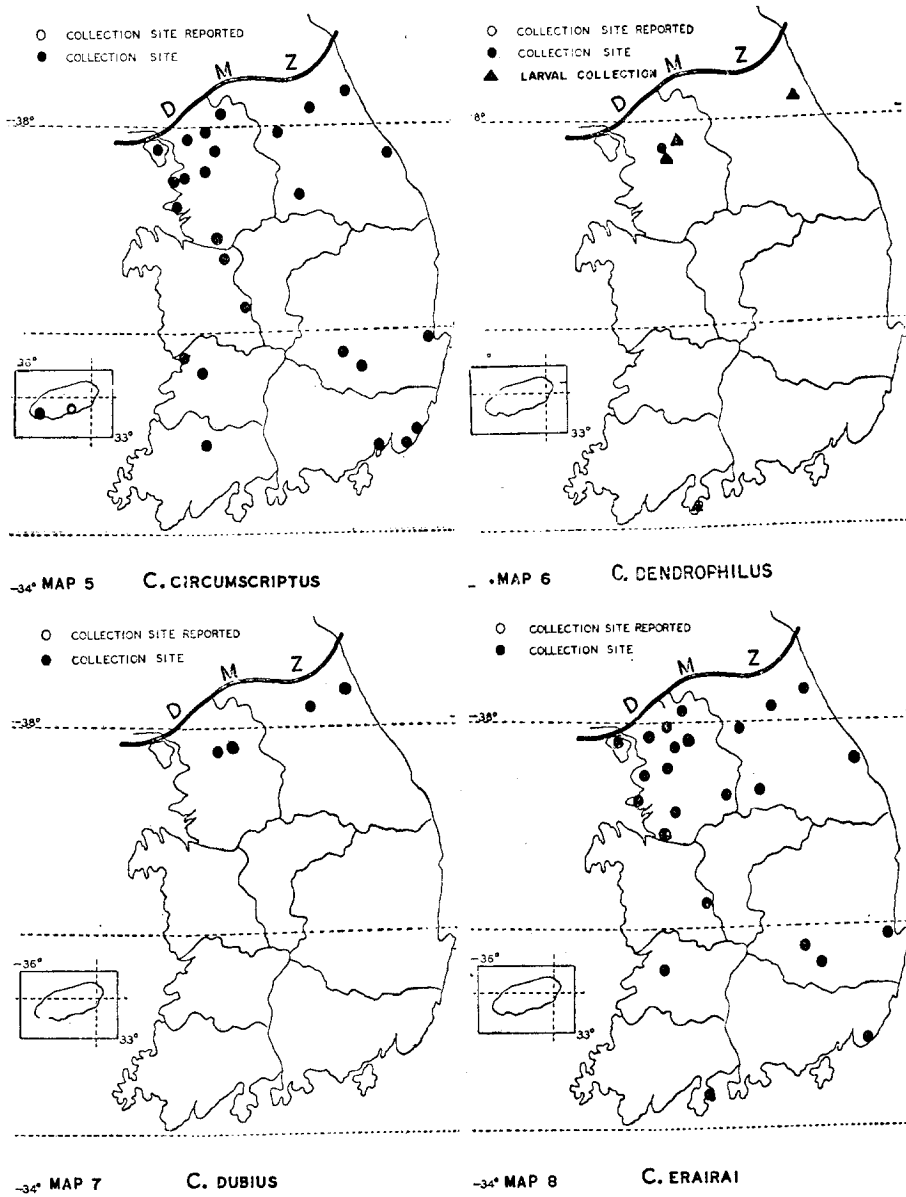
Culicoides clavipalpis Mukerji

Culicoides clavipalpis Mukerji, 1931, Indian J. Med. Res. 18:1052-1054 (India)

Culicoides clavipalpis McDonald and Lu, 1972, J. Med. Ent. 9 (5):403

DISTRIBUTION: Korea, Taiwan, India, Thailand, Philippines.

DISTRIBUTION OF CULICOIDES



NEW KOREA RECORDS: Kwangnung, Kyongki-do, 24-30 Jul, 1972, 1♀; Aug. 1972, 16♀; 1-4 Sep. 1972, 4♀; 1-10 Oct. 1972, 1♀; 1-9 Jul. 1973 1♀; 24-31 Jul, 1973, 1♀; Sorak Mt. Kangwon-do, 26-29 Jun. 1972, 2♀; 9-11 Jul. 1972, 1♀.

Remarks: we collected this species in fore-

sted and mountainous areas. See Map 4.

Culicoides circumscriptus Kieffer

Culicoides circumscriptus Kieffer, 1918. Annales Historico-Naturales Musei Nationalis Hungarici, 16:49 (Tunis)

Culicoides circumscriptus Arnaud, 1956. Microent. 21(3):97-100

DISTRIBUTION: Korea, Japan, Ussuri, China, Europe, Asia minor, Africa.

Remarks: This species is very common and widely spread throughout South Korea. See Map 5.

Culicoides dendrophilus Amosova

Culicoides dendrophilus Amosova, 1957, Entomol. Obozr. 36: 240-241 (Ussuri)

Culicoides reesi Bullock et Akiyama, 1959, Sani. Zool. 10(1):23-26

DISTRIBUTION: Korea, Ussuri, Japan.

Remarks: Bullock and Akiyama (1959) reported that this species could not be collected by light traps but we collected two females(2) by light traps in June and July of 1973. Most of larvae this species were collected from tree holes of *Quercus acutissima corruthers* on October 21, 1969, October 20, 1971, and in May and June 1973 in Kwangnung, Kyongki-do, on November 4, 1971 on Sorak Mountain, Kangwon-do, in May and June 1973 on Namhan castle, Sungnam, Kyongki-do, and on June 6, 1972, Sunchon, Chollanam-do. All adult specimens examined were reared in the Laboratory of the 5th Preventive Medicine Unit. Species of mosquito larvae collected with the *C. dendrophilus* larvae were *Aedes flavopictus*, *A. galloisi*, *A. albopictus*, *Tripteroides bambusa*, and *Toxorhynchites christophi*. See Map 6.

Culicoides dubius Arnaud

Culicoides dubius Arnaud, 1956, Microent. 21(3): 100-102 (Japan)

Culicoides dubius McDonald and Lu, 1972, J. Med. Ent. 9(5): 403-404

DISTRIBUTION: Korea, Japan, Taiwan.

NEW KOREA RECORDS: Kwandae Ri Kangwon-do, Apr-July 1966, 5♀; Nambang-Ni, Kyongki-do, July 1970, 4♀; Kwangnung, Kyongki-do, Jun-Aug. 1972, 2♂ 33♀; Apr-

July 1973, 1♂ 12♀; Uijongbu, Kyongki-do, July 1973, 2♀; Sorak Mt. Kangwon-do, Jun-July 1972, 9♂ 28♀.

Remarks: This species which is widely spread in central South Korea and supposed to occur in North Korea. See Map 7.

Culicoides erairai Kono and Takahasi

Culicoides erairai Kono and Takahasi, 1940, Insecta Matsumurana. 14: 69-71 (Japan)

Culicoides erairai Arnaud, 1956, Microent. 21(3):103-105

DISTRIBUTION: Korea, Japan, Manchuria, Siberia.

NEW KOREA RECORDS: Seoul, Kyongki-do (Unchon Ni, Chonsan Ni, Chaijon Ni, Tongduchon, Bongilchon Ni, Munsan, Songsan Ni, Nambang Ni, Kangwha Isd. Uijongbu, Bupyong, Pyongtaek, Yoju, Csan, Namyang, Muwon Ni,) Kangwon-do (Wonju, Chunchon, Sorak Mt., Kwandae Ri), Kyongsangpuk-do (Pohang, Taegu, Waegwan), Pusan, Kyongsangnam-do, Kimje, Chollapuk do, Sunchon, Chollanam-do, May-Sep. 1965-1973 Many ♂♀.

Remarks: This species is abundant and widely spread throughout South Korea. See Map 8.

Culicoides homotomus Kieffer

Culicoides homotomus Kieffer, 1922 (1921), Annales de la Societe Linneenne, 68:158. (Taiwan)

Culicoides homotomus Arnaud, 1956, Microent. 21(3):105-106

Culicoides homotomus Lien, 1969, WHO VBC 175:16

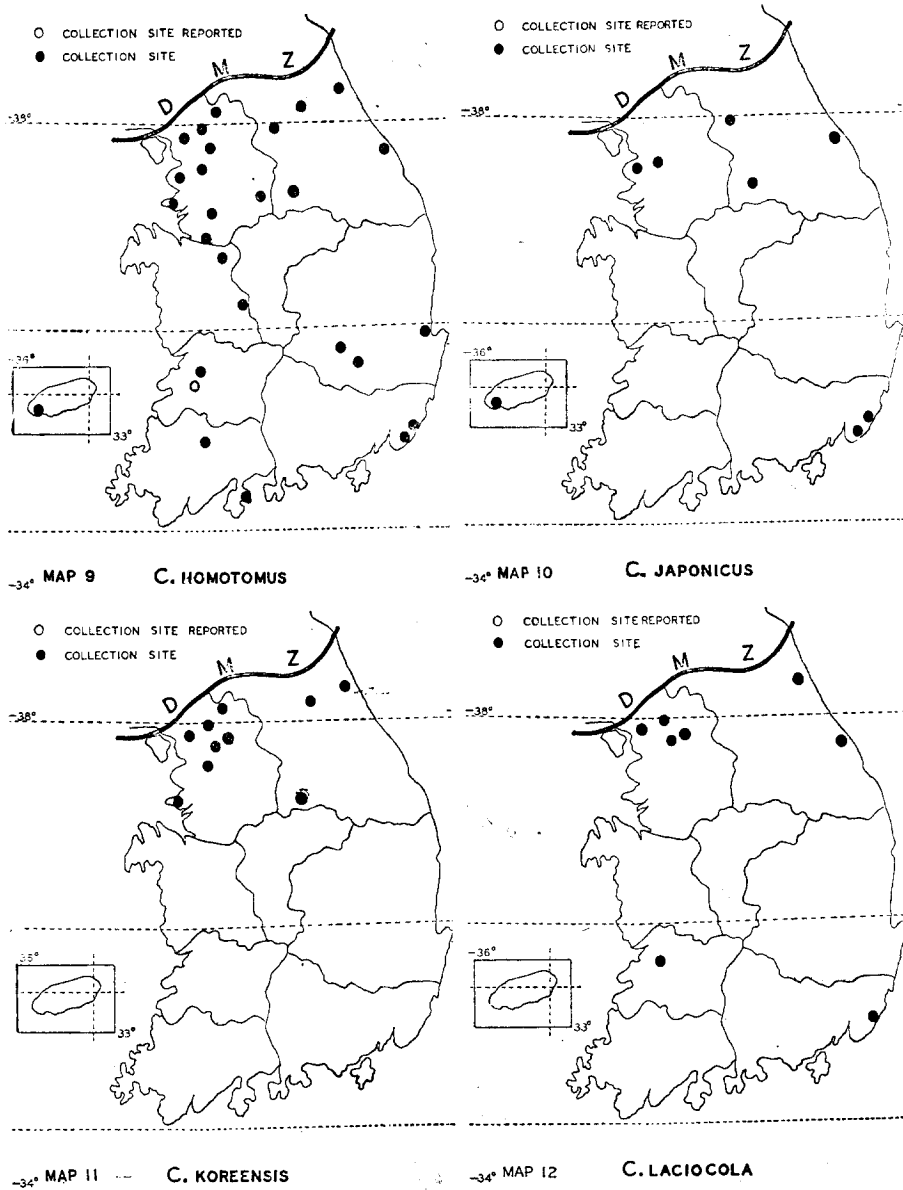
DISTRIBUTION: Korea, Japan, Taiwan.

Remarks: This species is common and widely spread throughout South Korea. See Map 9.

Culicoides japonicus Arnaud

Culicoides japonicus Arnaud, 1956, Micro-

DISTRIBUTION OF CULICOIDES



ent. 21(3):106-107 (Japan)

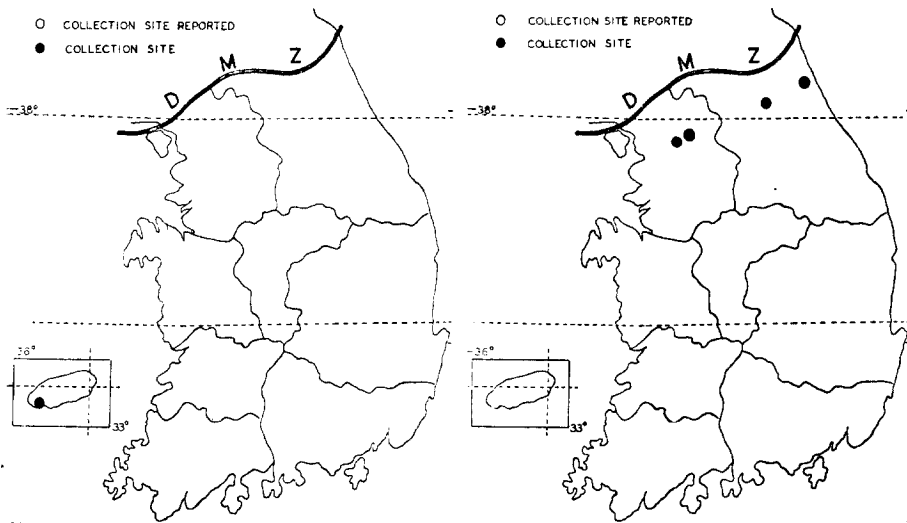
DISTRIBUTION: Korea, Japan.

NEW KOREA RECORDS: Mojin-dong, Seoul, Jun. 1965 3♂ 14♀; Bupyong, Kyongki-do, Jun. 1965, 8♀; Pusan, Kyongsangnamdo, 15 May 1967, 2♀; 10 May 1967, 2♀. 10 Jun. 1967, 1♀; Wonju, Kangwon-do, Jun. 1967,

1♂ 1♀: Bupycng, Kyongki-do, 13 Jun. 1970, 1♀; Nambang-Ni Kyongki-do, Jul. 1970, 9♂ 21♀; Mosulpo, Cheju-do, 21 Jun. 1970, 1♀; Kangnung, Kangwon-do, 21-27 Jun. 1972 1♀; Hwakok dong, Seoul, 4-8 Jun. 1973 1♀; Yongsan, Seoul, 11-16 May 1973 1♀.

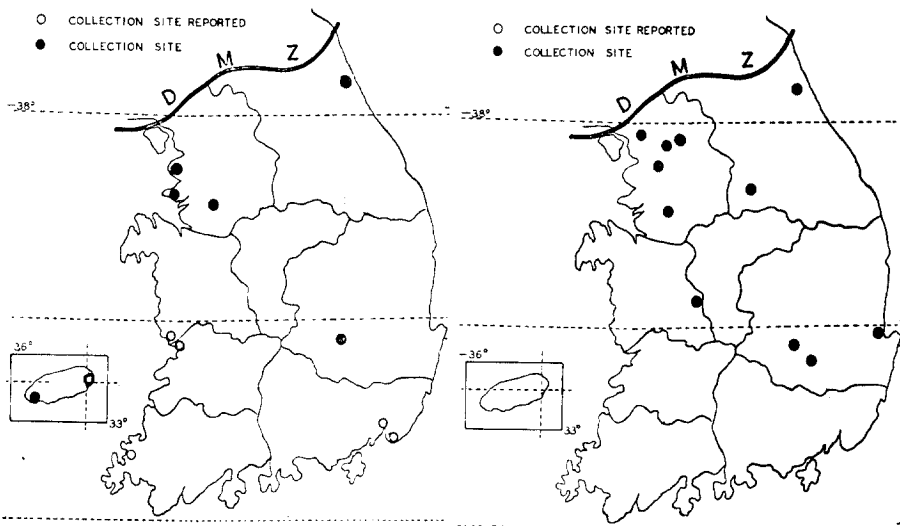
Remarks: This species is rare and was

DISTRIBUTION OF CULICOIDES



MAP 13 C. LONGIDENS

MAP 14 C. MATSUZAWAI



MAP 15 C. MIHARAI

MAP 16 C. NAGAHANAE

collected only in central and Southern parts of the peninsula, also on Cheju-do. See Map 10.

Culicoides koreensis Arnaud

Culicoides koreensis Arnaud, 1956, Microent. 21(3):109-110 (Korea)

Culicoides palustris Amosova, 1957, Ento-

mol. Obozr. 36: 247

DISTRIBUTION: Korea, Ussuri.

Remarks: This species is rare and was collected only in central Korea, Kyongki-do, and Kangwon-do. This species is believed to exist in North Korea too, possibly introduced there from Ussuri. See Map 11.

Culicoides laciocola Arnaud

Culicoides laciocola Arnaud, 1956, Microent. 21(3): 110-111 (Japan)

DISTRIBUTION: Korea, Japan.

NEW KOREA RECORDS: Tongduchon, Kyonki-do, Jun. 1956 1♀; Nambang-Ni, Kyongki-do, 24 Jun. 1966, 4♀; 4-12 Jun. 1969, 3♂ 3♀; Haeundae Pusan, Koyngsangnam-do Aug. 1966, 15♂ 18♀; Kimje, Chollapuk-do, Jun. 1959, 1♀; Sorak Mt. Kangwon-do in May, Jun., July and Oct. of 1972, 7♂ 27♀; Kangnung, Kangwon-do, Jun-July 1972, 1♂ 13♀; Kawangnung, Kyongki-do, 1-7 Jun. 1972, 1♂ 1♀; 18-30 Sept. 1972, 1♀.

Remarks: This species is rare and was collected only in Nambang Ni, Tongduchon, Haeundae, Kangnung, Sorak Mt. and Kimje. See Map 12.

Culicoides longidens Arnaud

Culicoides longidens Arnaud, 1956, Microent. 21(3):111-112 (Ryukyu Islands)

DISTRIBUTION: Korea, Japan.

NEW KOREA RECORD: Mosulpo, Cheju-do, 5-21 May 1970, 2♀; Jun. 1970, 19♀.

Remarks: Arnaud (1955) collected one female on Feb., 12 1955 in Okinawa, and described it as a new species. Twenty-one (21) female specimens were collected on Cheju-do. This species is generally associated with the Oriental region. See Map 13.

Culicoides matsuzawai Tokunaga

Culicoides matsuzawai Tokunaga, 1950, San. Zool. 1(3): 64-65 (Japan)

Culicoides matsuzawai Arnaud, 1956, Microent. 21(3):112-113

Culicoides matsuzawai McDonald and Lu, 1972 J. Med. Ent. 9(5):408-409

DISTRIBUTION: Korea, Japan, Taiwan.

NEW KOREA RECORDS: Kwandae Ri, Kangwon-do, Aug. 1965, 1♂ 6♀; 30 July 1966

2♀; Nambang Ni, Kyongki-do, May 1966, 2♀; Kwangnung, Kyongki-do, July 1972, 2♀; Aug 1972, 3♂ 14♀; Sorak Mt. Kangwon-do, July 1973, 2♀.

Remarks: This species is very rare and was collected in central South Korea. See Map 14.

Culicoides miharai Kinoshita

Culicoides miharai Kinoshita, 1938, Dobutsugakuzassi, 30 (354):155-160 (Mokpo, Korea)

Culicoides miharai Barnett and Toshioka, 1951, The bloodsucking Insects, mites and Ticks of Korea and Their Relation to Disease transmission, page 10

Culicoides miharai Arnaud, 1956, Microent. 21(3):114-115

DISTRIBUTION: Korea.

Remarks: According to the records, this species is very dense in the Mokpo area and the islands near Mokpo. It breeds in coastal areas. During the survey period, this species was collected in Cheju-do, Namyang, Incheon and Waegwan. Cheju-do, Namyang and Incheon are coastal areas but Waegwan is located inland. It is very difficult to explain occurrence of this species in Waegwan because there are no prior records of collection inland. It is not clear whether this species actually occurs inland or if the specimen collected from Waegwan was carried from coastal areas by wind or other means. Further study of distribution may clarify this point. See Map 15.

Culicoides nagahanai Tokunaga

Culicoides nagahanai Tokunaga, 1956, Sept. Saikyo Univ. Sci. Rept. Agr. 8:119-121 (Japan)

Culicoides mihensis Arnaud, 1956, Nov. Microent. 21(3): 115-116

Culicoides mihensis McDonald and Lu, 1972, J. Med. Ent. 9(5):409

DISTRIBUTION: Korea, Japan, Taiwan.

NEW KOREA RECORDS: Mojindong, Seoul, May-Oct. 1965-1970, Many ♂ ♀; Kyongki-do (Nambang Ni, May-Sept. 1966-1973, 3♂ 24♀; Bongilchon, Jun.-Aug. 1969-1970, 1♂ 10♀; Kwangju, Jun.-Aug. 1969, 10♂ 36♀; Jun. 1973 6♀; Bobwon Ni, Jun. 1973 1♀; Uijongbu, Apr. 1973, 2♀; Songsan Ni, Aug. 1972, 2♀; Jun. 1973 1♀; Kwangnung, Jul. 1972, 2♀; Apr. 1973, 2♀; Osan, Jul.-Oct. 1965, 2♂ 5♀), Kyongsangpuk-do (Taegu, Jul.-Oct. 1965-1969, Many ♂ ♀; Waegwan, Jul. 1966, 6♀; Jun. 1970, 1♂; Pohang, Jun. 1970, 4♀), Kangwon-do (Wonju, Aug. 1966, 17♀; Sorak Mt. 1♀).

Remarks: It is rare but widely distributed in central and extreme eastern part. See Map 16.

Culicoides nipponense Tokunaga

Culicoides nipponense Tokunaga, 1955, Sci. Rep. Saikyo Univ. Agr. 7: 4-5 (Japan, Korea)

Culicoides peregrinus Arnaud, 1956, Microent. 21(3): 122-123 (Misidentified)

Culicoides nipponensis Wirth and Hurbert, 1961, Pacific Insects, 3(1):18

Culicoides nipponence Lien, 1969, WHO, VBC, 175:16

DISTRIBUTION: Korea, Japan, Taiwan.

Remarks: This species is very common and widely spread throughout South Korea. Lien (1969) collected it from Shintain, Chollapuk-do and Sogwipo, Cheju-do. He reported this as the first record of this species in Korea. However, it had been recorded by Tokunaga in 1955. See Map 17.

Culicoides obsoletus (Meigen)

Culicoides obsoletus Meigen, 1818, Systematische Beschreibung der Bekannten Europäischen Zweifflugeligen Insekten. Erster Theil, (Europe)

Culicoides obsoletus Arnaud, 1956, Microent.

21(3): 116-118

DISTRIBUTION: Korea, Japan, Saghalien, Manchuria, North America, Siberia, Europe.

Remarks: Found only in two areas in June 1970; two(2) female specimens were collected in Uijongbu, Kyongdi-do and one female specimen from Sokcho, Kangwon-do. See Map 18.

Culicoides odiatus Austen

Culicoides odiatus Austen, 1921, Bull. Ent. Res., 12:112 (Palestine)

Culicoides odiatus Tokunaga, 1955, Saikyo Univ. Sci. Rept. Agr. 41(7):3-4

DISTRIBUTION: Korea, Palestine.

Remarks: Tokunaga (1955) collected one(1) female at Youngsung, Kyongsangpuk-do but this species was not collected during our survey period. See Map 19

Culicoides odibilis Austen

Culicoides odibilis Austen, 1921, Bull. Ent. Res., 12:114 (Palestine)

Culicoides odibilis Tokunaga, 1955, Sci. Rep. Saikyo Univ. Agr. 7:3-4

DISTRIBUTION: Korea, Japan, Ussuri.

Remarks: This species is common and widely spread throughout South Korea except Cheju-do. See Map 20.

Culicoides okumensis Arnaud

Culicoides okumensis Arnaud, 1956, Microent. 21(3): 119 (Ryukyu Islands)

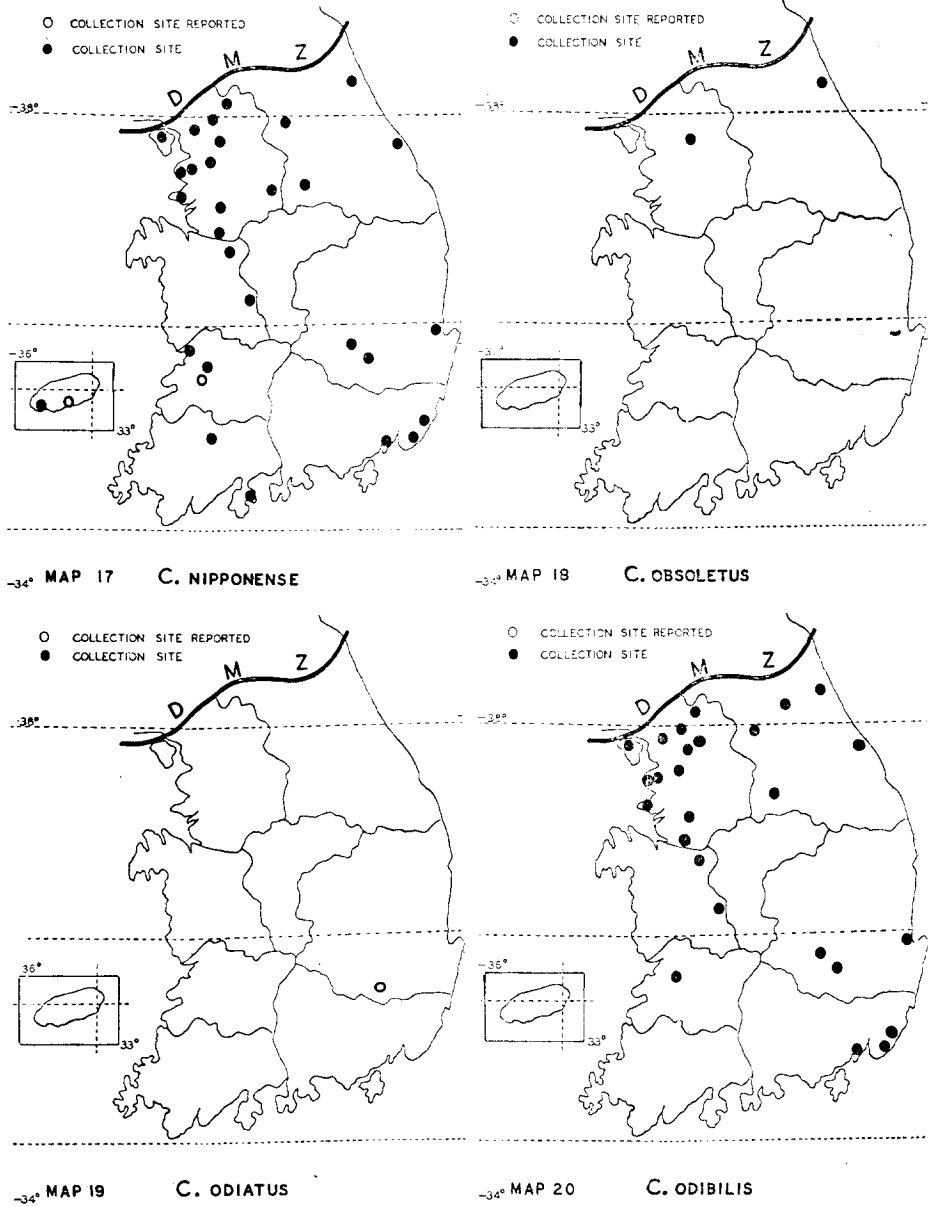
Culicoides okumensis Gutzevich, 1960, The bloodsucking midges (Diptera, Heleidae). The fauna of the U. S. S. R. Academy of Sciences of the U. S. S. R. Leningrad. 77-79

Culicoides okumensis McDonald and Lu, 1972, J. Med. Ent. 9(5):411

DISTRIBUTION: Korea, Japan, Saghalien.
NEW KOREA RECORD: Uijongbu, Kyongki-do, 16 May 1973, 1♀.

Remarks: Found only in Uijongbu, Kyongki-

DISTRIBUTION OF CULICOIDES



do in central Korea, possibly introduced there from Okinawa or Saghalien. See Map. 21.

Culicoides omogensis Arnaud

Culicoides omogensis Arnaud, 1956, Microent. 21(3):119-120 (Japan)

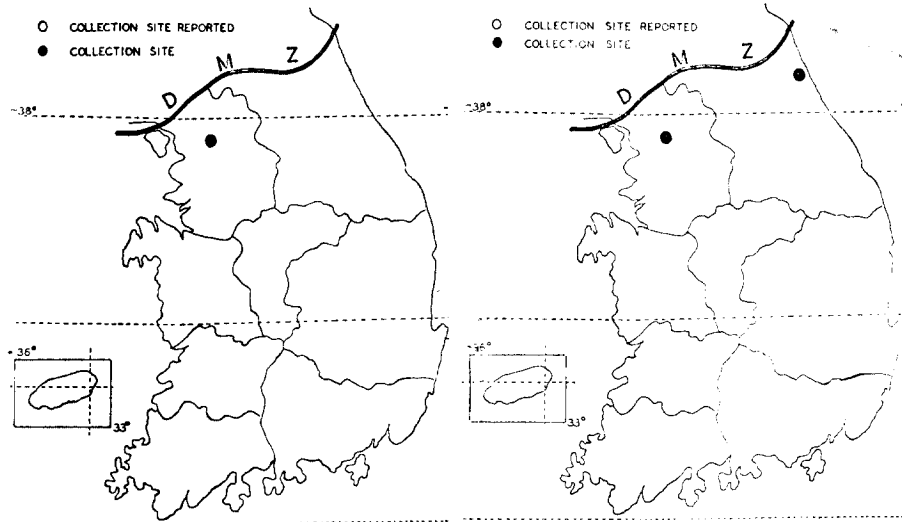
Culicoides omogensis Gutzevich, 1960,

The bloodsucking midges (Diptera, Heleidae). The fauna of the U.S.S.R. Academy of Sciences of the U.S.S.R. Leningrad. 110-111

DISTRIBUTION: Korea, Japan, Ussuri.

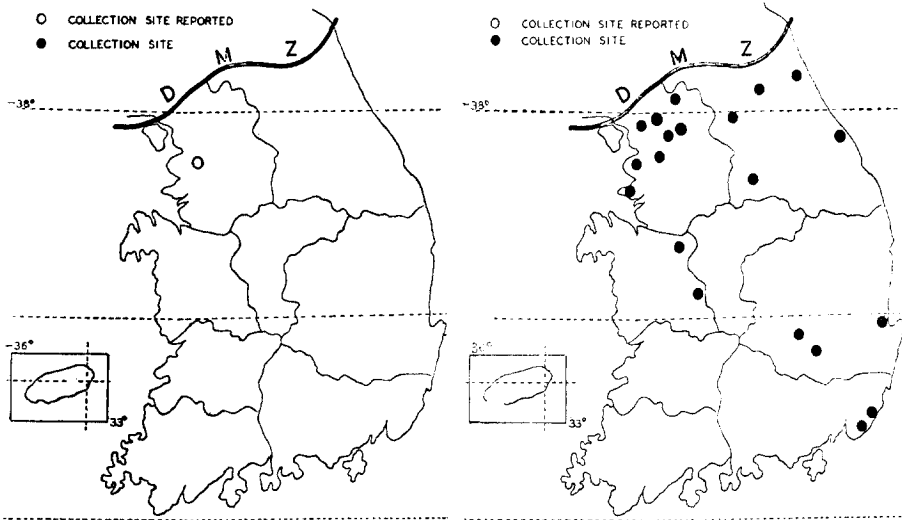
NEW KOREA RECORD: Sorak Mt. Kangwon-do, 1 Jul. 1972. 2♀; Uijongbu, Kyongki-do, 24-29 May 1973, 1♀.

DISTRIBUTION OF CULICOIDES



MAP 21 C. OKUMENSIS

MAP 22 C. OMOGENSIS



MAP 23 C. PICTIMARGO

MAP 24 C. PONKIKIRI

Remarks: Found only in two areas in central Korea. Possibly introduced there from Japan or Ussuri. See Map 22.

Culicoides pictimargo Tokunaga and Shogaki

Culicoides pictimargo Tokunaga and Shogaki, 1953, Proc. Ent. Soc. Wash. 55(5):

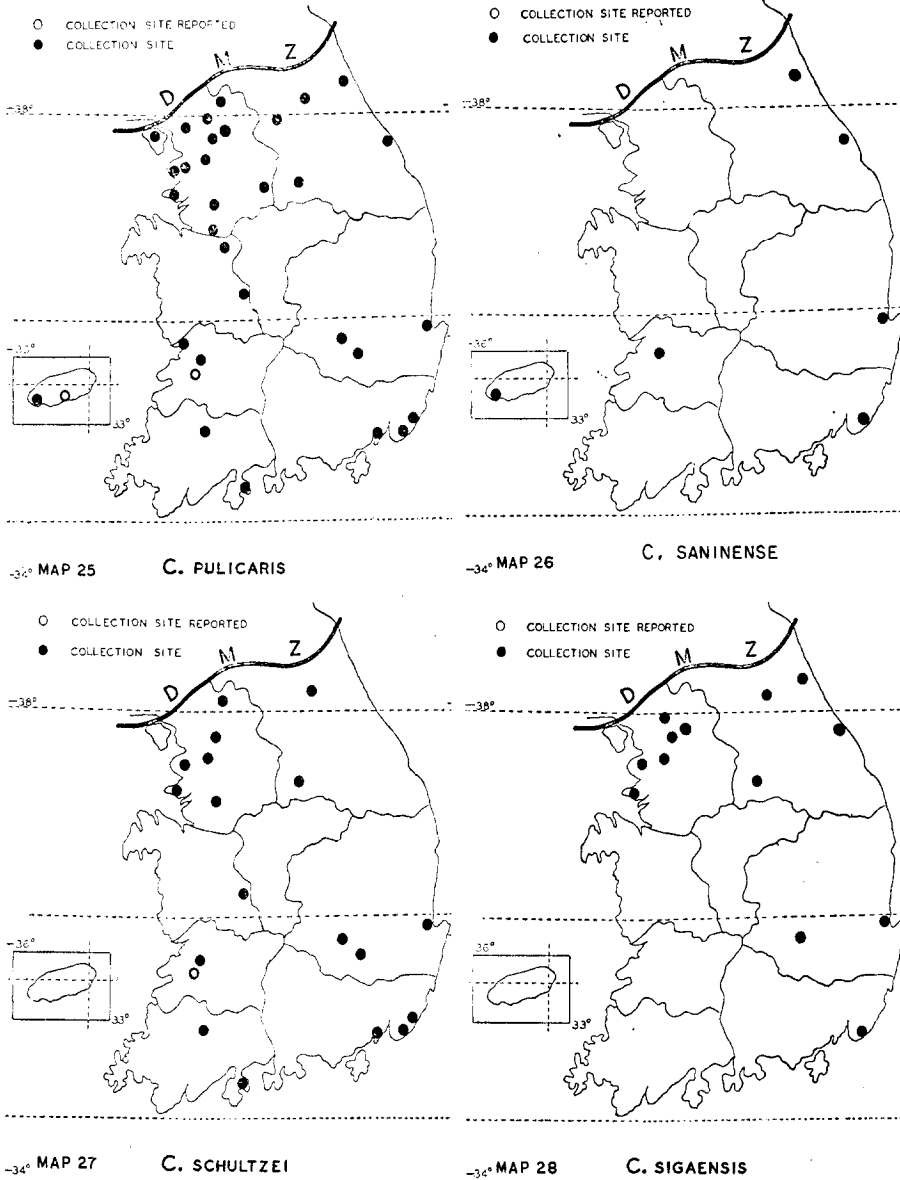
286-288 (Japan)

Culicoides pictimargo Arnaud, 1956, Microent. 21(3):123-125

DISTRIBUTION: Korea, Japan.

Remarks: Arnaud(1959) reported this species in Korea but it was not collected during the survey period. See Map 23.

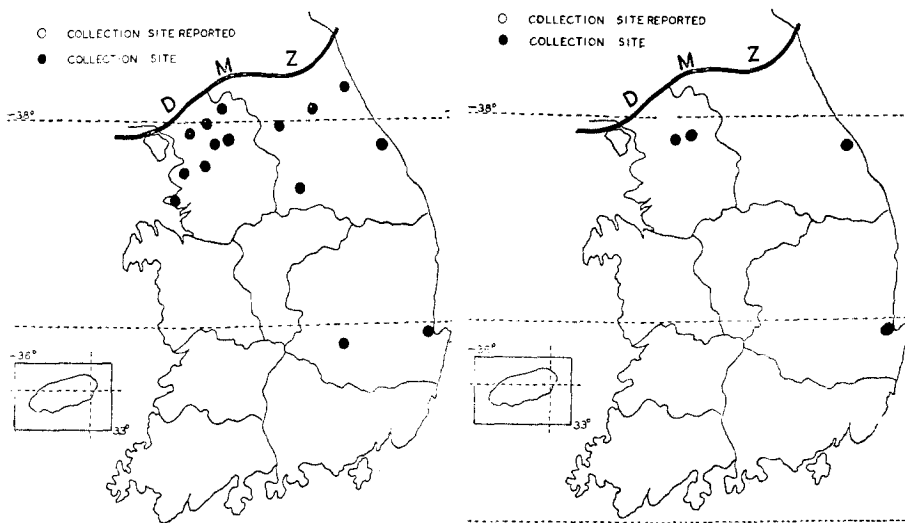
DISTRIBUTION OF CULICOIDES



Culicoides ponkikiri Kono and Takahasi
Culicoides ponkikiri Kono and Takahasi, 1940, Insect. Mats. 14(2/3):69 (Japan)
Culicoides kibunensis Arnaud, 1956, Microent. 21(3):107-109 (Misidentified)
Culicoides ponkikiri Wirth and Hubert, 1951, Pacific Insects 3(1):21

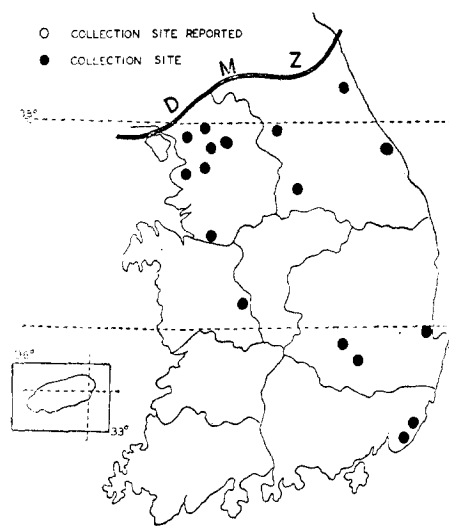
DISTRIBUTION: Korea, Japan.
 NEW KOREA RECORD: Seoul (Mojindong, Yongsan, Hwajok-dong) Kyongki-do (Sungnam, Kwangju, Unchon, Bongilchon Ni, Bobwon Ni, Songsan Ni, Kwangnung, Nambang Ni, Uijongbu, Bupyong, Incheon, Kimpo, Namyong, Muwon Ni), Kangwon-do (Wonju,

DISTRIBUTION OF CULICOIDES



MAP 29 C. SINANOENSIS

MAP 30 C. TOYAMARUAE



MAP 31 C. SP.

Cheju-do. See Map 24.

Culicoides pulicaris (Linnaeus)

Culicoides pulicaris Linnaeus, 1758, Syst. Nat., ed. X, P. 603 (Europe, North America)

Culicoides pulicaris Barnett and Toshioka, 1951, The Bloodsucking Insect Mites and ticks of Korea and Their Relation to Disease Transmission. p. 10

Culicoides pulicaris Arnaud, 1956, Microent. 21(3):125-126

DISTRIBUTION: Korea, Japan, Taiwan, Europe, Oriental Asia, Manchuria, Inner Mongolia, Saghali, Siberia.

Remarks: This species is abundant and widely spread throughout South Korea. See Map 25.

Culicoides saninense Tokunaga

Culicoides saninense Tokunaga, 1956, Sept., Saikyo Univ. Sci. Rept. Agr. 8: 116-118 (Japan)

Culicoides epactius Arnaud, 1956, Nov., Microent. 21(3):102-103

Chunchon, Sorak Mt., Kwandae Ri), Chung chongnam-do (Taejon, Chonan), Kyongsang-puk-do (Waegwan, Taegu, Pohang) Kyongsangnam-do (Pusan, Chinhae), May-Oct. 1965-1973, Many ♂♀.

Remarks: This species is common and widely spread throughout South Korea except

Culicoides epactius Ivanov and Glukhova, 1967, Rev. Ent. U.S.S.R. 46(4): 810-812

DISTRIBUTION: Korea, Japan, Primorskiy.

NEW KOREA RECORDS: Pohang, Kyongsangpuk-do, Jul. Aug. 1969, 2♀ May-Aug. 1970, 5♂ 105♀ Jun. 1973, 1♀ Aug. 1973 1♀; Kangnung, Kangwon-do, Jul.-Aug. 1969, 3♀; May-Jul. 1972, 9♂ 137♀; Sorak Mt., Kangwon-do, Jun. 1972, 5♂ 40♀; Kimje, Chollapuk-do, Jul.-Aug. 1969, 5♀; Molsulpo, Cheju-do, May-Aug. 1970, 10♂ 52♀. See Map 26.

Culicoides schultzei (Enderlein)

Culicoides schultzei (Enderlein, 1908, Denkschr. med-naturw. Var. jena 13:459 (S.W. Africa)

Culicoides oxystoma Arnaud, 1956, Microent. 21(3): 120-122

Culicoides schultzei Wirth and Hubert, 1961, Pacific Insects 3(1):22

DISTRIBUTION: Korea, Japan, Taiwan, Manchuria, Ussuri,

Remarks: This species is common and wide spread throughout South Korea. See Map 27.

Culicoides sigaensis Tokunaga

Culicoides sigaensis Tokunaga, 1937, Tenthredo, 1(3):322-234 (Japan)

Culicoides sigaensis Arnaud, 1956, Microent. 21(3):127-129

DISTRIBUTION: Korea, Japan, Manchuria
NEW KOREA RECORDS: Mojindong, Seoul, May-Oct. 1965, 1966 and 1970, 2♂ 22♀; Kyongki-do (Bobwon Ni, Aug. 1965, 3♂ 3♀; Nambang Ni, Jun.-Jul 1966. 4♂ 6♀; May 1972, 1♀; Bupyong, May 1965, 2♂; Jul. 1909, 5♀; Kwangju, May-Oct. 1967-1973, 13♂ 71♀; Chaijon Ni, Jul. 1937, 1♂ 4♀; Sungnam, Apr.-Oct. 1973, 2♂ 15♀; Kwangnung, Apr.-Oct. 1972-1973, many ♂♀;

Uijongbu, Jul. 1973, 10♂ 22♀; Songsan Ni, May 1973, 3♂ 10♀) Kangwon-do (Kwandae Ri, May-Oct. 1965-1969, many ♂♀; Sorak Mt., Jun. 1966, 2♂ 4♀; May-Oct. 1972 many ♂♀; Wonju, Jul. 1967, 3♀; May 1973, 2♀; Kangnung, Jun. 1972, 2♀), Kyongsangpuk-do (Waegwan, Aug. 1965, 1♀; Pohang, Jul. 1970, 1♂ 5♀) Pusan, Kyongsangnam-do, May-Jul. 1967, 11♀.

Remarks: This species is common and spread in central and east-southern parts. See Map 28.

Culicoides sinanoensis Tokunaga

Culicoides sinanoensis Tokunaga, 1937, Tenthredo, 1(3):331-332 (Japan)

Culicoides sinanoensis Arnaud, 1956, Microent. 21(3):129-130

Culicoides sinanoensis Gutzevich, 1960, The bloodsucking midges (Diptera, Heleidae). The fauna of the U.S.S.R. Academy of Sciences of the U.S.S.R. Leningrad. 77

DISTRIBUTION: Korea, Japan, Manchuria, Ussuri.

NEW KOREA RECORDS: Mojindong, Seoul; Kyongki-do (Nambang Ni, Unchon, Chonsan Ni, Munsan, Songsan Ni, Tongduchon, Chaijon Ni, Incheon, Kwangnung, Uijongbu) Kangwon-do (Kwandae Ri, Wonju, Chunchon, Sorak Mt., Kangnung), Apr.-Oct. 1965-1973, many ♂♀; Kyongsangpuk-do (Waegwan, May 1966, 1♀; Pohang, Jun. 1970, 6♀).

Remarks: This species is fairly common in central but rare in southern part. See Map 29.

Culicoides toyamaruae Arnaud

Culicoides toyamaruae Arnaud, 1956, Microent. 21(3): 133-134

DISTRIBUTION: Korea, Japan.

NEW KOREA RECORDS: Songsan Ni, Kyongki-do, May 1972, 1♀; Jul. 1972, 1♀;

Kangnung, Kangwon-do, 14 Jun. 1972, 1♀;
4-6 Jul. 1972, 1♀; Nambang Ni, Kyongki-do,
25-30 Jun. 1973 1♀; Pohang, 24 May 1972 1♀.

Remarks: This species is rare and found only
in Songsan Ni, Nambang Ni of Kyongki-do
and Pohang, Kyongsang puk-do. See Map 30.

Culicoides sp.

This apparently new species is widely spread
and common throughout South Korea except
Cheju-do. The authors will give a detailed
report on it in the future. See Map 31.

The following species were reported in Korea
but not collected during the survey period.

1. *C. amamiensis amamiensis*
2. *C. odiatus*
3. *C. pictimargo*

For the following three(3) species male as
well as female specimens were collected,
although only female specimens were recorded
in the past.

1. *C. japonicus*
2. *C. laciocola*
3. *C. matsuzawai*

A detailed report will be made in the future
on the male specimens of the above.

From the data obtained, the biting midges
of the genus *Culicoides* in South Korea, were
categorized into four types in accordance with
their distribution.

1. The species which are very widely spread
throughout South Korea:

- | | |
|------------------------|--------------------------|
| <i>C. arakawae</i> | <i>C. circumscriptus</i> |
| <i>C. dendrophilus</i> | <i>C. erairai</i> |
| <i>C. homotomus</i> | <i>C. japonicus</i> |
| <i>C. laciocola</i> | <i>C. nagahanai</i> |
| <i>C. nipponense</i> | <i>C. odibilis</i> |
| <i>C. ponkikiri</i> | <i>C. pulicaris</i> |
| <i>C. schultzei</i> | <i>C. sigaensis</i> |
| <i>C. sinanoensis</i> | <i>C. toyamaruae</i> |
| <i>C. sp.</i> | |

2. The species which are distributed in cen-
tral South Korea and supposed to occur in
North Korea:

- | | |
|------------------------------|-----------------------|
| <i>C. amamiensis ohmorii</i> | <i>C. clavipalpis</i> |
| <i>C. dubius</i> | <i>C. koreensis</i> |
| <i>C. matsuzawai</i> | <i>C. obsoletus</i> |
| <i>C. odiatus*</i> | <i>C. okumensis</i> |
| <i>C. omogensis</i> | <i>C. pictimargo*</i> |

3. The species which were collected in coa-
stal areas and southern islands:

- | | |
|-------------------|---------------------|
| <i>C. miharai</i> | <i>C. saninense</i> |
|-------------------|---------------------|

4. The species which were collected in
Cheju-do:

- | | |
|---------------------|---------------------------------|
| <i>C. longidens</i> | <i>C. amamiensis amamiensis</i> |
|---------------------|---------------------------------|

*The species which should be studied
further.

SUMMARY

A survey of the biting midges of the Genus
Culicoides was conducted by a joint effort of
numerous U.S. and Korean personnel throu-
ghout South Korea for seven years from 1965
through 1973 (except 1968, 1971) using New
Jersey light traps set up at fifty-nine (59)
different locations, to find out the seasonal
succession and geographical distribution of the
said insects both on an individual species basis
and as a whole, and to evaluate the medical
significance and epidemiology of these insects.

This provides some of the basic knowledge
needed for prevention of filarial and virus
transmission of diseases owing to these insects.

As a result the following results were
obtained:

1. Sixteen (16) species hitherto unrecorded
were added to the fauna of biting midges
known from South Korea. Together with the
already recorded fourteen (14) species, this
makes the total number of species of these
insects in South Korea thirty (30).

2. Through the monthly tabulation of the collected specimens it was possible to find out the general seasonal succession of these insects as well as their sex ratio.

3. Based on the data obtained the geographical distributions of the biting midges of the Genus *Culicoides* so far recorded in Korea were classified into the following four (4) types:

a. The species which are very widely spread throughout South Korea.

b. The species which are spread in central South Korea and supposed to occur in North Korea.

c. The species which were collected from coastal areas and southern island.

d. The species which were collected from Cheju-do.

ACKNOWLEDGMENTS

This paper is the result of the combined efforts of numerous individuals throughout Korea. Due to the large number of people involved only a few can be cited here: Captain Anthony B. Bosworth, Commanding Officer of the 5th Preventive Medicine Unit; First Lieutenant Stanley E. Malcolm, Survey Section Officer in charge, and enlisted men of the 5th Preventive Medicine Laboratory.

Recognition is also deserved by those personnel who sent specimens to the laboratory from the light traps in their respective areas.

The authors wish to express deepest appreciation to Dr. Willis W. Wirth, Systematic Entomology Laboratory, U.S. Department of Agriculture, Washington, D.C. 20560 and Dr. Hiroshi Takahasi, Ground Self-Defence Force Medical School, Tokyo, Japan, for their helpful comments and reprints of their papers. Particular thanks are due to Dr. Yoc-Hang Shin, Department of Biology, Kyung

Hee University, Seoul, Korea, and Dr. Hyong-Sun Ah, College of Veterinary Medicine, Georgia State University, for their kind advice in the preparation of the manuscript.

REFERENCES

- Amosova, I.S. (1957). Some New or little known *Culicoides* Latr. (Diptera, Heleidae) from Ussuriland, Zool. Inst. Acad. Sci. USSR 36(1):233-247.
- Arnaud, P. (1956). The heleid genus *Culicoides* in Japan, Korea and Ryukyu Islands (Insecta: Diptera). Microentomology, 21(3):84-207.
- Barnett, H.C. and Toshioka, S. (1951). The blood-sucking insects, mites and ticks of Korea and their relation to disease transmission. 406th Medical General Laboratory, pp. 1-25.
- Bullock, H.R. and Akiyama, J. (1959). A new biting midge from Japan and Korea (Diptera, Heleidae), Jap. J. Sanit. Zool. 10(1):23-26.
- Fujito, T. (1939). Studies on *Culicoides miharai* Kinoshita from Moppo. J. Chosen Med. Assoc. 29(11) Appendix: 2376-2377. (in Japanese).
- Gutzevich, A.V. (1960). The bloodsucking midges (Diptera, Heleidae). The fauna of the U.S.S.R. Academy of Sciences of the U.S.S.R. Leningrad. 1-13.
- Hubert, A.A. and Wirth, W.W. (1961). Key to the *Culicoides* of Okinawa and the description of two new species (Diptera, Ceratopogonidae). Proc. Ent. Soc. Wash. 63(4): 235-239.
- Ivanov, K.S. and Glukhova, V.M. (1937). New Data on the Fauna of Bloodsucking Midges (Diptera, Ceratopogonidae) from the coastal Zone of the Primorje territory. Rev. Ent. URSS 46(4):808-813. (In Russian)
- Kitaoka, S. (1963). Notes on distribution of the Genus *Culicoides* of Japan (in Japanese). Vet. Exp. Stat. 46:45-51.
- Kinoshita, S. (1918). Chosen-san-Kyuketsusei *Culicoides* ni tsukite. Dobutsugaku Zasshi, 30(354): 155-160.
- Kono, H. and Takahasi, H. (1940). A revision of the *Culicoides* species of Saghalien and Hokkaido (Ceratopogonidae, Diptera). Insecta Matsumu-

- rana. 14: 69-77.
- Lien, J. C. (1959). Preliminary observations on the mosquitos of Korea and Recommendations developed for the WHO Japanese Encephalitis vector research unit. pp. 16-17.
- McDonald, J.L. and Lu, L.C. (1972). Female *Culicoides* of Taiwan with Descriptions of New species (Diptera, Ceratopogonidae). J. Med. Ent. 9(5):396-417.
- Okanda, T. (1954). Note on some biting midges of inner Mongolia, North China, Manchuria and Korea (Diptera, Heleidae), Jap. J. Appl. Zool. 19(1):1-7.
- Takahasi H. (1941). Notes on some species of the Genus *Culicoides* from Manchoukuo with description of new species (Ceratopogonidae, Diptera). Insecta Matsumurana 15(3):8.
- Takahasi, S. (1953). Notes on some biting-midges in the Niigata-Yamagata District (Ceratopogonidae, Diptera). Acta Medica et Biologica. 6(2):111-117.
- Tokunaga, M. (1937). Sandflies (Ceratopogonidae, Diptera) from Japan. Tenthredo. 1:233-338.
- Tokunaga, M. (1940). Biting midges from Japan and neighboring countries, including Micronesia Island, Manchuria, North China and Mongolia (Diptera, Ceratopogonidae). Tenthredo. 3(1): 58-100.
- Tokunaga, M. (1943). Medical entomology, part 11. pp. 853-931. Kanahara Company, Tokyo, Japan. (in Japanese).
- Tokunaga, M. (1950). *Culicoides* flies from Kyushu, Japan (Ceratopogonidae, Diptera). San. Zool. 1 (3):64-67.
- Tokunaga, M. and Shogaki, Y. (1953). A new species of biting midge from Japan. Proc. Ent. Soc. Wash. 55(5):286-288.
- Tokunaga, M. 1955. Notes on biting midges from Japan and Korea (Heleidae or Ceratopogonidae, Diptera). Contribution from Entomological Laboratory, Saikyo Univ., Kyoto, Japan. 41:1-8.
- Wirth, W. W. and Hubert, A. A. (1959). *Trithecooides*, a new subgenus of *Culicoides* (Diptera, Ceratopogonidae) Pacific Insects. 11:1-38.
- Wirth, W. W. and Hubert, A. A. (1951.) New species and records of Taiwan *Culicoides* (Diptera, Ceratopogonidae). Pacific Insects. 3(1):11-26.

＝國文抄録＝

南韓産 등에모기屬의 등에모기에 관한 研究

美軍 5 豫防醫學

趙 厚 子 · 鄭 俊 植

筆者들은 1965년부터 1973년까지 등에 모기의 季節의 消長과 地理의 分布를 調査하기 爲하여 南韓 59個地域에 設置한 light trap 에 採集된 등에모기를 調査한 結果 다음과 같은 結果를 알게 되었다.

1. 過去 14種으로 알려졌던 韓國産 등에모기類에 새로 未記錄種 16種을 追加하게 되었다. 이로서 韓國産등에모기는 30種이 된다.
2. 非定期的의 採集으로 確實한 것은 알 수 없으나 등에모기의 種類別, 月別採集數의 年度別統計表에 依하여 季節的 消長關係와 性比의 輪廓을 알 수 있었다.
3. 南韓産등에 모기 30種의 地理的 分布를 현재까지 筆者들이 얻은 知識에 基礎하여 다음과 같은 네가지 型으로 나누어 보았다.
 - a. 南韓全域에 廣範圍하게 分布하고 있는 種.
 - b. 中部韓國과 北韓에도 分布하고 있으리라고 짐작되는 種.
 - c. 海邊과 南韓島嶼地方에 分布하고 있는 種.
 - d. 濟州島에서만 採集된 種.