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USAFOEHL REPORT

89-012OL0610CEC

1987 MOSQUITO IDENTIFICATIONS FROM USAF INSTALLATIONS IN THE PACIFIC REGION

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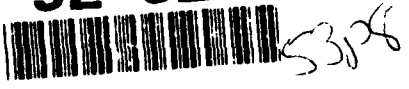
19. ABSTRACT (Continue on reverse if necessary and identify by block number)
A summary is provided of mosquito identifications accomplished by the OL AD USAFOEHL Vector Taxonomy Section for sixteen PACAF installations/locations and one SAC air base in the Pacific Region. Discussions are also provided on mosquito surveillance, adult mosquito differentiation, specimen packaging and shipping, trap count indices, mosquito control, and mosquito bionomics.



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I. INTRODUCTION

A. Section II provides a summary of adult, larval, and oval mosquito specimens we received and identified from Air Force installations in the Pacific during CY 87. A total of 46,654 specimens were identified during the year, including 24,068 adults, 5,990 larvae, and 16,596 eggs (based on reared adults). Material from 16 PACAF and 1 SAC installations was received. Appendix A contains information prepared by Lt Col Dennis D. Pinkovsky on mosquito surveillance, data interpretation, and control.

B. BASE SUMMARIES

A synopsis of the annual data for all the facilities is provided at the beginning of the this section. Statistics are then provided on the number of specimens and species submitted to OL AD, USAFOEHL/VTS by each participating base. Monthly trap indices are presented along with total trap collection figures.

CONSOLIDATED MOSQUITO SURVEILLANCE DATA - 1987

INSTALLATION	FEMALE	LARVA	EGG	TOTAL
ANDERSEN	1363	0	1602	2965
BELLOWS	0	0	910	910
CAMP O'DONNELL	405	1424	0	1829
CLARK	18591	3184	1132	22907
CROW VALLEY	83	424	0	507
HICKAM	55	157	301	513
JOHN HAY	16	26	0	42
KADENA	1716	505	11470	13691
KUNSAN	353	51	0	404
KWANG JU	137	0	0	137
MISAWA	181	14	0	195
OSAN	962	188	0	1150
SUWON	6	0	0	6
TAEGU	200	15	0	215
WALLACE	0	0	0	0
WHEELER	0	0	314	314
YOKOTA	0	2	867	869
TOTAL	24068	5990	16596	46654

ANDERSEN AFB, GUAM
MOSQUITO SURVEILLANCE SUMMARY - 1987
NO. OF ADULT FEMALES IDENTIFIED

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
AEDES													
albopictus									1	4			5
pandani			15						39	882	155		1091
rotanus			1						1	135	43		180
saipanensis			2						1	46	11		60
vexans									20	4	1		25
CULEX													
quinquefasciatus										1			1
tritaeniorhynchus									1				1
Total Females	0	0	18	0	0	0	0	0	63	1072	210	0	1363
New Jersey Trap/Light			10						63	194			
New Jersey Trap/CO2			8							878			
Total Trap Collections			4						10	18	24		56
New Jersey Trap/Light			2						10	17			
New Jersey Trap/CO2			2							1			
Overall Trap Index			4.5						6.3	59.6	8.8		
New Jersey Trap/Light			5.0						6.3	11.4			
New Jersey Trap/CO2			4.0							878.0			

NOTE:
For the month of Mar - trap indices for positive trap collections only.
For Nov, the number of specimens and the number of collections for each specific trapping method (NJ/light and NJ/CO2) cannot be determined.

No. of Males	2
No. Damaged	1
Shipments Received	5
Total Collections	56
Total Specimens	1366

NO. OF OVITRAP PADDLES AND EGG COUNT - 1987
(BASED ON DATE COLLECTED)

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
PADDLE COUNT	13(3)*	5(3)	2(0)	6(2)	2(0)	14(0)	19(0)	17(7)	17(15)	5(4)	0	0	100(34)
EGG COUNT	160	46	0	9	0	0	0	95	1170	122			1602

*The number in each parentheses is the number of paddles positive for Aedes spp. eggs.
Rearings of positive ovitrap paddles produced all Aedes albopictus (159 females, 215 males).

BELLOWS AFB, HAWAII
MOSQUITO SURVEILLANCE SUMMARY - 1987
NO. OF OVITRAP PADDLES AND EGG COUNT
(BASED ON DATE COLLECTED)

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
PADDLE COUNT	32(10)*	28(12)	8(5)	0	0	0	0	0	0	0	27(11)	48(22)	143(60)
EGG COUNT	80	133	60	0	0	0	0	0	0	0	103	534	910

*The number in each parentheses is the number of paddles positive for Aedes spp eggs.
Rearing results of positive ovitrap paddles yielded 28 females and 54 males of Aedes albopictus.

CAMP O'DONNELL, PHILIPPINES
MOSQUITO SURVEILLANCE SUMMARY - 1987
NO. OF FEMALES IDENTIFIED

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
AEDES													
lineatopennis						3	1			6	7	48	65
pampangensis										1		2	3
vexans			1										1
ANOPHELES													
annularis				1			1			5	2	4	13
filipinae												1	1
flavirostris										1			1
indefinitus			4			1				1	10	5	21
lesteri				1									1
limosus											3		3
ludlowae			4	2									6
peditaeniatus												1	1
philippinensis											1		1
pseudobarbirostris			2										2
subpictus			6	1			4			15	34	18	78
vagus			1									1	2
CULEX													
fuscanus			3										3
fuscocephala						19	5					3	27
gelidus						3	2			1		1	7
quinquefasciatus				1									1
tritaeniorhynchus			1	2		35	21			7	4	14	84
vishnui			5			4				4	3	8	24
whitmorei							1			10	6	1	18
MANSONIA													
annulifera												1	1
uniformis			15			1				6	5	12	39
MIMOMYIA													
chamberlaini												2	2
Total Females	0	0	42	8	0	66	35	0	0	57	75	122	405
New Jersey Light Trap			42	8		66	35			57	75	122	
Total Trap Collections			4	3		5	4			3	5	10	34
New Jersey Light Trap			4	3		5	4			3	5	10	
Overall Trap Index			11	3		13	9			19	15	12	
New Jersey Light Trap			11	3		13	9			19	15	12	

CAMP O'DONNELL
(Continued)

LARVAE

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
ANOPHELES													
indefinitus			10										10
limosus			1						2				3
pseudopunctipennis								1					1
quadrimaculatus			3			6				1			10
vagus			6					1	9		2		18
spp			1			3							4
CULEX													
annulirostris						7							7
fuscanus	4		2								1	1	8
fuscocephala	120	30	23	3	3	12	36	52	65	131	79	40	594
gelidus			3			7				2		9	21
mimulus				19									19
reidi				4									4
rubithoracis				26	1	2							29
tritaeniorhynchus	54	85	46	60	23	63	10	27	2	48	10		428
vishnui	12	32	31	11	23	18	29	3		6			165
whitei			1										1
spp	2		8	44	13	3	11	7	4				92
MANSONIA													
chamberlaini				1	1	2							4
uniformis						1						4	5
URANOTAENIA													
mercidesi	1												1
Total Larvae	193	147	135	168	64	124	86	91	82	188	92	54	1424
Larval Collection	8	8	8	8	8	8	4	8	4	8	8	4	84

No. of Males	15
No. Damaged	7
Shipments Received	29
Total Collections	118
Total Specimens	1851

CLARK AB, PHILIPPINES
MOSQUITO SURVEILLANCE SUMMARY - 1987
NO. OF ADULT FEMALES IDENTIFIED

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
AEDEOMYIA													
catastica		1	1		1							1	4
AEDES													
albopictus				1		1		1				2	5
alcasidi				1		1	1						3
flavipennis								2					2
lineatopennis	1			1	1	11	9	34	113	17	21	9	267
pampangensis									1	1	2	1	5
poicilius	10	1					3	1	5	3	4	3	30
vexans	5				1	12	16	142	179	8	3	4	366
ANOPHELES													
annularis	1		3		1	5	5	13	39	27	22	9	125
filipinae	1	2				1		1	1	1	1	7	15
flavirostris	1						3	1	5	1		10	21
indefinitus	7	8	31	14	7	24	29	52	173	149	173	130	797
karwari									1	1	1	1	4
lesteri				4				2	10	0			16
limosus	1	2	2	1	1	4	2	6	29	13	5	6	72
ludlowae	29	32	40	23	16	9	13	5	2	3	8	21	201
maculatus	1	9	2	1	2					1			16
manalangi				1									1
minimus?												1	1
peditaeniatus	6	2	2	10	10	14	13	34	135	118	42	18	404
philippinensis		1						2	7	5	4	2	21
pseudobarbirostris	4	1							2	1		2	10
subpictus	15	16	38	24	29	69	35	174	480	297	371	242	1,790
tessellatus	1	1				12	2	20	35	12	4	12	99
vagus	5	4	1		6	10	20	56	90	15	38	19	264
ARMIGERES													
subalbatus			1										1
CULEX													
annulirostris	39	22	8	3	3	4	4	1		1	1		86
bitaeniorhynchus	1		1	4	1		1	4	4	1	2		19
fuscanus	0						1	4	5	1			12
fuscocephala	15	12	15	19	8	96	285	358	1,027	167	238	186	2,426
gelidus	12	16	5	2	1	38	89	375	2,549	499	187	93	3,866
(lophoceraomyia)						1		1	1	0		6	9
luzonensis	2						1		3	0	1		7
nigropunctatus				1	1		1	1	3	0	2		9
quinquefasciatus	2	1	1	4	1	1		2	3	0	3	6	24
tritaeniorhynchus	34	6	8	8	3	104	439	732	3,113	184	113	282	5,026
vishnui	55	47	52	5	4	30	30	155	725	289	300	371	2,063
vishnui subgroup	5	1	1			1	1		6	0		3	18
whitei					1				4	0	1		6
whitmorei				2		1	1	17	111	28	12	5	177

CLARK
(Continued)

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
MALAYA													
genurostris	1												1
MANSONIA													
uniformis	1		3		5	4	8	37	69	73	56	20	276
MIMOMYIA													
chamberlaini		1						2	1		1	1	6
luzonensis	1					2	2	3	4		1	2	15
URANOTAENIA													
bicolor	1												1
confusa								1			1		2
demeilloni								1					1
modesta												1	1
Total Females	257	186	215	129	103	455	1,014	2,290	8,927	1,916	1,623	1,476	18,591
New Jersey Light Trap	82	95	112	81	44	395	901	2,226	8,767	1,881	1,610	1,441	
New Jersey Light + CO2	42	1	34	20	23								
SSAM Light Trap	133	90	69	28	35	60	113	64	160	35	13	35	
SSAM Light Trap + CO2					1								
NOTE:													
6 Collections of Sep and 3 Collections of Oct (New Jersey Light Trap)									579	309			
identified are approx. 1/5 of total									2,895	1,545			
Additional 4/5 of total:									2,316	1,236			
Total Trap Collections	36	36	39	36	44	52	52	68	82	86	74	83	688
New Jersey Light Trap	18	22	18	22	16	26	26	48	56	67	55	65	
New Jersey Light + CO2	6	2	8	2	8								
SSAM Light Trap	12	12	13	12	19	26	26	20	26	19	19	18	
SSAM Light Trap + CO2					1								
Overall Trap Index	7.1	5.2	5.5	3.6	2.3	8.8	19.5	33.7	137.1	36.7	21.9	17.8	
New Jersey Light Trap	4.6	4.3	6.2	3.7	2.8	15.2	34.7	46.4	197.9	46.5	29.3	22.2	
New Jersey Light + CO2	7.0	0.5	4.3	10.0	2.9								
SSAM Light Trap	11.1	7.5	5.3	2.3	1.8	2.3	4.3	3.2	6.2	1.8	0.7	1.9	
SSAM Light Trap + CO2					1.0								

CLARK
(Continued)

LARVAE

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
AEDES													
albopictus							30						30
spp							89						89
ANOPHELES													
annularis							1						1
indefinitus				1		5		1	1				9
limosus				1									1
pecitaeniatus					1				2				3
subpictus	2		1		1	3			4			1	11
vagus	15	3		13	15	11		15	5			1	78
spp	1	5					1	4				1	12
CULEX													
annulirostris	1				4			3					8
bitaeniorhynchus	11	4											15
fuscanus	1	23	15	7	1	4	1	3	7	1			63
fuscocephala	66	36	14	48	54	127	38	95	193	142	73	26	912
gelidus	1		12	21	10	3				2			49
infula	1												1
pseudosinensis	24												24
quinquefasciatus		34	185	1									220
tritaeniorhynchus	103	2		8	33	38	17	22	42	32	40	16	353
vishnui	72	159	3	60	61	42		73	332	231	95	13	1,141
spp	78	8		25	5	6	39	1	1			1	164
Total Larvae	376	274	230	185	185	240	216	217	587	408	208	58	3,184
Larval collection	21	18	17	16	13	18	18	19	26	22	11	6	205

No. of Males	560
No. Damaged	1,004
Shipments Received	89
Total Collections	893
Total Specimens	23,339

NO. OF OVITRAP PADDLES AND EGG COUNT - 1987
(BASED ON DATE SUBMITTED)

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
PADDLE COUNT	54(0)*	60(1)	73(1)	21(0)	0	0	10(9)	44(6)	19(8)	10(0)	0	0	291(25)
EGG COUNT	0	36	14	0	0	0	753	97	232	0	0	0	1,132

* The number in each parentheses is the number of paddle/paddles positive for Aedes spp eggs.
Egg rearings yielded a total of 85 female, 113 male Aedes albopictus and 21 female, 11 male Aedes alcasidi.

CROW VALLEY, PHILIPPINES
MOSQUITO SURVEILLANCE SUMMARY - 1987
NO. OF ADULT FEMALES IDENTIFIED

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
AEDEOMYIA													
catastica			1										1
AEDES													
albopictus						1							1
lineatopennis			1			2							3
ANOPHELES													
annularis						1							1
indefinitus				1									1
lesteri				2									2
ludlowae			8	3		1							12
pecitaeniatus			1	1									2
philipoinensis			1										1
suboictus			5										5
tessellatus			1			1							2
vagus			1										1
CULEX													
fuscanus			1										1
fuscocephala			3			11							14
pelidus			1			2							3
quinquefasciatus				2									2
tritaeniorhynchus			1	1		19							21
vishnui			4			1							5
whitmorei						3							3
MANSONIA													
uniformis						1							1
MIMOMYIA													
luzonensis			1										1
Total Females	0	0	30	10	0	43	0	0	0	0	0	0	83
New Jersey Light Trap			30	10		43							
Total Trap Collections			4	3		4							
New Jersey Light Trap			4	3		4							
Overall Trap Index			8	3		11							
New Jersey Light Trap			8	3		11							

CROW VALLEY
(Continued)

LARVAE

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
AEDES													
spp								1					1
ANOPHELES													
indefinitus										1			1
lesteri				3									3
limosus										4			4
pseudotaeniatus	1		1		5			1		4			12
subpictus						2							2
vagus		4									2		6
spp	1									1			2
CULEX													
annulirostris		1	1										2
edwardsi			1										1
fuscanus			9										9
fuscocephala		9	4			9		26	16	22	6	10	102
gelidus			1			1	1	1					4
rubithoracis			1	1	2								4
tritaeniorhynchus		2	13	25	10	11	5	3	9	23	19		120
vishnui	7	4		2	6	7	1	2		3	2	4	38
whitei			2	1	3								6
whitmorei										5			5
spp	6		27	30	2	9	8	7		3			96
MIMOMYIA													
chamberlaini			1	3									4
luzonensis			1									3	4
URANOTAENIA													
argyrotarsis					1								1
spp				1									1
Total Larvae	15	20	62	66	29	39	15	41	25	66	29	17	424
Larval collection	2	2	4	4	3	4	2	4	2	4	2	3	35

No. of Males	1
No. Damaged	2
Shipments Received	23
Total Collections	46
Total Specimens	510

HICKAM AFB, HAWAII
MOSQUITO SURVEILLANCE SUMMARY - 1987
NO. OF ADULT FEMALES IDENTIFIED

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
AEDES													
vexans	2											1	3
CULEX													
quinquefasciatus	18										32	2	52
Total Females	20	0	0	0	0	0	0	0	0	0	32	3	55
New Jersey Light Trap	20										32	3	
Total Trap Collections	6										2	3	11
New Jersey Light Trap	6										2	3	
Overall Trap Index	3.3										16.0	1.0	
New Jersey Light Trap	3.3										16.0	1.0	

LARVAE

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
AEDES													
albopictus							18						18
spp							4						4
CULEX													
quinquefasciatus							125						125
spp							10						10
Total Larvae	0	0	0	0	0	0	157	0	0	0	0	0	157
Larval Collection							1						1

No. of Males	26
No. Damaged	0
Shipments Received	13
Total Collections	12
Total Specimens	238

NO. OF OVITRAP PADDLES AND EGG COUNT - 1987
(BASED ON DATE COLLECTED)

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
PADDLE COUNT	20(5)*	10(4)	6(4)	0	0	0	0	0	0	0	33(2)	39(1)	108(16)
EGG COUNT	85	45	125	0	0	0	0	0	0	0	11	35	301

*The number in each parentheses is the number of paddles/paddle positive for Aedes spp eggs.
Egg rearings yielded all Aedes Albopictus (13 females and 7 males).

JOHN HAY AB, PHILIPPINES
MOSQUITO SURVEILLANCE SUMMARY - 1967
NO. OF FEMALES IDENTIFIED

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
ANOPHELES													
gigas formosus											1		1
CULEX													
bitaeniorhynchus											1		1
diengensis *											1	2	3
luzonensis									1				1
quinquefasciatus								1				5	6
tritaeniorhynchus								1					1
vishnui								1					1
TRIPTEROIDES													
sp											1		1
URANOTAENIA													
modesta										1			1
Total Females	0	0	0	0	0	0	0	3	1	1	4	7	16
New Jersey Light Trap								3	1	1	4	7	
Total Trap Collection								1	2	2	3	3	11
New Jersey Light Trap								1	2	2	3	3	
Overall Trap Index								3.0	0.5	0.5	1.3	2.3	
New Jersey Light Trap								3.0	0.5	0.5	1.3	2.3	

LARVAE

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
CULEX													
quinquefasciatus									8	10		7	25
tritaeniorhynchus									1				1
Total Larvae	0	0	0	0	0	0	0	0	9	10	0	7	26
Larval Collection									1	1		1	3

No. Of Males	0
No. Damaged	0
Shipments Received	16
Total Collections	14
Total specimens	42

NOTE: All ovitrap paddles collected were negative for Aedes mosquito eggs.
* For species verification/consultation.

KADENA AB, JAPAN
MOSQUITO SURVEILLANCE SUMMARY - 1967
NO. OF ADULT FEMALES IDENTIFIED

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
AEDES													
albopictus				2	3	8		10	89	35			147
vexans nipponii				41	4	237	83	4	97	39	3		508
ANOPHELES													
lesteri				17	1	7	6	3	1	3			38
sinensis				3	2	1	7	4		2			19
ARMIGERES													
subalbatus					4	7	4	3		5	1		24
COQUILLETTIDIA													
crassipes						1				1			2
ochraceae										2			2
CULEX													
bitaeniorhynchus				1	2	1	1	1		1			7
fuscanus						2	1		2	1			6
halifaxii				1	2	1							4
hayashii						1							1
infantulus				1									1
nigropunctatus						1							1
okinawae						1							1
quinquefasciatus				80	178	39	22	7	16	8			350
rubithoracis						1	2						3
ryukyensis									1				1
sitiens										11			11
tritaeniorhynchus				22	14	130	174	38	53	81			512
MANSONIA													
uniformis						3	8	10	5	11	1		38
MIMOMYIA													
elegans						1	7	6	11	4			29
luzonensis						6	3			2			11
Total Females	0	0	0	168	210	448	318	86	275	206	5	0	1,716

KADENA AB
(CONTINUED)

LARVAE

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
AEDES													
albopictus					18				56				74
riversi									28				28
vexans nipponii									2	25			27
spp									16				16
ANOPHELES													
lesteri/sinensis				13	9	7	8						37
sinensis				13	1								14
spp				4		5	1						10
CULEX													
bitaeniorhynchus				14	25		14		13	12			78
fuscanus									1	1			2
pseudovishnui										1			1
quinquefasciatus				1	44	3			2	13			63
sinensis										3			3
tritaeniorhynchus						15	6		65	6			92
spp						32	2		3	21			58
(Lop) quadripalpis										2			2
Total Larvae	0	0	0	45	97	62	31	0	186	84	0	0	505
Larval collections				7	10	10	9		9	9			54

NOTE: Positive larval collections only

No. of Males	4
No. Damaged	8
Shipments Received	43
Total Collections (Estimate)	388
Total Specimens	2,221

NO. OF OVITRAP PADDLES AND EGG COUNT - 1987
(BASED ON DATE SUBMITTED)

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
PADDLE COUNT	0	0	0	36(34)	30(24)	40(37)	49(45)	0	38(32)	47(44)	11(11)	0	251(227)
EGG COUNT	0	0	0	1,446	1,366	1,931	2,392	0	1,282	2,530	523	0	11,470

*The number in each parentheses is the number of paddles positive for Aedes spp eggs.
Egg rearings from positive ovitrap paddles yielded all Aedes albopictus (1051 females and 1237 males).

KUNSAN AB, KOREA
MOSQUITO SURVEILLANCE SUMMARY - 1987
NO. OF ADULT FEMALES IDENTIFIED

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
ANOPHELES													
sinensis						3			1				4
CULEX													
pipiens pallens						45	3		3				51
tritaeniorhynchus							239		48				287
vagans					10	1							11
Total Females	0	0	0	0	10	49	242	0	52	0	0	0	353
Total Trap Collection					4	3	9		6				22
Overall Trap Index					2.5	16.3	26.9		8.7				

NOTE: Trap collection data were from I.D. forms and are only positive collections.

LARVAE

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
AEDES													
ANOPHELES													
spp							2						2
CULEX													
pipiens pallens						14	17						31
tritaeniorhynchus						3	6						9
spp						9							9
Total Larvae	0	0	0	0	0	26	25	0	0	0	0	0	51
Larval Collections						3	2						5

NOTE: Positive Larval collections only.

No. of Males	0
No. Damaged	0
Shipments Received	6
Total Collections*	27
Total Specimens	404

*Positive collections

KWANG JU AB, KOREA
MOSQUITO SURVEILLANCE SUMMARY - 1987
NO. OF ADULT FEMALES IDENTIFIED

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
AEDES													
ANOPHELES													
sinensis						1	1						2
CULEX													
pipiens pallens						71	13		10				94
sinensis									2				2
tritaeniorhynchus							4	1	34				39
Total Females	0	0	0	0	0	72	18	1	46	0	0	0	137
New Jersey Light Trap						72	18	1	46				
Total Trap Collection						5	3	1	9				18
New Jersey Light Trap						5	3	1	9				
Overall Trap Index						14.4	6.0	1.0	5.1				
New Jersey Light Trap						14.4	6.0	1.0	5.1				

No. of Males	0
No. Damaged	0
Shipments Received	4
Total Collections	18
Total Specimens	137

NOTE: Positive trap collection data only. No surveillance summary provided that gives the total number of collections.

MISAWA AB, JAPAN
MOSQUITO SURVEILLANCE SUMMARY - 1987
NO. OF ADULT FEMALES IDENTIFIED

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
AEDES													
vexans nipponii								1					1
ANOPHELES													
lesteri							5	31					36
sinensis							26	92					118
CULEX													
orientalis							2						2
pipiens pallens								4					4
rubensis							2						2
tritaeniorhynchus								13					13
vagans								5					5
Total Females	0	0	0	0	0	0	35	146	0	0	0	0	181
New Jersey Light Trap							17	110					
SSAM Light Trap							18	36					
Total Trap Collection							18	16					34
New Jersey Light Trap							9	13					
SSAM Light Trap							9	3					
Overall Trap Index							1.9	9.1					
New Jersey Light Trap							1.9	8.5					
SSAM Light Trap							2.0	12.0					

NOTE: AUG Trap index is for positive collection only . No surveillance summary for the month provided that would show total number of collection, both positive and negative.

LARVAE

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
ANOPHELES													
lesteri/sinensis								3					3
spp								5					5
CULEX													
orientalis								1					1
spp								5					5
Total Larvae	0	0	0	0	0	0	0	14	0	0	0	0	14
Larval Collection								3					3

No. of Males	25
No. Damaged	58
Shipments Received	4
Total Collections	37
Total Specimens	278

OSAN AB, KOREA
MOSQUITO SURVEILLANCE SUMMARY - 1987
NO. OF ADULT FEMALES IDENTIFIED

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
AEDES													
vexans nipponii						64	5						69
ANOPHELES													
lesteri						6	9	7	1				23
sinensis						120	302	92	126				640
CULEX													
orientalis							1						1
pipiens pallens							3		2				5
tritaeniorhynchus							19	152	53				224
Total Females	0	0	0	0	0	190	339	251	182	0	0	0	962
New Jersey Light Trap						103	295	162	131				
New Jersey Light + CO2						87	44	89	51				
Total Trap Collections						25	33	36	29				123
New Jersey Light Trap						21	30	28	22				
New Jersey Light + CO2						4	3	8	7				
Overall Trap Index						7.6	10.3	7.0	6.3				
New Jersey Light Trap						4.9	9.8	5.8	6.0				
New Jersey Light + CO2						21.8	14.7	11.1	7.3				

LARVAE

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
AEDES													
vexans nipponii							2	2					4
spp							1						1
ANOPHELES													
lesteri/sinensis						18	18	16	92				144
CULEX													
tritaeniorhynchus							2	10	27				39
Total Larvae	0	0	0	0	0	18	23	28	119	0	0	0	188
Larval Collections						4	4	6	7				21

No. of Males	9
No. Damaged	5
Shipments Received	16
Total Collections	44
Total Specimens	1,154

NOTE: Number of trap collections and trapping methods used are based on Taxonomic I.D. sheets data.
No Monthly Mosquito Surveillance Activities Summary for any month provided.

SUWON AB, KOREA
MOSQUITO SURVEILLANCE SUMMARY - 1987
NO. OF ADULT FEMALES IDENTIFIED

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
ANOPHELES													
sinensis						4							4
CULEX													
orientalis								1					1
tritaeniorhynchus								1					1
Total Females	0	0	0	0	0	4	0	2	0	0	0	0	6
Trap Collection						2		1					3
Trap Index						2		2					

No. of Males	0
No. Damaged	0
Shipments Received	3
Total Collections	3
Total Specimens	6

TAEGU AB, KOREA
MOSQUITO SURVEILLANCE SUMMARY - 1987
NO. OF ADULT FEMALES IDENTIFIED

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
ANOPHELES													
sinensis							63	20	2				85
CULEX													
pipiens pallens						21	60	1	3				85
quinquefasciatus							6	5					11
tritaeniorhynchus							7	10	2				19
Total Females	0	0	0	0	0	21	136	36	7	0	0	0	200
New Jersey Light Trap						21	136	36	7				
Total Trap Collection						4	5	2	1				12
New Jersey Light Trap						4	5	2	1				
Overall Trap Index						5.25	27.2	18	7				
New Jersey Light Trap						5.25	27.2	18	7				

NOTE: Jul to Sep collection data were from ID sheets and indicate positive trap collection only. Lack of complimentary data from Monthly Mosquito Surveillance Activities Summary (AMD form 208 or AFSC form 3151) precludes accurate trap index computation.

LARVAE

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
CULEX													
tritaeniorhynchus								9					9
spp								6					6
Total Larvae	0	0	0	0	0	0	0	15	0	0	0	0	15
Larval Collection								1					1

No. of Males	2
No. Damaged	1
Shipments Received	6
Total Collections	13
Total Specimens	218

WHEELER AFB, HAWAII
MOSQUITO SURVEILLANCE SUMMARY - 1987
NO. OF OVITRAP PADDLES AND EGG COUNT
(BASED ON DATE COLLECTED)

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
PADDLE COUNT	41(7)*	32(4)	15(6)	0	0	0	0	0	0	2	26(5)	47(2)	156 24
EGG COUNT	70	28	36	0	0	0	0	0	0	0	74	98	31

*The number in each parentheses is the number of paddles positive for feces and eggs.
Rearing results from positive ovitrap paddles yielded 15 females and 24 males of Aedes albopictus.

YOKOTA AB, JAPAN
MOSQUITO SURVEILLANCE SUMMARY - 1987
NO. OF LARVAE IDENTIFIED

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
CULEX													
tuscanus									1				1
ryukyensis								1					1
Total Larvae	0	0	0	0	0	0	0	1	1	0	0	0	2
Larval Collection								1	1				2

No.of Males	0
No. Damaged	0
Shipments Received	2
Total Collections	255
Total Specimens	2

NOTE: Adult collections were all negative.

NO. OF OVITRAP PADDLES AND EGG COUNT - 1987
(BASED ON DATE COLLECTED)

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
PADDLE COUNT	0	0	0	0	11(1)*	7(3)	2(1)	2(2)	3	0	0	0	22(7)
EGG COUNT	0	0	0	0	15	273	89	490	0	0	0	0	867

*The number in each parentheses is the number of paddle/paddles positive for Aedes spp eggs.
Each trap is counted one paddle i.e., any number of paddles in an ovitrap is counted as one.
All successful rearings from positive ovitrap paddles yielded Aedes albopictus (9 females and 13 males).

APPENDIX A

INFORMATION ON MOSQUITO SURVEILLANCE, BIONOMICS AND CONTROL

INFORMATION ON MOSQUITO SURVEILLANCE, BIONOMICS AND CONTROL

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I. MOSQUITO SURVEILLANCE*

A. Environmental Survey. To establish or strengthen a mosquito surveillance program, an annual baseline environmental survey should be accomplished at every Pacific area Air Force installation at the beginning of each mosquito season. Such a survey could, for example, be made during April-May in Okinawa, May-June in Korea and Japan, and in the Philippines and Guam with a year-long mosquito season, during the early rainy season (May-July). The survey involves the first noting or plotting on a topographical map the prevailing winds and the base swamps, lakes, and other permanent and stationary water bodies, streams and other flowing water, major open drainage ditches, other mosquito breeding sites such as low, water-collecting areas near flight lines, and wooded or other areas known from past experience to be regions of intense adult mosquito activity. A thorough search by vehicle and on foot is then made to confirm that previously known breeding areas still hold water and to locate new, potential mosquito breeding spots which are then indicated on the map. Consideration should be given to pest/vector production from man-made breeding sources like clogged rain gutters and storm sewer catch basins and mosquito infiltration from suspected or known mosquito breeding sources nearby off base. Possible on-base breeding sites identified in the environmental survey are sampled during routine larval surveillance throughout the mosquito season and control efforts are directed at locations positive for mosquito immatures to minimize on-base generation of adult mosquitoes.

B. Adult Mosquito Collections

1. New Jersey Trap. The New Jersey (NJ) trap (NSN 3740-00-607-0337) is the primary tool used for adult mosquito surveillance on Pacific theater Air Force installations. This sturdy metal trap is normally placed in permanent or fixed locations during a given mosquito season. For computer entry of trapping data, the collecting sites should be coded T-1, T-2, and so on, and OL AD/ES should be provided a short letter at the beginning of each mosquito season which lists the site codes and gives a brief description of each location. PACAF Supplement 1 to AFR 161-1 outlines the required minimum number of NJ mosquito traps and trapping nights per week based on installation population. Generally, this is three to five traps operated three evenings each week. Traps are placed in fairly secure spots where the possibility of pilferage is low and where disturbances due to other lights and wind will be minimal but trap light visibility is not too restricted and electric power is available for non-battery operated traps. Traps may be placed near the base perimeter to detect mosquitoes invading from off-base

*Information in this appendix was prepared by Lt Col Dennis D. Pinkovsky for the CY 85 mosquito summary. The data included should be particularly beneficial for individuals who have not worked in mosquito surveillance programs before.

breeding sources, in critical populated areas of the base (housing areas, flight line maintenance areas--an MQI program requirement, golf course, main base) or between the populated areas and known mosquito production locations. Locations just within the margins of woods or swamps are often very productive mosquito collecting spots. Trap locations are marked on the map. In general, mosquitoes have relatively short flight ranges, and the farther traps are located from known mosquito breeding areas, the fewer mosquitoes one would normally expect to catch. Traps are suspended so that the light bulb is five to six feet above the ground, and traps can be secured with cables to retard possible swinging. Civil Engineering can construct simple, inverted L-shaped, concrete-based, trap supports. Some installations incorporate electrical outlets into the trap support design; other bases hang traps from tree limbs and supply electrical power by extension cords. Avoid hanging NJ traps from fencing which may accidentally become electrified. A 60-watt white incandescent light bulb serves as the "attractant" for the trap; alternatively, carbon dioxide as dry ice can be used to draw mosquitoes into the trap vicinity. Figure 1 shows a schematic NJ trap equipped with light and carbon dioxide. The dry ice is placed in a styrofoam container located above the trap, and the CO_2 flows through a tygon tube and exits underneath the trap rain cover. Insects lured by the light or CO_2 are pulled downward by the trap fan along a screen funnel into the collecting or kill jar. An exclusion screen of ¼ inch mesh hardware cloth prevents large beetles and moths from reaching the collection of fragile mosquitoes. Vapors from a 1- to 2-inch section of DDVP-impregnated resin fly strip (No-Pest^R) placed in the bottom of the jar kills captured insects. A paper or plastic cup, perforated with many small holes, should be placed in the mouth of the kill jar to retain insects and keep the mosquitoes off the insecticide strip but allow entrance of killing vapors. Light traps are operated from sunset to sunrise; CO_2-baited traps can be operated for 24-hour periods to collect day-flying as well as night-flying mosquitoes. Carbon dioxide generally attracts greater numbers and a greater variety of mosquitoes and far fewer beetles, moths, and other unwanted insects than does light. Photoelectric attachments or electrical timers may be connected to the NJ light traps to switch them on at dusk and off at dawn. Specimens should be retrieved from the killing jar each morning after a night of trap operation. Female mosquitoes should be separated from male mosquitoes and non-mosquitoes, and the number of female mosquitoes in each trap should be logged. Prevailing temperature, phase of the moon, wind, and rain, in addition to control efforts, are some factors which can affect trap collections. EHS personnel should telephone mosquito trap counts and other surveillance information in a timely fashion to Civil Engineering (CE) Pest Control, and EHS should receive from CE a written report on mosquito control activities at the end of each month of the mosquito season. Correlated with complaint calls due to mosquitoes, historical information from past outbreaks of mosquito-borne disease, and other factors, control trigger numbers or the number of female mosquitoes per trap which indicate ground-based fogging efforts are needed can be established. Captured mosquitoes should be packaged for shipment (Section IV) and mailed for identification each week. The numbers and species of submitted adult mosquitoes are reported by VTS to each installation on AMD Form 658, Female Mosquito Identifications.

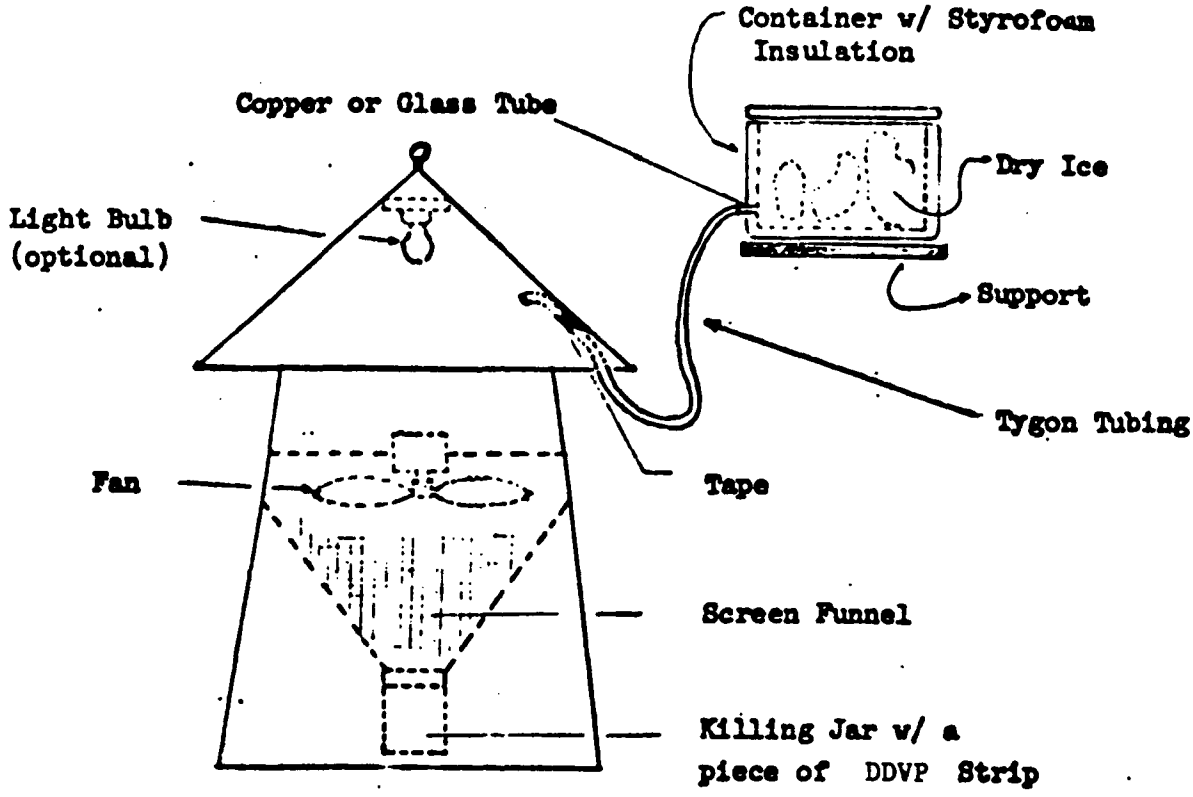


Figure 1. CO_2-Baited NEW JERSEY Light Trap

2. Solid State Army Miniature Light Trap. A portable, light weight, battery-powered mosquito trap developed by the US Army and available in the Federal Supply System is the Solid State Army Miniature Light Trap (SSAM), NSN 3740-01-106-0091 (Figure 2). The SSAM trap replaced the earlier Centers for Disease Control (CDC) portable trap. This trap weighs about four pounds including the battery. Features include a clear plastic trap body, solid state circuitry, an improved fan and motor, improved light bulb, and a photo-electric switch. The SSAM trap is especially useful for augmenting NJ trap collections by allowing the monitoring of mosquitoes in base areas where electrical outlets are unavailable. Mosquitoes may be collected alive in a cloth mesh bag (useful for mosquito-borne viral disease studies) or dead in a kill jar. The live-caught specimens can be killed by freezing in the laboratory and, when thawed, they are usually in excellent, undamaged condition for packaging and identification. The SSAM trap automatically activates at dusk as daylight decreases; increasing light at sunrise deactivates the light bulb but the fan continues to operate to retain mosquitoes captured live in the mesh bag. A gel-cell rechargeable battery (NSN 6140-00-432-0490) and battery charger (NSN 6130-00-629-7396) are available for the trap. Like the NJ trap, the SSAM trap can use dry ice as the mosquito attractant for the trap. Precautions must be taken to minimize pilferage in the field of these compact mosquito traps. Replacement light bulbs are available under NSN 6240-00-761-0979 (10 bulbs/box). If rain is anticipated, especially when using the cloth collection bag, place the SSAM trap under a roof overhang or other shelter to minimize weather-caused specimen damage.

3. Fay-Prince Trap. A portable, light weight, battery-powered mosquito trap specifically intended as a daytime trap for the collection of male and female Aedes aegypti and Aedes albopictus mosquitoes (vectors of dengue viruses) is the Fay-Prince trap (Figure 3). The design is based on the attraction of contrasting glossy black and white panels. There is a wind-orienting trapezoidal cover, a cylinder holding a suction motor, and a suspended collection bag. There is no trap light. The trap should be placed in the vicinity of suspected mosquito breeding sites, especially in the backyards of or between human habitations. This trap should be positioned in a location somewhat protected from the wind and three feet above the ground (interference from animals and children may be a problem). If rain is a possibility, a roof overhang or other additional rain protection is advisable. Dry ice can increase the mosquito catch. The trap operates on a 6-volt power source; the Federally stock-listed gel-cell rechargeable battery mentioned in the SSAM trap discussion above is appropriate for running the Fay trap. The Fay-Prince trap (Model 712) is available for approximately $125.00 from the John W. Hock Co., P. O. Box 12852, Gainesville, Florida 32604.

4. Resting Collections. Mosquitoes which fly and bite at night (most do this) can be collected during daylight hours while they rest in culverts, beneath bridges, in tree holes, inside sheds, or in other shaded locations. Artificial resting sites can be made from one cubic foot wooden or cardboard boxes which are painted red inside and placed in woods, swamps, near shrubbery or elsewhere; the next morning the boxes can be examined for mosquitoes sheltering in them. A flashlight and a battery-powered aspirator

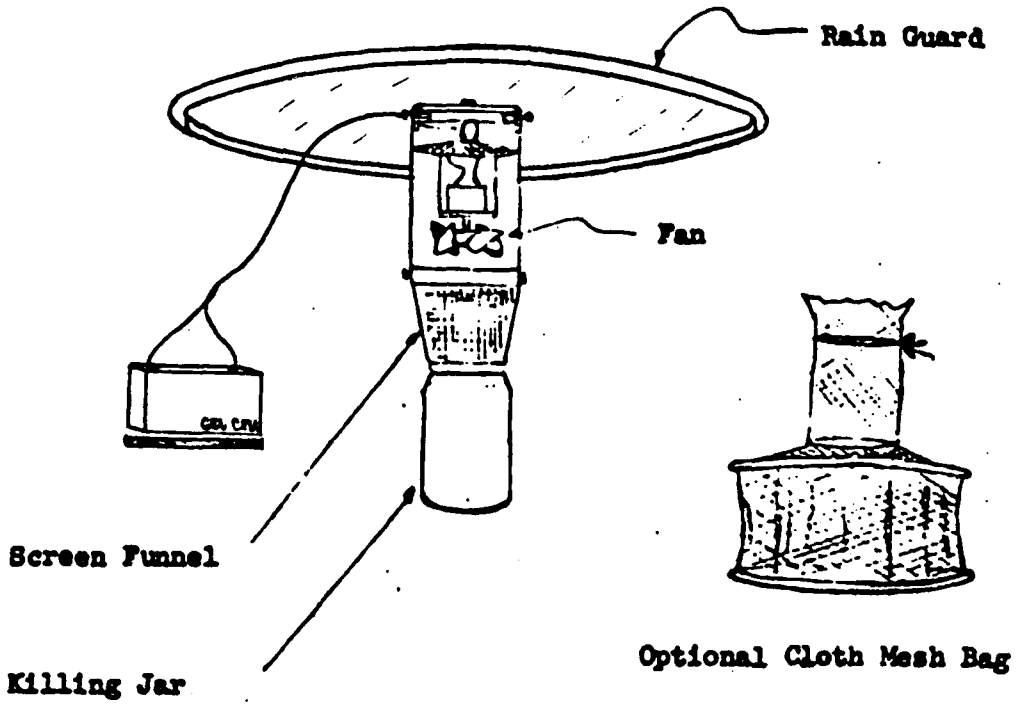


Figure 2. **Solid State Army Miniature (SSAM) Trap**

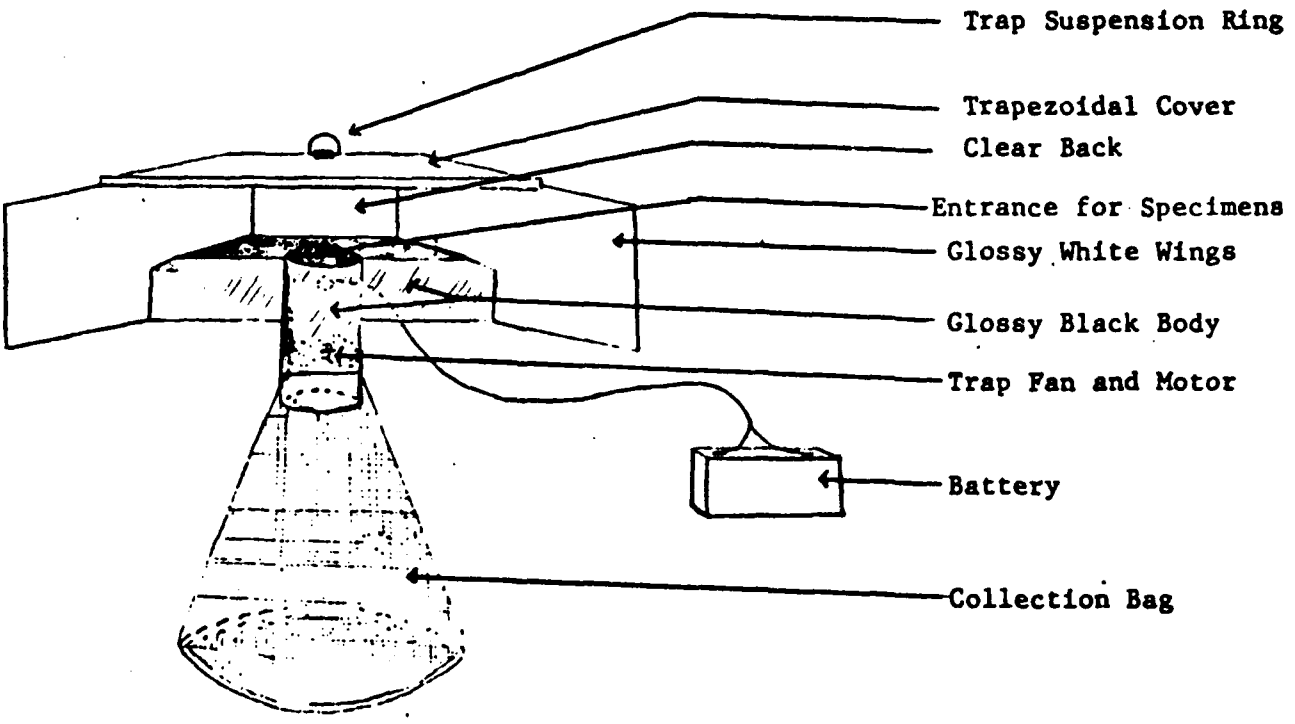


Figure 3. Fay-Prince Trap

make capturing mosquitoes in resting sites relatively easy. The captured mosquitoes are transferred to holding containers and then killed by freezing and prepared for shipment and identification.

5. Landing/Biting Collections. Landing or biting collections of mosquitoes using humans as the attractant hosts in different areas of the base can give an indication of the actual intensity of human biting mosquitoes in different locations and can be compared with mosquito trap counts to better determine control trigger numbers. Mosquitoes attracted to and landing on or biting the exposed body portion such as legs of a person are collected with an aspirator and counted for periods of 5 to 15 minutes. Individuals differ in attractiveness to mosquitoes so the same individual must be used in all areas for valid comparisons. Naturally, mosquito repellents must not be applied. Landing/biting collections using personnel as the attractant hosts are not recommended in areas where transmission of mosquito-borne diseases is a possibility unless adequate chemical prophylaxis against all potential mosquito-borne diseases can be assured. Carabao, dogs, birds, or other animal hosts can be used in Magoon (baffled)-type traps or fully exposed as bait for biting collections, but such animal bait collections do not reflect true human biting activity.

C. Collections of Mosquito Immatures

1. Mosquito Larvae and Pupae Surveys. If mosquito populations can be discovered in the less mobile wriggler or larval stage, or as pupae, and killed, the blood-seeking, pathogen-transferring adult female stage is avoided. Mosquitoes develop in almost any type of water--rice-fields, ditches, swamps, salt marshes, stream edges and pools, carabao wallows, ground pools, sewer catch basins, clogged rain gutters, discarded vehicle tires, open washing machines in salvage yards, tree holes, leaf axils of Pandanus, banana, and other plants, and so on. In surveys for the immature stages of mosquitoes, at least twenty sites should be sampled semimonthly. A white-colored dipper, vials, MacGregors (see Section IV) preserving fluid or 80% ethanol, a wide orifice eye dropper, and boots are the basic larval sampling essentials. In dipping, the trick is to rapidly submerge one side of the dipper allowing water and larvae to flow in but not overflow the container. Avoid casting shadows or disturbing the water surface before each dip; disturbed larvae will submerge and can remain at the bottom of the breeding site for a few minutes. Try to collect large (late instar) larvae; they are more easily identified. Place all larvae from one sampling site in a vial separate from larvae collected at other locations. Each vial must contain a label (written in pencil) which includes the collection site (for example: L-1, grassy ditch at Bldg 32 or L-2, ricefield near TMO), installation, date, and name of collector. (Note: If live larvae are left too long in water with a penciled soft paper label, the insects' "grazing" feeding behavior may obliterate the label information.) Place larvae in vials of water in the field, "fix" the larvae in hot but not boiling water in the laboratory, and ship the larvae in appropriately labeled vials of preservative (see Section IV). Mosquito pupae are difficult to identify and pupae are not normally submitted; however, live mosquito pupae collected in the field can be placed in small containers of water or on moist paper

toweling in labeled petri dishes and held alive to allow the adults to emerge, which are then killed, packaged, and sent for identification. Notify CE Pest Control of locations positive for mosquito larvae and pupae for control action. For submitted larval specimens, VTS will return AMD Form 652, Larval Mosquito Identifications, with annotations of the mosquito species and numbers that were submitted.

2. Ovitrapping. Installations in Guam, Hawaii, Okinawa, and the Philippines, in particular, should monitor populations of container-breeding Aedes mosquitoes by using oviposition traps or ovitraps. These glass or plastic, wide-mouth, pint jars are painted glossy black on the outside, an inch or two of water is placed into each jar, and a "paddle" is affixed vertically with a clip to the inside of the jar. The paddle is the rough surface on which the Aedes females lay their eggs and can be made by wrapping a GI-brown paper towel around a wooden tongue depressor and securing it with rubber bands. Aedes aegypti and Aedes albopictus, important vectors of dengue viruses, are usually not readily collected in other standard mosquito traps, and the ovitrap is an effective means for locating and monitoring populations of these mosquitoes. Ten to twenty ovitraps are positioned at ground level in shaded but visible locations (near shrubbery, under elevated homes, against or inside open sheds) for periods of one week in small sections of housing areas or other appropriate populated base areas. The ovitraps are visited each week, paddles are removed and placed into individual, labeled (site, base, date) plastic bags, and the paddles are shipped to VTS for examination and identification (through egg hatching and specimen rearing) of the species which deposited any eggs present.* Mosquito larvae and pupae present in the ovitrap water are also collected, placed in a vial of preservative, and submitted for identification. The ovitrap jars are flushed with clean water, fresh water and a new paddle are added, and the traps are left for a second, third, or fourth week at the same locations or are repositioned to a new area of the base. Checking and cleaning the ovitraps each week (every 7 days) is critical because under appropriate conditions the Aedes mosquitoes (or other container breeders) can develop from eggs to adults in as little as nine or ten days and ovitraps must not be allowed to become mosquito breeding locations. A search should be made within 100 yards or so of positive ovitraps for flower pots, clogged rain gutters, or other breeding sources of the detected Aedes populations.

D. Monthly Mosquito Surveillance Activities Summary (AMD Form 208). Shown on the next page (Figure 4) is a sample AMD Form 208, Monthly Mosquito Surveillance Activities Summary. Environmental Health Services at each Pacific area base should complete and submit to ES one AMD 208 at the end of each month during the mosquito season. Each trapping date should be indicated, whether or not mosquitoes were captured. Sections are provided for summarizing adult trapping, ovitrapping, and larval surveillance

* Operational Note: Open the plastic bags and let the paddles air dry one day prior to shipping. This helps curtail hatching of moist eggs in shipment. Also use clear (ziplock) plastic bags without any commercial writing on them; this assists the examination efforts of our vector taxonomist.

SAMPLE ONLY

MONTHLY MOSQUITO SURVEILLANCE ACTIVITIES SUMMARY

INSTALLATION	MONTH/YEAR
Skeeter AB, Philippines	June 1986

TRAP SITE DATA *(NEW JERSEY TRAPS ONLY)*:

SITE NO.	TRAP NO.	BULB SIZE	CO_2 USED?	SITE DESCRIPTION
1	T-1	60W	Yes	Behind 3d ARRS Hangar, Bldg 205
2	T-2	60W	No	Quarters #72, Hill Housing, 5th Place
3	T-3	60W	Yes	Quarters #806, Capehart Housing, Bugless Ave
4	T-4	60W	Yes	Base picnic grounds, Bldg 4
5				
6				

TRAP OPERATION DATA:

DATES OPERATED[1]

SITE NO.	LIGHT ONLY	CO_2 ONLY	LIGHT AND CO_2
1	2^+,6^+, 9,13^+,16^+,20^+,23^+,27^+	4^+,11^+,18^+,25^+	----------
2	2 (trap in for repairs, rest of April)		----------
3	2,6,9,13,16,20,23,27	4,11,18,25 (Plan to move trap)	----------
4	2^+,6^+,9^+,13^+,16^+,20^+,23^+,27^+	4^+,11^+,18^+,25^+	
5			
6			

WERE ANY CDC PORTABLE LIGHT TRAPS USED DURING THE MONTH? ANY SSAM PORTABLE TRAPS USED?

3 SSAM traps used.

IF CDC OR SSAM TRAPS WERE USED, INDICATE LOCATIONS, DATES AT EACH LOCATION, AND EACH INSTANCE IN WHICH CO_2 WAS USED WITH A TRAP.

SSAM traps used, with CO_2, at Bldgs 191, 215, and 322 along the flight line on 11 and 25 April. Mosquitoes were captured on each date at each location.

OTHER TYPES OF ADULT MOSQUITO COLLECTIONS DURING THE MONTH:

None

[1] *A "+" BY A DATE INDICATES MOSQUITOES WERE CAPTURED ON THAT DATE AND SUBMITTED FOR IDENTIFICATION.*

AFSC Form 3151, FEB 86 REPLACES AMD FORM 208, JAN 84, WHICH IS OBSOLETE.

LARVAL COLLECTION DATA:

SITE NO.	SITE DESCRIPTION	NO. OF DIPS	NO. OF LARVAE	DATE(S) SAMPLED
1	(3)* Ditch, Bldg 191	10	8	12, 26
2	(4) Marsh, Bldg 3	10	16	"
3	(5) Pond, Bldg 83	10	3	"
4	(3) Ditch, Bldg 215	10	20	"
5	(1) tire, Bldg 79	2	50	"
6	(2) Catch Basin, Bldg 85	3	25	"
7	(1) Washers, Salvage	10	200	"
8	(7) pool, Bldg 192	10	15	"
9	(3) Ditch, Bldg 322	10	1	"
10	Stream Edge, Stables	10	0	"
11	Stream Edge, Stables	10	5	"
12	(2) Catch Basin Bldg 100	4	75	"
13	(3) Ditch, Bldg 105	10	10	"
14	(7) Pool Bldg 112	dry	0	"
15	(2) Catch Basin, Bldg 73	dry	0	"
16	(4) Swamp, Kennels	5	112	"
17	(3) Ditch, Hospital	10	36	"
18	(3) Ditch Bldg 4	10	30	"
19	(3) Ditch Bldg 47	10	0	"
20	(3) Ditch, Bldg 60	10	0	"

OVITRAP DATA:

SITE NO.	SITE DESCRIPTION	DATES OVITRAPS CHECKED	DATES POSITIVE FOR EGGS OR LARVAE
1	NCO Club, front	4, 11, 18, 25	4
2	NCO Club, Rear	"	4, 11, 25
3	O Club, Side	"	11, 18
4	O Club, Rear	"	11, 18, 25
5	CCC, Side	"	----------
6	CCC, Rear	"	----------
7	Quarters #77 Rear	"	----------
8	Quarters #77 Side	"	----------
9	Quarters #89 Rear	"	4, 11, 18, 25
10	Quarters #89 Side	"	4, 11, 18, 25
11			
12			

* Number in parentheses is the site type from larval identifications (AMD Fm 652) sheet

DISTRIBUTION: 1 CY TO SUBMITTING BASE; 1 CY TO OL-AD USAF OEHL/ES; 1 CY TO USAF OEHL/ECQ

AFSC Form 3151, FEB 86 (Reverse)

activities. This form assists your own periodic internal review of the mosquito surveillance program and helps us at OL AD identify problem areas (maintenance, aged traps, trap location problems, etc.) which we can assist you in solving.

II. DIFFERENTIATION OF COLLECTED ADULT SPECIMENS

A. Mosquitoes from Non-Mosquitoes. The females of most species of mosquitoes (order Diptera, family Culicidae) are blood suckers. The mosquitoes are characterized, among other body features, by their relatively small size (about 1 cm long), typical wing venation, presence of many scales on wings and body, and long central proboscis on the head (see Figure 5A)*. Other flies which may be captured in traps along with mosquitoes that have similar size and appearance and may be confused for mosquitoes include the dixid, phantom, and chironomid midges. The latter is shown in Figure 5B. These non-mosquito insects lack the central proboscis, are not blood feeders, and lack or have far fewer scales on the wings.

B. Female Mosquitoes from Male Mosquitoes. Differences in the appearance of the antennae enable separation of the females from the males of most mosquito species. The antennae of male mosquitoes (Figure 5, F & H) are very bushy or plumose compared to the relatively short-haired antennae of the females (Figure 5, E & G). The males of most mosquito species have maxillary palps which extend beyond the central proboscis while the palps of the females are much shorter. In Anopheles species, however, the palps are relatively equivalent in length in both sexes but the male's palps are clubbed (swollen) at the distal end.

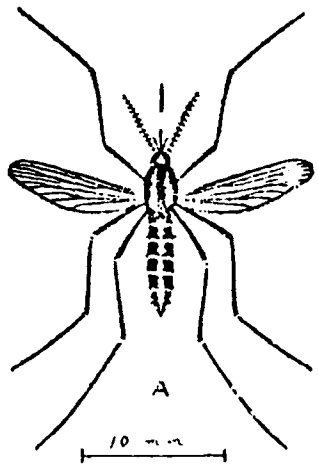
III. PACKING AND SHIPPING

A. General. Dead, preserved mosquito specimens submitted for identification should be prepared for shipment as described in this section. Viable mosquito eggs on ovitrap paddles are the only live specimens that should be submitted without first contacting OL AD at AV 89-33245. All mosquitoes submitted for identification must be labeled with the following: (1) locality--place of collection (Osan AB, Korea); (2) source--T-1 (NJ light trap #1); T-2 (CO_2-baited NJ trap #2), L-4 (Larval station #4), and so on; (3) collector--Sgt Sharpsky, SGPM; and (4) date--day, month, and year of collection. Ship all mosquito specimens to: Vector Taxonomy Section (VTS), OL AD, USAFOEHL, APO San Francisco 96528-0007.

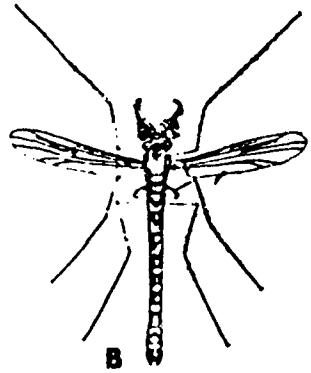
B. Adult Mosquitoes

1. Pick up the insects accumulated in the killing jars of the mosquito traps each morning after a night of trap operation. Separate the female

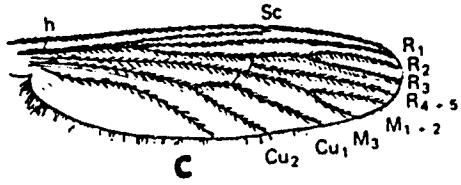
* Modified from: Borror, D. J., D. M. De Long, and C. A. Triplehorn. 1976. An Introduction to the Study of Insects, 4th Ed., Holt, Rinehart, and Winston, pp 569, 571, 573, 574.



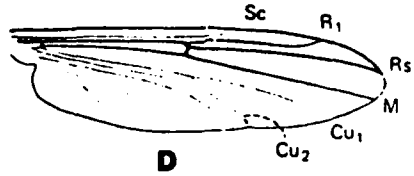
Aedes Mosquito (Female)



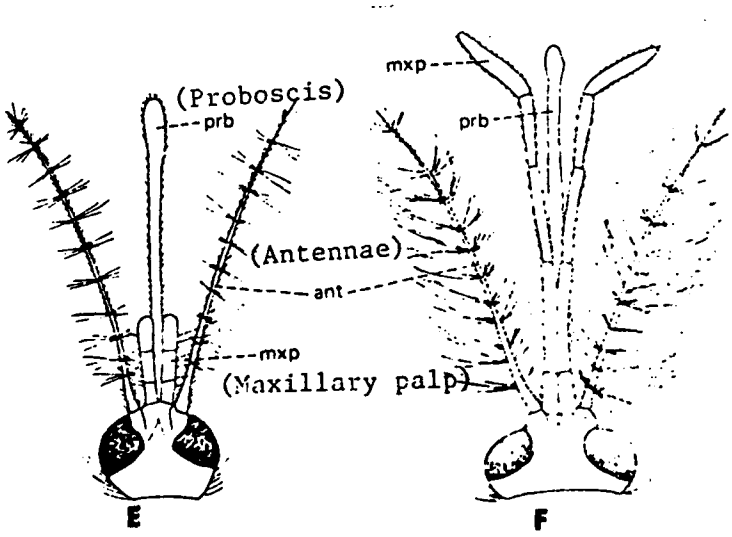
Chronomid Midge (Male)



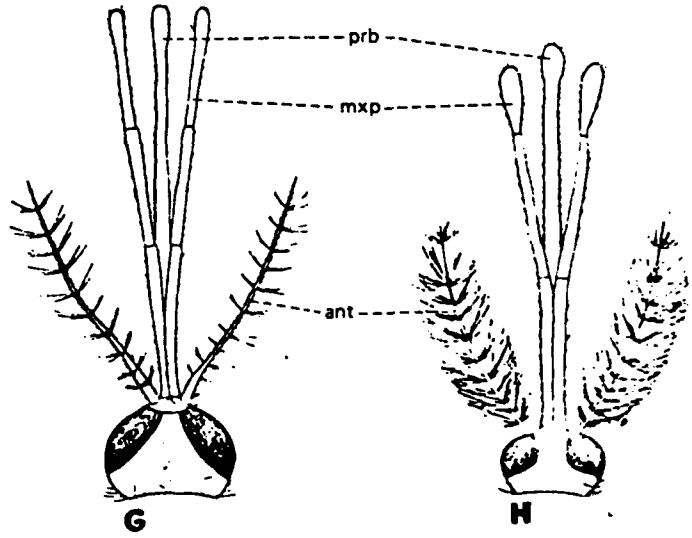
Mosquito Wing



Chronomid Midge Wing



(Female) Aedes (Male)



(Female) Anopheles (Male)

Figure 5. Mosquito and Non-Mosquito Morphology

mosquitoes from the unwanted insects and pack them for shipment as soon as possible. If the time between the end of the collection period and the time the mosquitoes are packed exceeds 6 hours, the specimens dry and become brittle. When brittle mosquitoes are packed, legs, wings, and other parts necessary for identification break off, and the mosquitoes cannot be identified. Poor collection discipline results in specimen loss due to: compression by the weight of excessive numbers of insects, mold formation, or excessive killing time because the killing agent cannot penetrate the thick layer of accumulated insects.

2. Mosquitoes packaged for shipment in the manner depicted in Figures 6A through D below will arrive in excellent condition and be identifiable. A number of the culture dishes may be required to handle a large collection of mosquitoes. Proper labeling of each container is essential. The necessary packaging materials are available to all Environmental Health Services offices and consist of facial tissues and plastic petri dishes (Dish, culture, Petri, top and bottom complete, FSN 6640-01-030-9012).

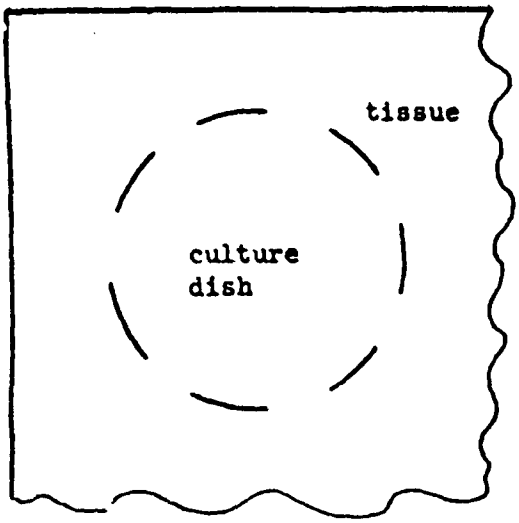
3. Stack and tape multiple culture dishes together. Pack the plastic dishes for shipment in a strong cardboard carton which is large enough to insure that the dishes are surrounded on all sides by at least 1 inch of packing material. Packing material can be styrofoam chips, wadded tissues, paper towels, rolled newspapers, or anything of this nature. The carton should be taped securely shut so that it cannot open in the mail.

C. Larval Mosquitoes

1. Ship all larvae from a single collection site in one container. Do not mix larvae from two or more collection sites in the same container of preservative. If possible, kill the larvae by placing them in hot, but not boiling water for two minutes. The water from a hot water tap is normally scalding enough for this purpose. The hot water prevents the larvae from turning black and becoming difficult to identify. Drain the water from the mosquitoes before adding the preservative. If hot water is not available, the larvae may be placed in a mixture of glacial acetic acid and alcohol (1:6) to kill them and then can be transferred to a shipping vial or bottle filled with preservative. Larvae can also be placed directly in the preservative after all field-collected water has been drained from them.

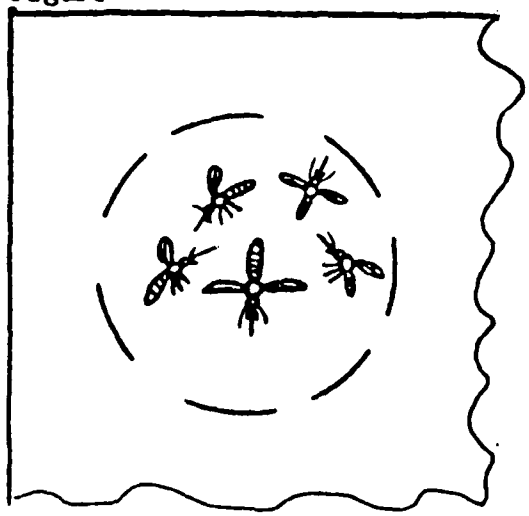
2. Larvae are generally preserved and shipped in 80 percent ethyl or isopropyl alcohol. Ethanol is superior to isopropanol. These preservatives may, however, cause hardening and distortion of the larvae which make identification difficult. Environmental Entomology Services recommends that MacGregor's solution, rather than alcohol, be used for preserving and shipping mosquito larvae. This solution is made by dissolving 5 grams of borax (sodium borate) in a small amount of water, then adding 2.5 ml of glycerine and 100 ml of 37 percent formaldehyde to the mixture, and finally adding sufficient distilled water to make a total volume of 1 liter (1000 ml).

Figure 6A



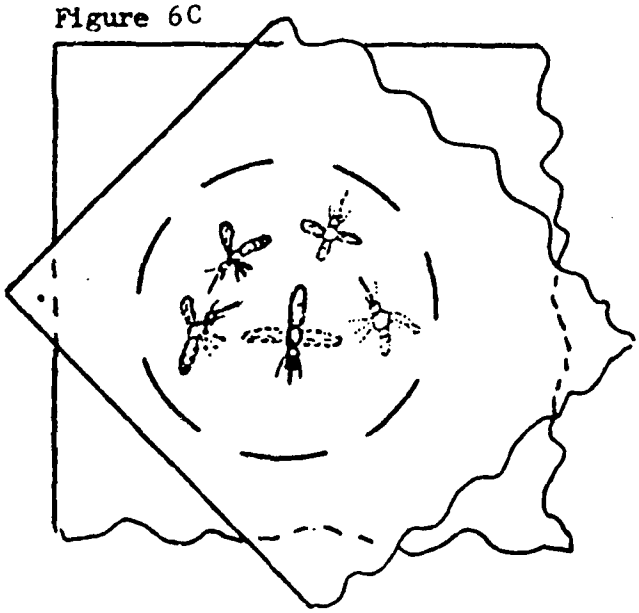
Place a piece of tissue over the bottom half of the culture dish, as diagrammed. The tissue must be large enough to completely cover the dish, with 1 inch of overlap on all sides.

Figure 6B



Using fine pointed forceps, gently place mosquitoes on the tissue covering the culture dish. Mosquitoes should be positioned so that they do not touch each other. From 16 to 30 mosquitoes will usually fit into each container, depending on the size of the specimens.

Figure 6C



Cover the mosquitoes with a second piece of facial tissue.

Figure 6D

Place the cover of the culture container on the bottom portion. Press the 2 halves together and tear off excess tissue. The halves of 5 cm (diameter) culture dishes fit snugly and need not be taped; larger petri dishes, if used, should be taped together. Write necessary collection data on the culture dish with a china marking pencil or, better, a permanent felt-tipped lab marker.

Figure 6. Packaging Adult Mosquitoes

The nomenclature and National Stock Numbers for these items are:

Sodium borate, ACS, 6810-00-234-8369, 1 lb bottle

Glycerine, USP, 6505-00-153-8220, 1 lb bottle

Formaldehyde solution, USP, 6550-00-139-1321, 1 pt bottle

3. Write the collection data specified above on a small piece of paper and insert it into the preservative along with the larvae. It is imperative that only pencil or waterproof India ink be used to write the collection data, as any other type of ink will dissolved in the preservative. Do not use a ball point pen. Allow India ink labels to dry overnight before inserting them.

4. The bottles or vials used to ship the mosquitoes should be filled with preservative as completely as possible to minimize the amount of air space and reduce the jostling of the larvae during shipment. Screw cap vials or bottles may be used but the tops should be securely tightened and taped to prevent loosening of the caps and leakage. Lip vials (4-dram is a convenient size for most collections) or blood collecting tubes sealed with rubber stoppers are also recommended. Air bubbles and excess fluid may be removed with a hypodemic needle positioned in the neck of the vial or tubes as the stopper is inserted.

5. For shipment, wrap each vial individually in several layers of paper toweling, cellucotton, or a similar material. These wrapped vials can then be packed by the same method as described for packing adult mosquitoes, and mailed to VTS for identification.

D. Ovitrap Paddles. Remove paddles from ovitrap jars and place each paddle in a small zip-lock, twist-tie, or similar plastic bag. Air dry paddles one day in the lab, then reinsert paddles into the bags, seal each bag and be sure each bag bears the appropriate collection information including, in particular, the base, ovitrap number, specific location, and the date collected. Cushion the bags with the paddles inside a cardboard carton and mail to VTS.

IV. TRAP COUNT INDICES*

A. Definition. Trap indices (TIs) are numbers calculated from mosquito trap counts which serve as indicators of trends of the size of the mosquito populations that were sampled. These numbers may be plotted on a graph for visualizing population fluctuations over time, as in Figures 7 and 8. They may represent a consolidation of all specimens collected (Figure 7) or they may be plotted for individual species (Figure 8). Individual species plots can also be drawn on the graph with the consolidated specimen line(s) to show individual species deviations compared to the overall picture.

* Modified from 6201 EPID FLT RPRT ENT 78-003.

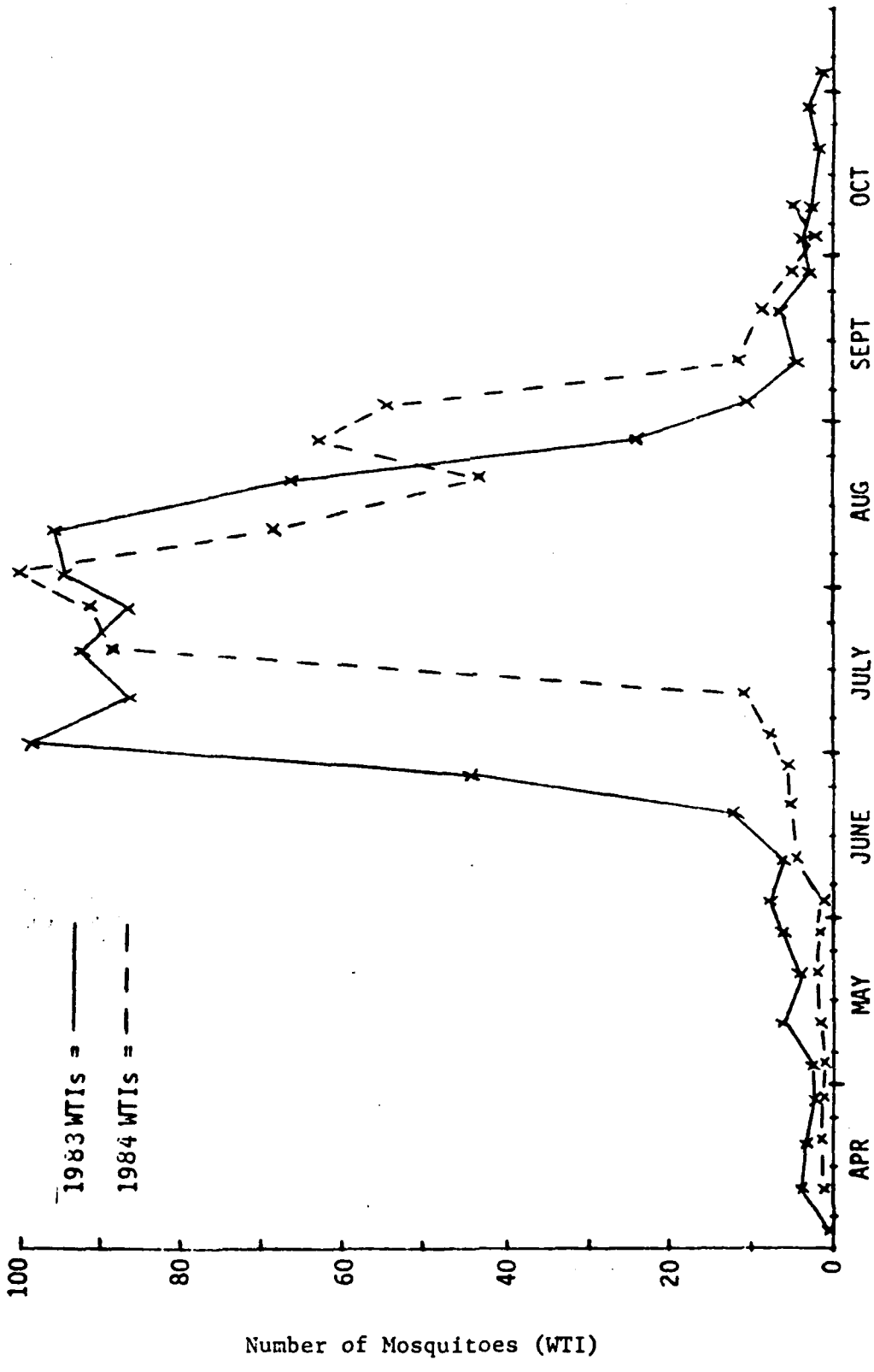


Figure 7. Weekly mosquito trap indices for all specimens taken during successive years at Naplong Air Base, Korea.

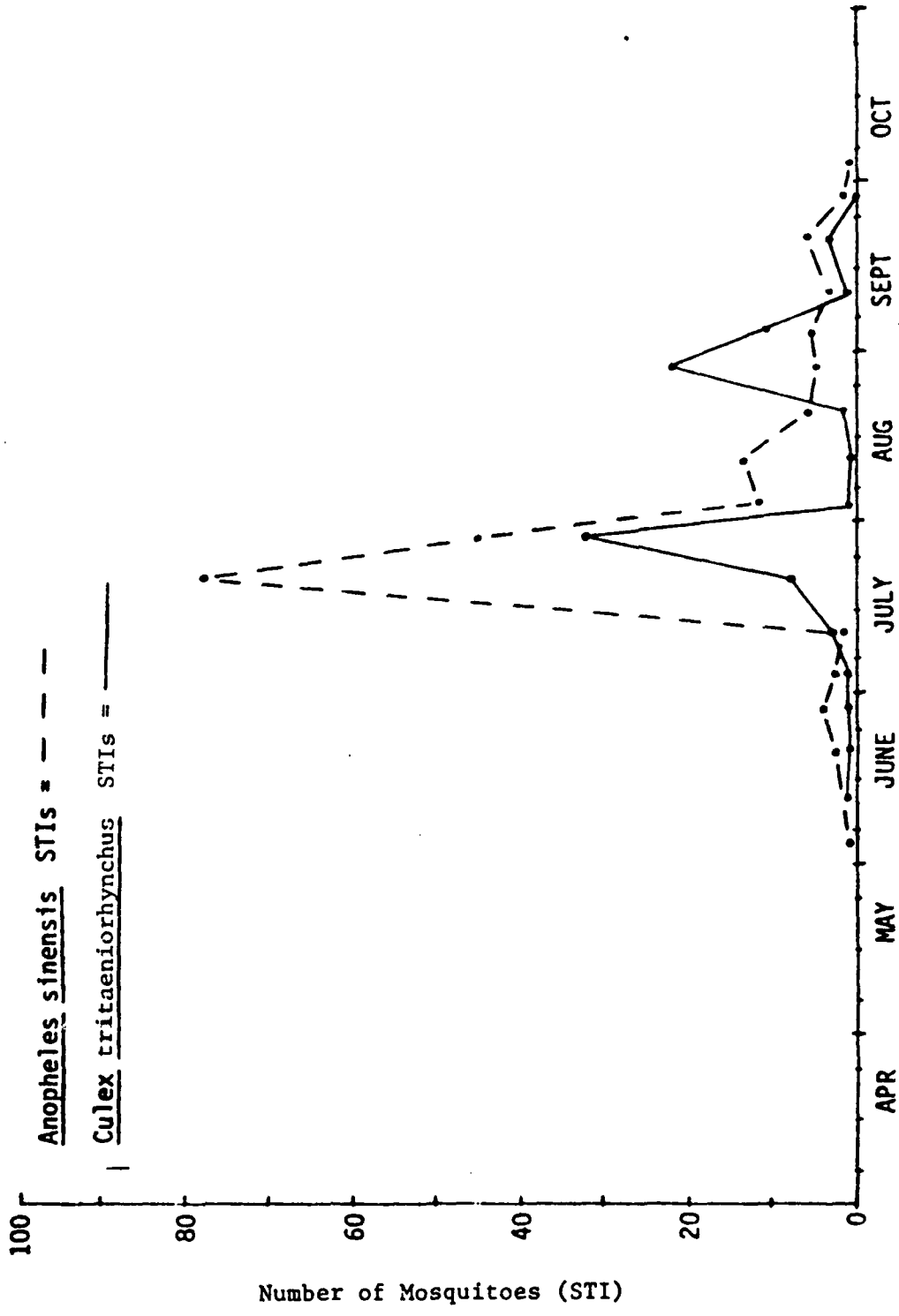


Figure 8. Specific trap indices for vector species at Naplong Air Base, Korea.

B. Mechanics

1. Daily and Weekly Trap Indices. Daily and weekly trap indices (DTI and WTI) are computed as follows:

$$DTI = \frac{A}{B} \qquad WTI = \frac{C}{D}$$

where:

A = Number of female mosquitoes collected in one night

B = Total number of traps operated that night = number of trap nights

C = Number of female mosquitoes collected in one week

D = Total trap nights that week

One trap night equals the operation of one trap for one night. The figure for total trap nights for the DTI equals the number of traps operated that one night. The total trap nights figure for the WTI, "D", is the total number of trap operations during one week. This number is obtained by multiplying the number of traps used by the number of nights they were operated. For example, 4 traps each used 3 full nights during the week equals 12 trap nights. A trap which was nonoperational one night for any reason is not figured into the denominator; however, a trap which was operated but captured no mosquitoes is figured into the denominator with 0 being computed into the total number of female mosquitoes. Note the following example where 2 traps were used for 3 nights per week:

Date	Light Trap No.	No. of Female Mosquitoes
21 June	1	8
	2	0* (trap operated - no mosquitoes captured)
22 June	1	17
	2	30
23 June	1	0** (trap not operational)
	2	25

$$WTI = \frac{(8 + 0^* + 17 + 30 + 25)}{(2 \times 3) - 1^{**}} = 16$$

2. Specific Trap Indices. Each installation has one or more species of mosquitoes which, due to their role as severe pests of man or importance as disease vectors, warrant close monitoring. A specific Trap Index (STI) may be calculated for one or more species as follows:

$$STI = \frac{\text{Total number of female mosquitoes collected of specific vector or pest species known to occur on the base}}{\text{Total number of trap nights on the base for the designated study or sampling period}}$$

Examples:

For Anopheles sinensis, an important vector of malaria in Korea, the STI equals the total females of Anopheles sinensis collected during one week divided by the number of trap nights in that week.

For a Japanese B encephalitis vector in the Philippines, the STI equals the total females of Culex tritaeniorhynchus captured in one week divided by the number of trap nights in that week.

Figure 8 illustrates typical plots based on the STIs for 2 species.

3. Localized Mosquito Upsurges. The above discussion deals with manipulations of the actual numbers of mosquitoes captured and the calculation of averages or arithmetic means; however, there are pitfalls in using averages. A large collection of mosquitoes in one or a few traps of a series can give a false indication of the actual insect populations on an installation as a whole. For example, hypothetically, if 10 traps are used and 1 is placed in an area where mosquitoes are continually or sporadically very numerous compared to the other trap locations, a situation as follows may occur: in 9 traps a total of 50 mosquitoes is caught and 450 mosquitoes are captured in the remaining trap. This gives an arithmetic mean of 50. On the next trapping day, 200 mosquitoes are captured in the first 9 traps and only 100 mosquitoes in the tenth trap with a resulting arithmetic mean of 30. The arithmetic mean or average from the second light trap sample of the population seemingly reflects a decrease in the number of mosquitoes present when actually populations quadrupled over most of the survey area. A population upsurge in one area of the base may indicate where specific control efforts should be directed but it must not be allowed to exert undue influence or cause alarm when the results from the entire complement of traps are viewed overall and over a reasonable period of time*. Continued increases in the number of mosquitoes over a period of a week or more and in the majority of traps warrant careful attention and action.

*Calculation of a geometric mean using logarithms will dampen the disruptive effect of a single large collection; however, for most installations this extra step is not necessary. Contact OL AD/ES if you are interested in learning more about geometric means.

C. Interpretation of Graphs of Trapping Data

a. Genetic variability and the resulting environmental tolerances of species and individuals within species will enable a few hardy specimens to emerge early in the mosquito season. These specimens may be captured with surveillance devices and will produce the first few, small, erratic peaks on the charts.

b. The early population fluctuations shown on the graphs will generally be followed by steadily rising plots as environmental conditions become more suitable for mosquito development. The rapidly climbing lines on the graphs indicate increasing numbers of captured mosquitoes which are part of the first vernal or spring mass emergence.

c. Twin peaks as appear on the STI plot for Culex tritaeniorhynchus in Figure 8 could indicate the emergence of 2 generations of the species (versus 1 peak and 1 generation for Anopheles sinensis in the same Figure), or such a graph may result from weather influence, trap malfunctions, or other factors like an invasion of the base by mosquitoes from an adjacent, heavily infested area.

d. Breaks in the graphs would indicate periods when trapping was not attempted. Graphs which fall to the zero population level would mean trapping was attempted but no specimens were captured. This in turn might have been caused by excessive winds, rain, other natural phenomena, or mechanical problems such as loss of electrical power, burned out bulbs, or motor failure.

e. The day-to-day success of base mosquito control efforts can be judged from the subsequent peaks or valleys on the trapping data graphs which indicate the effect of the control effort on the mosquito populations. The actual numbers of mosquitoes or the calculated indices should be transmitted to CE with notification of the locations where counts are rising. A marked decrease in the number of mosquitoes present, reflected in significant dips in the plots of the mosquito trap counts, is desired after fogging or ULV misting or other massive area treatment programs. Circumstances such as storms or the arrival of a cold front can give false indications of control.

f. The descending trapping data plots which occur toward the end of the mosquito season usually signal the autumnal decrease in mosquito populations. This is related to lower temperatures, less favorable breeding conditions, reduction in food availability, a significant drop in the number of adults carrying over from earlier generations, and a decrease in the number of new adults emerging to replace older ones that die.

V. MOSQUITO CONTROL

A. General. There are many practicable measures for mosquito control including physical, mechanical, biological, and chemical approaches. Ditching, proper storm drainage, landscaping, and filling are physical actions that can eliminate standing water and stop mosquito production. Vegetation control aids mosquito control: minimizing aquatic and emergent vegetation as well as debris in ditches and streams increases water flow and evaporation and lessens chances for standing water and mosquito breeding, and mowing grass and trimming back base perimeter vegetation minimizes resting sites for adult mosquitoes near human habitations. Screening buildings, removing discarded vehicle tires, cans, and other potential water collectors, and cleaning rain gutters are helpful mechanical actions. Natural mosquito parasites and predators like certain protozoa, nematodes, fungi, top-feeding fish, dragonflies, and other insects can exert noticeable natural control on mosquito populations and bacterial insecticides (Bactimos^{R}, Teknar^{R}, VectoBac^{R}) are commercially available for larval mosquito management. Chemical insecticidal measures are discussed below. Additional chemical control measures such as monomolecular organic surface films (Arosurf^{R}) are available for local purchase. Personal protective measures to lessen mosquito biting include use of mosquito repellents applied to the skin, repellent-treated cloth mesh jackets and tents, Permanone^{R} aerosol for clothing application to kill/repell mosquitoes, wear of long-sleeved shirts and long pants, and limiting outdoor crepuscular and nighttime activities to avoid peak mosquito biting periods.

B. Insecticidal Control. Individuals can release indoor space sprays of D-Phenothrin (2%) pyrethroid insecticide from aerosol cans in aircraft (disinsection), quarters, and other locations for temporary control of flying mosquitoes. All mosquito control, with the exception of required aircraft disinsections, like most other pest control must be justified by prior surveillance which documents the extent of the pest/vector problem. Figure 9 is a table of published recommendations for mosquito larvicides and adulticides including residual treatments and outdoor ultra low volume (ULV) space treatments. Dursban 2(%) Coated Granules for larviciding, Clarke 1.5 lb (Dursban) Mosquitocide Fogging Concentrate, and bendiocarb (Ficam^{R}) ULV are a few newer products. ULV space treatment is currently the most frequently employed mosquito control technique at most installations and deserves further discussion. Truck-mounted ULV cold aerosol generators saturate an area with insecticide in micron-sized (10-15 u optimum) droplets which remain diffused in the air and able to contact flying mosquitoes for some time before settling. The insecticidal fogging is a temporary mosquito control measure and usually must be accomplished repetitively every 24 to 48 hours based on surveillance findings. Ground-based ULV control trigger numbers of 20-30 female mosquitoes per trap per night are generally employed at most installations based on historical connection between rising number of complaint calls due to mosquito annoyance and rising trap counts; however, each local installation situation is unique with different pestiferous mosquito species, different mosquito-borne disease potential, varying medical and other command concern, and other variables which must be considered in establishing action thresholds. For most mosquito species, outdoor space

treatments are most effective when applied in crosswind swaths within the period from sunset to sunrise, when surface winds are 8 MPH or less, temperature is between 65°F and 85°F, and there is no rainfall. Diurnally active (day-flying Aedes) species are an exception which require control during daylight hours. The proper insecticide application rate and vehicle speed recommended on the insecticide label must be strictly adhered to, ULV vehicles are required to have passenger cab air conditioners, operators wear respirators, and an emergency spill containment kit is carried on the fogging vehicle. Technical malathion is disseminated by the majority of bases for mosquito adulticiding. Aerial ULV and other aerial insecticide applications offer rapid, wide area mosquito control, provided trained/certified air spray crews and specially equipped spray aircraft are available, and aerial applications may be justified under certain disease outbreak or pest infestation situations. AFR 91-22, Aerial Dispersal of Pesticides, discusses air spray validation statements, environmental assessments, and other prespray requirements.

Figure 9. Chemical Control Measures*+x

Larvicides

Insecticide	Formulation or Application Rate
methoprene (Altosid^R)	3-4 fl oz of 10% EC/acre; 7.9% briquet
temephos (Abate^R)	45.1% EC; 1, 2, 5% granular
chlorpyrifos (Dursban^R)	0.4 - 1.6 fl oz of 44.4% EC/acre
Arosurf^R MSF	0.2 - 0.5 gal/surface area

Adulticides - Outdoor Space Treatment

malathion	91% ULV, 2.6 - 3.0 fl oz/acre
chlorpyrifos (Dursban^R)	61.5% ULV, 0.005 - 0.01 lb/acre

Outdoor Residual Treatment

malathion	4.5 fl oz of 57% Emulsifiable Concentrate/gal water (2% finished concentration); apply to shrubs, lower trees, and lawns
chlorpyrifos (Dursban^R)	44.4% EC, 0.8 - 1.6 fl oz/Ac
propoxur (Baygon^R)	13.9% EC, 8 fl oz/gal (1.1% finished concentration), apply to screens, doors, window frames, and other mosquito congregation surfaces.
carbaryl (Sevin^R)	0.33 - 1.25 lb of 80% wettable powder/acre. Spray shade trees, shrubs, grass and buildings where mosquitoes congregrate

Adulticide - Indoor Space Treatment

d-Phenothrin	2% (active ingredient) aerosol

*Source: Navy DVECC Pocket Guide to Pest Management, November 1984, pp 48-50.

+Always consult the label and adhere to host country regulations.

xPACAF Sup 1, AFR 161-1, requires CE Entomology report monthly to SG mosquito control efforts including dates control was accomplished, operations involved (larviciding, fogging, residual applied to vegetation, and so on), locations treated, and insecticides used.

VI. MOSQUITO BIONOMICS

The table below presents bionomic information on selected mosquito species in the Pacific area:

Mosquito Species	Larval Habitats[1]	Biting Period[2]	Hosts[3]	Flight Range[4]	Diseases Transmitted[5]
Aedes					
aegypti	AC,RH,SS,TH	D(N)	H,Z	.2 km	C,D
albopictus	AC,LA,RH,TH	D(N)	H,Z	1 km	C,D,DI,(JBE)
poicilius	AC,LA	N	H,Z	.2 km	BF
togoi	AC,RH,SM	N(D)	H,Zs	1 km	MF,(BF)
vexans	AC,DD,FS,FW,GP,RF,SM,WP	N(D)C	H,Z	9 km	BF
vexans nipponii	CW,DD,FW,GP,GRP,LM,SE	N(D)	Z,H	----	JBE
Anopheles					
balabacensis	FS,GRP,WP,SE	N,C(D)	H,Z	.1 km	M
flavirostris	DD,GS,GP,GRP,LM,SE	N	Z,H	2 km	BF,M,MF
lesteri	DD,FS,GP,GRP,LM,RF,SE	N	Z,H	----	M
minimus	DD,FS,GP,RF,SE	N	H,Z	----	M,(BF)
sinensis	DD,FW,GRP,RF,SE	N	Z,H	1 km	M,BF,MF
subpictus	AC,CS,CW,DD,FS,GP,GRP,RF	N	Z,H	6 km	M,BF,(JBE)
Culex					
bitaeniorhynchus	CW,DD,FS,GRP,RF,RH,SE	N,C	B,Z,H	----	BF,S,(JBE)
fuscocephala	AC,CW,DD,FS,GRP,LA,RF,TH	N	Z,B,H	1.4 km	JBE,BF
pipiens pallens	AC,DD,GRP	N	H,B,Z	----	JBE,BF
pseudovishnui	CW,GRP,RF	N	B,Z,H	----	JBE
quinquefasciatus	AC,CW,DD,GRP,SCB	N	H,Z,B	5 km	BF,MF,DI,(C),(JBE)
tritaeniorhynchus	AC,CW,DD,FS,GRP,RF,SM	N	Z,B,H	2 km	JBE,C,S
vishnui	GRP,LM,RF	N	Z,B,H	----	JBE,S
whitmorei	FS,GP,GRP,RF,SE	N	H,Z	----	BF,JBE
Mansonia					
uniformis	FS,SE	N,D,C	Z,H,Zs	----	BF,MF

[1]AC = Artificial containers; CS = coastal swamp; CW = carabao wallow; DD = drainage ditch; FS = freshwater swamp/marsh; FW = flood waters; GP = grassland pool; GRP = ground pools; LA =leaf axils; LM = lake/pond margins; RF = ricefields; RH = rock holes; SCB = sewer catch basins; SE = stream edges; SM = saltwater marsh; SS = snail shells; TH = tree holes; WP = woodland pools (primary habitat underlined).

[2]C = crepuscular (dusk and dawn); D = day; N = night. (Parentheses = biting reported in some areas.)

[3]B = birds; H = humans; Z = Zoophilic (large mammals); Zs = Zoophilic (small mammals).

[4]Values given are estimates of maximum normal flight ranges.

[5]BF = Bancroftian filariasis; C = Chikungunya fever; D = dengue, dengue hemorrhagic fever; DI = Dirofilaria immitis; JBE = Japanese B encephalitis; M = malaria; MF = Malayan filariasis; S = Sindbis virus. Parentheses indicate disease agent for which the species is a secondary vector.

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