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Ramos, A.C., J.M. Valder & D.R. Sutton

1975 PACAF MOSQUITO IDENTIFICATION SUMMARY

ENTOMOLOGY SERVICES

PARATI SUMUS

1st MEDICAL SERVICE WING (PACAF)
APO SAN FRANCISCO 96274

MARCH 1976

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1975 PACAF MOSQUITO IDENTIFICATION SUMMARY

WITH

A MOSQUITO SURVEILLANCE GUIDE FOR THE PACIFIC AREA

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TECHNICAL REPORT No. 76-1

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I. INTRODUCTION:

This report consists partially of a record of identifications of mosquitoes captured on Pacific area USAF bases during CY 1975. A number of additional topics have been included, so that the report will be useful as a vector surveillance reference to base level organizations. With this goal in mind, sections have been prepared on interpretation of light trap data, mosquito surveillance methods, and proper specimen packing and shipping protocols. Also included are short biological data sketches of some of the more important disease vector and pest species in the PACAF area, and a list of mosquito disease vectors with the diseases that they transmit. Proper use of this information will improve the utility of vector surveillance programs by insuring that base programs are designed to yield maximal results and by identifying ways that surveillance data may be used for more efficient mosquito control.

Information or advice pertaining to any aspect of USAF entomology can be obtained at any time by calling Entomology Services, 1st Medical Service Wing, Clark Air Base, extensions 33291, 33292, 33245, or 33246. Correspondence may be addressed to:

HQ 1st Medical Service Wing/SGE
APO San Francisco 96274

II. BASE MOSQUITO SUMMARIES:

G U A M

ADULT MOSQUITOES: ANDERSEN AFB, GUAM, 1975

Species	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Aedes albopictus	-	-	-	-	-	-	1	-	-
Aedes pandani	28	362	160	59	22	8	4	3	4
Aedes vexans vexans	-	-	-	-	-	-	-	-	14
Culex litoralis	-	1	2	-	4	5	-	-	-
Culex quinquefasciatus	-	2	6	11	-	-	1	-	-
Culex tritaeniorhynchus	-	-	-	-	-	3	-	-	-
Males	-	2	5	1	2	-	1	1	-
Damaged/Unidentifiable	-	27	34	3	7	3	3	-	-

LARVAL MOSQUITOES: ANDERSEN AFB, GUAM, 1975

Species	MAY	OCT	NOV	DEC
Aedes albopictus	-	22	3	-
Aedes guamensis	-	1	-	-
Aedes vexans vexans	-	-	-	23
Aedes young instar	-	1	-	-
Culex quinquefasciatus	31	5	-	-

H A W A I I

ADULT MOSQUITOES: HICKAM AFB, HAWAII, 1975

Species	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Aedes albopictus	-	1	-	-	-	-	-
Aedes vexans vexans	1	-	-	1	-	-	-
Culex quinquefasciatus	611	845	604	210	100	14	2
Males	7	3	10	5	1	-	-
Damaged/Unidentifiable	-	-	-	1	-	-	-

LARVAL MOSQUITOES: HICKAM AFB, HAWAII, 1975

Species	OCT
Culex quinquefasciatus	69

J A P A N

ADULT MOSQUITOES: MISAWA AB, JAPAN, 1975

Species	JUN	JUL	AUG	SEP
Aedes vexans nipponii	2	3	-	-
Anopheles sinensis	2	19	68	22
Culex mimeticus	1	1	1	-
Culex quinquefasciatus	2	-	3	-
Culex tritaeniorhynchus	-	-	-	1
Males	-	-	-	1

LARVAL MOSQUITOES: MISAWA AB, JAPAN, 1975

Species	DATE (UNK)
Culex p. pallens	17
Culex young instar	1

ADULT MOSQUITOES: YOKOTA AB, JAPAN, 1975

Species	JUL	AUG	SEP
Aedes vexans nipponii	-	1	-
Anopheles sinensis	1	12	-
Culex quinquefasciatus	1	-	-
Culex tritaeniorhynchus	1	-	-
Culex vishnui subgroup	-	1	-
males	-	1	1

K O R E A

ADULT MOSQUITOES: KUNSAN AB, KOREA, 1975

Species	JUL	AUG	SEP
Aedes vexans nipponii	-	1	-
Anopheles sinensis	203	977	1081
Culex bitaeniorhynchus	-	-	2
Culex p. pallens	2	2	1
Culex pipiens subgroup	-	-	5
Culex quinquefasciatus	-	2	3
Culex tritaeniorhynchus	13	320	294
Culex vishnui subgroup	205	1379	816
Males	47	985	218
Damaged/Unidentifiable	42	416	45

LARVAL MOSQUITOES: KUNSAN AB, KOREA, 1975

Species	AUG	SEP
Aedes koreicus	1	-
Anopheles sinensis	8	-
Culex p. pallens	119	49
Culex tritaeniorhynchus	45	9
Culex vagans	3	-
Culex young instars	8	-
Damaged	1	-

ADULT MOSQUITOES: KWANGJU AB, KOREA, 1975

Species	JUN	JUL	AUG
Aedes vexans nipponii	1	-	-
Anopheles sinensis	-	9	-
Culex tritaeniorhynchus	-	-	2
Culex vagans	6	-	-
Culex vishnui subgroup	-	-	8
Males	8	2	3
Damaged/Unidentifiable	2	-	-

ADULT MOSQUITOES: OSAN AB, KOREA, 1975

Species	MAY	JUN	JUL	AUG	SEP	OCT	NOV
Aedes vexans nipponii	123	440	70	130	58	6	2
Armigeres subalbatus	-	-	-	-	1	-	-
Anopheles sinensis	2	139	960	980	208	18	7
Culex bitaeniorhynchus	-	-	-	1	-	-	-
Culex mimeticus/jacksoni	-	-	1	-	1	-	-
Culex orientalis	-	-	-	7	11	4	2
Culex p. pallens	-	-	2	17	70	23	10
Culex quinquefasciatus	6	11	13	14	9	1	-
Culex tritaeniorhynchus	-	-	-	18	74	2	1
Culex vagans	2	16	1	-	-	-	-
Culex vishnui subgroup	2	-	-	221	633	-	-
Males	117	455	423	993	1213	117	64
Damaged/Unidentifiable	18	127	131	502	970	3	-

O K I N A W A

ADULT MOSQUITOES: KADENA AB, JAPAN, 1975

Species	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Aedes albopictus	-	-	-	-	-	10	3	3	-	-	-	-
Aedes vexans nipponii	-	-	1	3	5	17	16	8	3	4	5	-
Anopheles sinensis	-	-	-	-	1	3	9	2	-	-	1	-
Culex bitaeniorhynchus	-	-	-	-	-	1	1	1	-	-	-	-
Culex p. pallens	-	-	-	-	-	-	1	-	-	-	2	1
Culex quinquefasciatus	-	-	1	-	3	6	1	-	-	-	-	-
Culex tritaeniorhynchus	-	-	-	-	-	5	3	2	6	15	8	-
Culex vagans	-	-	-	1	-	-	-	-	-	-	-	-
Culex vishnui subgroup	-	-	-	-	1	1	15	-	1	17	14	-
Mansonia uniformis	-	-	-	-	1	-	-	1	-	2	3	-
Uranotaenia bimaculata	-	-	-	-	-	-	-	-	-	-	1	1
Males	-	-	-	-	2	12	13	2	4	-	19	19
Damaged/Unidentifiable	-	-	-	-	-	3	4	1	6	10	7	2

P H I L I P P I N E   I S L A N D S

ADULT MOSQUITOES: CLARK AB, PHILIPPINES, 1975

Species	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Aedeomyia catasticta	-	1	12	9	26	5	-	5	-	-	7	5
Aedes flavipennis	-	1	-	-	-	-	-	-	-	-	-	-
Aedes lineatopennis	-	-	-	1	-	-	2	5	1	2	2	-
Aedes poecilus	-	-	-	-	-	-	-	2	-	-	-	-
Aedes vexans vexans	2	6	2	3	-	1	1	19	7	4	1	7
Anopheles annularis	-	1	1	6	1	1	3	6	1	1	-	2
Anopheles filipinae	2	2	-	-	-	-	-	-	-	-	-	-
Anopheles flavirostris	1	-	-	-	-	1	-	2	-	-	-	-
Anopheles ludlowae	2	23	24	7	2	5	5	8	2	-	1	-
Anopheles indefinitus	1	5	3	2	-	3	4	14	6	4	9	8
Anopheles maculatus	-	1	-	-	-	-	-	1	-	-	1	-
Anopheles peditaeniatus	1	2	1	1	-	-	-	1	2	2	3	1
Anopheles philippinensis	-	-	-	-	-	-	-	-	-	-	1	-
Anopheles subpictus	3	10	35	12	7	39	24	42	18	1	4	4
Anopheles tessellatus	2	-	1	-	-	-	1	-	1	-	-	1
Anopheles vagus limosus	2	4	10	7	-	4	1	7	-	-	3	-
Anopheles vagus vagus	10	17	16	6	-	-	5	5	-	-	2	4
Coquillettidia ochracea	1	6	1	-	-	-	-	-	-	-	-	-
Culex annulus	-	-	-	-	-	-	1	-	4	-	-	-
Culex bitaeniorhynchus	1	-	1	-	-	-	1	-	-	-	1	1
Culex fuscanus	-	10	1	-	-	-	-	-	-	-	1	-
Culex fuscocephala	7	4	9	6	4	13	32	145	25	2	6	3
Culex gelidus	9	19	2	7	-	3	3	24	12	3	2	8
Culex nigropunctatus	-	-	-	1	-	-	-	-	-	-	-	-
Culex pseudovishnui	2	-	-	-	-	-	-	1	-	-	-	-
Culex quinquefasciatus	-	1	2	5	-	-	1	-	-	-	-	-
Culex sinensis	-	3	-	-	-	-	1	-	-	-	-	-
Culex sitiens	-	-	-	-	-	-	2	1	-	-	-	-
Culex tritaeniorhynchus	9	16	14	20	7	19	26	65	22	4	9	10
Culex vishnui subgroup	14	57	43	9	8	11	12	57	37	1	19	7
Culex whitmorei	1	7	3	-	-	1	3	12	2	7	5	-
Ficalbia luzonensis	-	2	1	-	-	-	-	-	-	-	-	-
Mansonia annulifera	-	1	-	-	-	-	-	-	-	-	-	-
Mansonia uniformis	3	2	3	-	-	-	1	-	1	1	2	-
Uranotaenia arguellesi	1	-	-	-	1	-	-	-	-	-	-	-
Uranotaenia testacea	-	-	-	-	-	-	-	-	1	-	-	-
Males	36	62	32	41	7	7	7	14	2	21	7	8
Damaged/Unidentifiable	14	70	42	8	9	-	13	7	6	4	2	-

LARVAL MOSQUITOES: CLARK AB, PHILIPPINES, 1975

Species	JAN
Culex annulus	11
Culex fuscocephala	4
Culex gelidus	2
Culex nigropunctatus	28
Culex tritaeniorhynchus	1

T A I W A N

ADULT MOSQUITOES: CHING CHUAN KANG AB, TAIWAN, 1975

Species	APR	MAY
Anopheles sinensis	-	7
Culex fuscanus	8	-
Culex quinquefasciatus	-	3
Males	-	1
Damaged/Unidentifiable	13	29

ADULT MOSQUITOES: SHU LIN KOU AB, TAIWAN, 1975

Species	APR	MAY	JUN	JUL	AUG	SEP
Anopheles sinensis	4	14	7	7	-	2
Armigeres subalbatus	-	-	1	-	-	-
Culex bitaeniorhynchus	55	20	3	1	-	1
Culex fuscanus	1	1	-	-	-	-
Culex fuscocephala	-	-	-	-	1	-
Culex p. pallens	-	2	-	-	-	-
Culex pseudosinensis	-	-	-	-	-	1
Culex pseudovishnui	-	-	-	-	2	-
Culex quinquefasciatus	6	8	4	1	-	-
Culex tritaeniorhynchus	3	11	20	2	20	11
Culex vishnui subgroup	22	2	14	63	8	22
Ficalbia luzonensis	-	-	-	-	-	1
Mansonia uniformis	-	1	3	-	1	-
Males	19	18	8	6	3	6
Damaged/Unidentifiable	4	-	6	8	3	6

T H A I L A N D

ADULT MOSQUITOES: CHANDY RANGE, THAILAND, 1975

Species	15 JAN - 17 FEB
Anopheles aconitus	6
Anopheles argyropus	1
Anopheles nitidus (= indiensis)	1
Anopheles pursati	1
Anopheles vagus	1
Coquillettidia crassipes	1
Culex fuscocephala	7
Culex gelidus	22
Culex quinquefasciatus	14
Culex tritaeniorhynchus	17
Culex vishnui subgroup	5
Ficalbia minima	2
Mansonia annulifera	1
Mansonia uniformis	5
Damaged/Unidentifiable	3

ADULT MOSQUITOES: KORAT AB, THAILAND, 1975

Species	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Aedeomyia catasticta	5	4	-	5	4	3	2	1	4	3	72	10
Aedes dux	-	-	-	-	-	-	-	-	-	-	1	-
Aedes lineatopennis	-	1	3	-	1	11	6	2	5	-	2	-
Aedes mediolineatus	-	-	-	-	-	-	10	-	3	-	-	-
Aedes vexans vexans	2	2	6	2	4	71	76	20	87	-	25	1
Anopheles aconitus	8	-	-	-	-	-	1	-	1	-	21	3
Anopheles annularis	3	-	-	1	-	-	6	-	-	-	9	-
Anopheles argyropus	1	-	-	-	-	-	-	-	-	-	-	-
Anopheles nitidus (= indiensis)	-	1	-	-	-	-	-	-	-	-	-	-
Anopheles pallidus	-	-	-	-	1	-	-	-	-	-	-	-
Anopheles peditaeniatus	1	-	-	-	-	1	-	-	1	-	6	-
Anopheles philippinensis	-	2	1	-	2	5	4	9	2	1	5	-
Anopheles pursati	1	-	-	-	-	-	-	-	-	-	-	-
Anopheles sinensis	-	-	-	-	-	1	-	1	-	-	1	-
Anopheles subpictus	3	2	3	5	9	9	1	1	2	-	1	-
Anopheles tessellatus	-	1	-	-	-	3	-	2	1	1	2	-
Anopheles vagus	-	7	13	18	5	22	12	12	12	4	2	-
Coquillettidia crassipes	-	2	-	2	-	-	1	-	1	-	1	-
Culex annulus	-	-	-	1	-	-	1	-	-	-	-	-
Culex bitaeniorhynchus	3	-	-	-	2	-	-	-	1	1	1	-
Culex fuscanus	-	-	-	-	-	1	1	-	-	-	1	1
Culex fuscocephala	20	9	25	30	26	99	93	21	37	11	34	3
Culex gelidus	233	77	19	32	18	127	109	36	77	43	111	41
Culex hutchinsoni	1	-	-	-	-	-	-	-	-	-	-	-
Culex nigropunctatus	-	-	-	-	-	-	1	-	1	-	3	-
Culex quinquefasciatus	174	110	25	28	18	4	-	1	-	1	98	3
Culex sinensis	-	-	-	-	-	-	-	-	-	-	1	-
Culex tritaeniorhynchus	23	14	14	15	21	89	65	12	19	14	51	4
Culex vishnui subgroup	36	5	8	12	9	64	65	18	56	31	55	23
Culex whitmorei	-	-	-	-	-	-	5	-	9	6	16	-
Ficalbia hybrida	-	1	-	3	3	2	4	1	5	-	4	3
Ficalbia luzonensis	12	1	3	-	-	-	-	-	-	-	4	-
Ficalbia minima	1	1	-	-	1	-	-	-	-	-	-	-

KORAT AB, Cont'd

Species	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Mansonia annulata	-	-	-	-	2	-	-	-	-	-	-	-
Mansonia annulifera	1	1	3	1	5	4	7	6	-	-	3	-
Mansonia dives	-	-	-	-	-	-	1	-	-	-	-	-
Mansonia uniformis	8	4	-	3	15	12	8	2	5	-	13	2
Mimomyia chamberlaini	-	1	-	-	-	-	1	-	-	-	-	-
Males	79	2	4	2	1	10	6	-	80	132	51	-
Damaged/Unidentifiable	23	12	12	31	66	82	83	11	87	13	110	7

LARVAL MOSQUITOES: KORAT RTAFB, THAILAND, 1975

Species	JUL	OCT
Anopheles vagus	8	3
Culex annulus	21	-
Culex fuscocephala	50	6
Culex gelidus	20	-
Culex quinquefasciatus	65	-
Culex nigropunctatus	4	-
Culex scanloni	-	7
Culex tritaeniorhynchus	8	-
Damaged/Unidentifiable	84	1

ADULT MOSQUITOES: NAKHON PHANOM AB, THAILAND, 1975

Species	JAN	FEB	MAR	JUN	JUL	AUG
Aedeomyia catasticta	4	2	1	-	-	-
Aedes albopictus	-	-	-	-	2	-
Aedes lineatopennis	-	-	-	-	2	1
Aedes mediolineatus	-	-	-	22	15	1
Aedes vexans vexans	-	-	1	6	4	1
Anopheles aconitus	-	-	-	-	1	-
Anopheles annularis	-	-	-	3	1	1
Anopheles culicifacies	-	-	-	-	1	-
Anopheles lesteri	-	-	-	-	-	1
Anopheles maculatus	-	-	-	1	-	1
Anopheles pallidus	-	-	-	1	-	1
Anopheles philippinensis	-	-	-	12	11	36
Anopheles sinensis	-	-	-	-	-	1
Anopheles vagus	1	2	3	17	5	-
Coquillettidia crassipes	-	-	-	1	4	-
Culex annulus	-	-	-	-	-	1
Culex bitaeniorhynchus	-	-	-	1	5	-
Culex fuscocephala	3	-	-	225	122	9
Culex gelidus	19	11	58	162	147	18
Culex nigropunctatus	-	-	-	3	3	1
Culex pseudosinensis	-	-	-	-	4	1
Culex quinquefasciatus	5	-	1	-	4	2
Culex sinensis	-	-	-	2	1	-
Culex tritaeniorhynchus	4	2	6	397	187	9
Culex vishnui subgroup	4	2	7	48	59	14
Culex whitmorei	-	-	-	210	116	26
Ficalbia luzonensis	-	-	-	6	14	-
Ficalbia minima	-	-	1	-	1	-
Ficalbia hybrida	-	-	-	-	15	3
Mansonia annulata	-	-	-	-	1	-
Mansonia annulifera	2	-	1	1	-	-
Mansonia uniformis	-	-	-	28	41	6
Uranotaenia annandalei	-	-	-	-	4	-
Males	14	5	18	519	254	24
Damaged/Unidentifiable	-	-	2	21	53	7

ADULT MOSQUITOES: UDORN AB, THAILAND, 1975

Species	JAN	FEB	JUN	JUL	AUG
Aedeomyia catasticta	23	6	-	-	-
Aedes lineatopennis	-	-	2	1	-
Aedes mediolineatus	-	-	9	8	-
Aedes vexans vexans	1	-	-	2	-
Anopheles campestris	-	-	-	1	-
Anopheles peditaeniatus	-	-	-	3	1
Anopheles philippinensis	-	-	-	1	1
Anopheles vagus	4	4	4	8	2
Coquillettidia crassipes	1	-	-	13	2
Culex bitaeniorhynchus	-	-	1	6	-
Culex fuscanus	1	-	-	1	-
Culex fuscocephala	32	10	62	37	5
Culex gelidus	94	21	97	154	18
Culex hutchinsoni	-	2	-	-	-
Culex quinquefasciatus	368	146	3	11	-
Culex tritaeniorhynchus	4	1	58	31	2
Culex vishnui subgroup	3	4	3	50	12
Culex whitmorei	-	-	6	3	-
Ficalbia luzonensis	1	-	-	-	-
Ficalbia minima	1	-	-	2	1
Ficalbia hybrida	-	3	-	33	-
Mansonia annulifera	1	-	1	6	1
Mansonia indiana	-	-	-	6	-
Mansonia uniformis	4	-	8	62	1
Mimomyia chamberlaini	-	-	-	6	-
Males	18	24	10	60	21
Damaged/Unidentifiable	102	24	138	109	23

LARVAL MOSQUITOES: UDORN AB, THAILAND, 1975

Species	AUG
Culex fuscocephala	17
Culex gelidus	32

ADULT MOSQUITOES: U-TAPAO AB, THAILAND, 1975

Species	APR	MAY	JUL	AUG	SEP	OCT	NOV	DEC
Aedeomyia catasticta	-	-	1	-	1	-	-	1
Aedes dux	-	-	-	-	1	1	-	-
Aedes lineatopennis	3	-	1	2	1	5	-	-
Aedes mediolineatus	-	-	1	-	-	-	-	-
Aedes vexans vexans	72	1	211	14	16	26	2	-
Anopheles aconitus	-	-	1	-	-	-	-	-
Anopheles argyropus	-	-	1	-	-	-	-	-
Anopheles crawfordi	-	-	1	-	-	-	-	-
Anopheles lesteri paraliae	-	-	-	-	-	1	-	-
Anopheles nitidus (= indiensis)	-	-	-	-	-	-	1	-
Anopheles peditaeniatus	-	-	1	-	-	3	1	-
Anopheles sinensis	-	-	2	-	-	-	-	-
Anopheles tessellatus	-	-	-	-	-	1	-	-
Coquillettidia crassipes	-	-	-	1	1	1	1	-
Culex bitaeniorhynchus	-	1	-	1	-	-	-	-
Culex fuscocephala	-	1	-	-	-	7	1	-
Culex gelidus	103	9	31	1	6	20	9	-
Culex nigropunctatus	1	-	1	-	-	4	-	-
Culex quinquefasciatus	2	-	3	-	-	1	-	-
Culex tritaeniorhynchus	44	62	36	13	5	19	4	1
Culex vishnui subgroup	12	-	6	1	2	4	2	-
Culex whitmorei	-	-	-	-	1	-	-	-
Ficalbia luzonensis	1	-	-	-	-	2	2	-
Mansonia uniformis	12	6	44	75	6	6	3	1
Males	47	4	275	14	5	64	18	2
Damaged/Unidentifiable	8	293	15	9	6	6	8	-

LARVAL MOSQUITOES: U-TAPAO AB, THAILAND, 1975

Species	JUL	SEP	OCT
Aedes vexans	-	1420	52
Aedes young instar	-	-	11
Culex annulus	-	1	3
Culex fuscanus/halifaxii	-	1	4
Culex fuscocephala	-	-	2
Culex gelidus	-	5	4
Culex tritaeniorhynchus	4	11	2
Damaged/Unidentifiable	2	2	-

III. INTERPRETATION OF LIGHT TRAP DATA:

The adult mosquito surveillance program of most PACAF bases is designed around the New Jersey light trap (NJLT). One or more NJLTs are operated by the base medical service for a number of nights per week throughout the mosquito season. Any mosquitoes captured are sent to the 1st Medical Service Wing Vector Taxonomy Service (VTS) for identification. After a short period of time, the submitting unit receives a 1MSEW Form 2 from VTS (Figure III-1) showing the numbers of specimens for each species captured. These forms are maintained by the base Environmental Health Service.

A number of questions pertaining to light trap data asked by the field are indicative of some of the problems faced by base level personnel. These questions include, "how useful are the data obtained from light traps?" "what is the use of all those long names with the numbers behind them?" and "how many mosquitoes per night constitute a threat to health and/or morale?" This section discusses the use and interpretation of light trap data.

The following information can be derived from light trap catches:

a. The day-to-day effectiveness of the base level mosquito control program can be evaluated.

b. The presence of disease vectors on the base can be detected, their numbers determined, and this information correlated with the incidence of vector-borne disease on- and off-base.

c. The fluctuation of total numbers of captured mosquitoes or of selected mosquito species can be followed over time, so that periods of heavy mosquito populations and times when disease vectors are present can be predicted.

Light traps can be used to determine the efficiency of ongoing mosquito control programs simply by counting the mosquitoes recovered every morning and telephonically reporting these raw numbers to the Civil Engineer Entomology Section prior to sending the mosquitoes to VTS for identification. This gives the Civil Engineer immediate idea of his fogging efficiency, or when and where to initiate fogging if fogging is not routinely performed.

FIGURE III-1

PACIFIC AIR FORCES AREA MOSQUITO IDENTIFICATIONS

SUBMITTING UNIT	DATE RECEIVED BY VECTOR TAXONOMY SERVICE	DATE PROCESSED BY VECTOR TAXONOMY SERVICE
COLLECTOR	PROCESSED BY (Chief, Vector Taxonomy Service APO San Francisco 96528)	

	ADULT COLLECTIONS					LARVAL COLLECTIONS		
TRAP NUMBERS[1]								
DATE TRAP OPERATED						DATE	LOCATION	NO. SPEC
AEDEOMYIA								
catasticta								
malex								
AEDES								
albopictus								

Identification is necessary to detect the disease vector species that are present on a base. This is the reason that bases are requested to submit all mosquitoes captured to VTS for identification. After mosquitoes are identified, an identification sheet, 1MSEW Form 2, is prepared on each shipment and returned to the submitting unit. A valid criticism of this procedure in the past has been that there was no indication as to which mosquitoes identified were vectors and which were not. The inclusion of a list of disease vectors in the PACAF area (Section V) corrects this oversight. By comparing this list with VTS identifications, the presence of vectors on base can be immediately determined by base level personnel.

Finally, by properly manipulating light trap data accumulated over a period of several years, times of peak mosquito activity can be predicted, as can peak activity periods of selected species. To do this, however, a certain amount of simple data processing is necessary. Specifically, the raw data received from the light traps must be converted to a form which allows the data to be compared directly with previously collected data. The easiest way to do this is to calculate weekly trap night indices (TIs). TIs are calculated as follows:

$$TI = \frac{\text{Total female mosquitoes captured in one week}}{\text{Total trap nights in that week}}$$

One trap night equals one trap operated for one night. This figure is normally calculated by multiplying the number of traps operated by the number of nights that they are operated, such that two traps operated for three nights equals six trap nights, etc. If a trap malfunctions, it is not included in the trap nights figure and the denominator of the TI equation must be adjusted as will be shown in the following example.

For example, let us assume that during the first week in July the following light trap data were obtained on a PACAF Air Base, which routinely operates three light traps.

Date	Light Trap No.	No. Female Mosquitoes
3 Jul	1	6
	2	15
	3	22
4 Jul	1	0 *(trap operated, no mosquitoes)
	2	4
	3	11
5 Jul	1	3

Date	Light Trap No.	No. Female Mosquitoes
	2	0 *(trap inoperational)
	3	8

The TI would then be calculated as follows:

$$TI = \frac{(6+15+22+0+4+11+3+8)}{(3 \times 3) - 1} = \frac{69}{9-1} = \frac{69}{8}$$

$= 8.6$, or TI $= 9$ to the nearest whole number

* When a trap is inoperational, such as Trap 2 on 5 July, it is not figured into the equation, but when a trap is operated and the catch is zero, such as Trap 1 on 4 July, it is counted in the denominator of the TI equation.

As the weekly TIs are calculated, they should be plotted on a graph such as Figure III-2. The same graph is used for consecutive years for comparison purposes. Such a graph can show a number of useful things.

a. Yearly periods of peak mosquito activity can be identified and predicted. This information can then be used for mosquito control planning. In other words, TIs accumulated over a number of years can be developed into a predictive tool.

b. After several years of plots have been accumulated on the graph, abnormally high or low numbers of mosquitoes can be seen. Such variations might be due to abnormal weather conditions, failure of control equipment, or a change in control procedures. The causes of any fluctuation noted should be determined whenever possible.

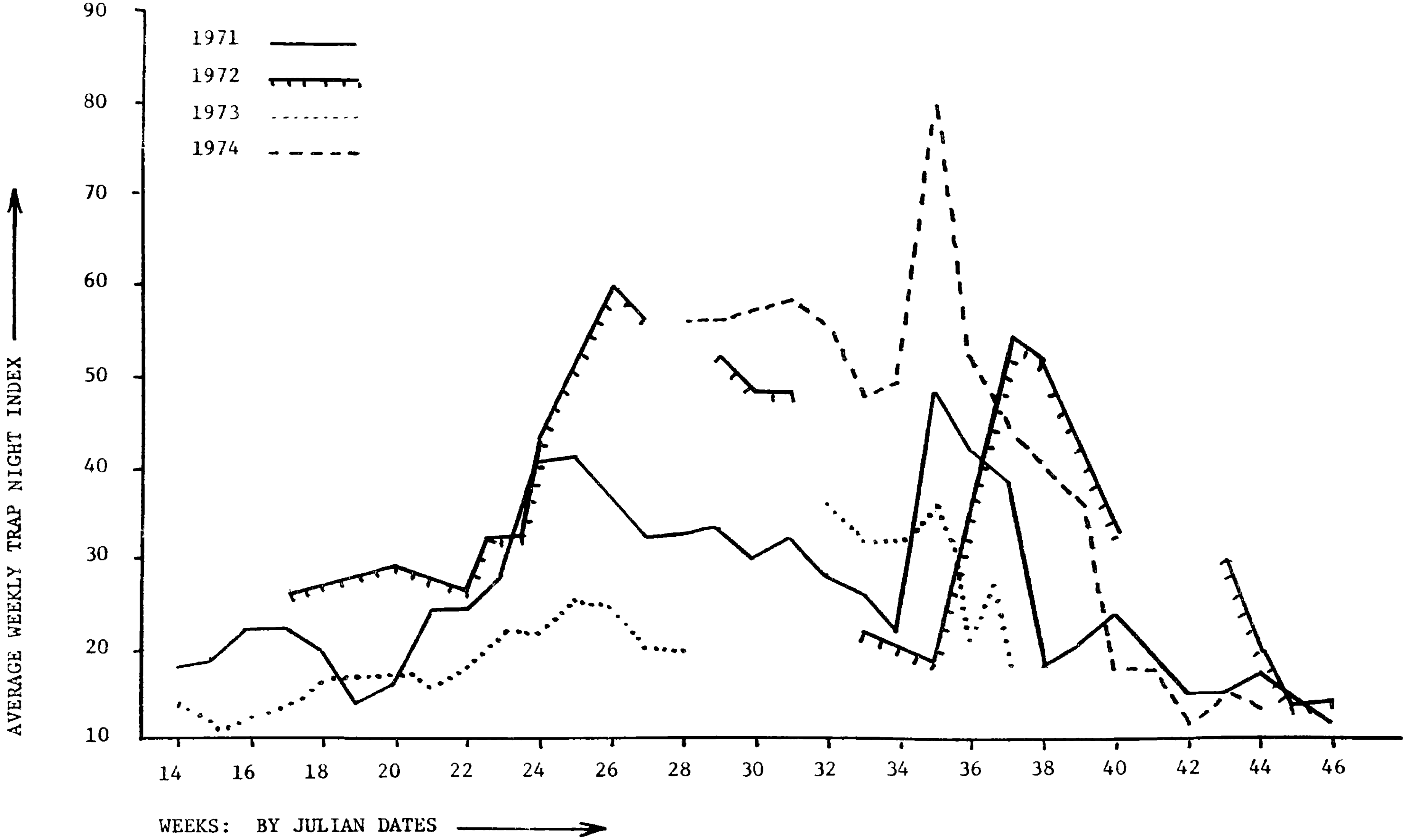
c. In countries such as Korea, where mosquitoes do not breed throughout the year, or on bases such as Hickam, where normally low mosquito populations make a base fogging program unnecessary, except for usual outbreaks, graphed TIs can be used to determine the optimum times for beginning and ending control measures, or the necessity to establish temporary control measures.

d. There is another type of TI which can be used to follow the fluctuations of one or more species of mosquitoes which are disease vectors or extreme pests. In this Specific Trap Index (STI) only the species or combination of species being followed is calculated and graphed as shown by the following examples.

(1) For *Aedes vexans* (a pest species):

$$STI = \frac{\text{Female Aedes vexans captured in one week}}{\text{No. of trap nights in that week}}$$

FIGURE III-2: Graphed Trap Index Data



(2) For Japanese B encephalitis vectors on Taiwan:

$$\text{STI} = \frac{\text{Female } \underline{\text{Culex tritaeniorhynchus}} + \underline{\text{C. fuscocephala}} + \underline{\text{C. annulus}}}{\text{No. of trap nights in that week}}$$

Cumulative STIs can be used in the same manner as cumulative TIs for prediction of peak mosquito population periods and for maximizing the effectiveness of control measures. They are routinely used in several areas of CONUS for accurate prediction of disease outbreaks, whereby if the STIs exceed an experimentally determined level, an outbreak of the disease vectored by the mosquito species being followed can be predicted. Unfortunately, such "magic numbers" for the PACAF area have not been established.

It is hoped that publication of this "correspondence course" in light trap data utilization will answer at least the most common questions which have been asked by the field, and that the continued use of light traps for mosquito surveillance has been sufficiently justified in the minds of the personnel tasked with conducting this surveillance. Any questions which have not been answered may be addressed to 1MSEW/SGE at any time.

IV. ALTERNATIVE MOSQUITO SURVEILLANCE METHODS:

AFR 161-1, PACAF Supplement 1, requires all PACAF bases to perform mosquito surveillance; specifically, light trap surveys for adult mosquitoes and dipping surveys for larvae are to be accomplished at designated intervals. These methods were chosen because they combine relatively efficient mosquito surveillance methods with minimal time spent in accomplishing the program. Most vector and pest species are readily captured in light traps, but several significant vector species are not attracted to light and their presence on a base might not be detected by use of the light trap. These species include *Aedes aegypti* and *A. albopictus*, vectors of dengue and hemorrhagic fever in Thailand and the Philippines, *Anopheles flavirostris*, the most significant Philippine malaria vector, and *Anopheles minimus* and *A. balabacensis*, which vector malaria in Thailand.

Larval surveys are an excellent method of determining the species present on a base and their relative abundance; however, this method requires a large amount of time and effort expended as well as a working knowledge of where the various mosquito species breed. For these reasons, larval surveys performed by base level personnel are not always as productive as desired.

Another reason why both larval and adult mosquito surveys in the PACAF area are often unproductive is poor timing. In the northern PACAF area, surveys are started too late and terminated prematurely. In the southern PACAF area, where surveillance should be maintained continually, it is stopped arbitrarily, for indeterminate periods of time, so that graphed TIs show large "holes" in the data. The following table indicates when mosquito surveillance, both larval and adult, should be accomplished in all 1MSEW-serviced areas.

Area	Start Surveillance	Stop Surveillance
Guam	-- Continual	surveillance --
Hawaii	-- Continual	surveillance --
Japan	1 April	30 November
Korea	1 April	30 November
Okinawa	-- Continual	surveillance --
Philippines	-- Continual	surveillance --
Taiwan	-- Continual	surveillance --
Thailand	-- Continual	surveillance --

A number of other mosquito surveillance methods can be used to detect species that are not attracted to light. Some of these methods use specialized equipment or require an unacceptable amount of time be spent in their performance; others can easily be accomplished at base level whenever desired. The following alternative methods of mosquito surveillance are briefly outlined:

a. Landing Collections

b. Biting Collections

c. Resting Collections

d. Ovitrap Collections

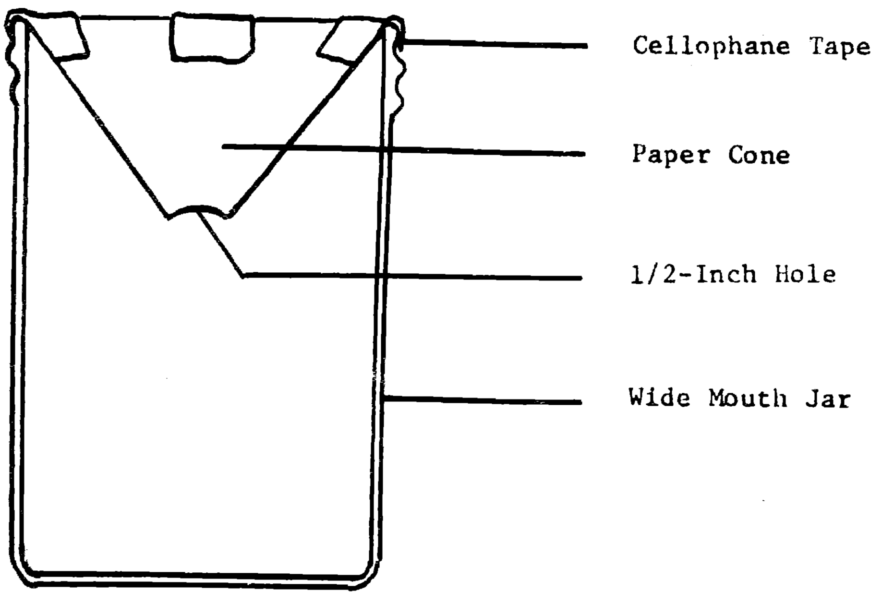
e. CO_2 Baited New Jersey Traps

f. CDC Miniature Traps

a. Landing Collections.

Two individuals are necessary to perform a landing collection survey. The first individual counts or collects the mosquitoes which land on the second individual who acts as "bait." A landing rate is then calculated on the basis of the number of mosquitoes landing on the bait during a given time period, which can be from 1 to 15 minutes. This method is not recommended in areas that do not support high populations of mosquitoes, as not enough mosquitoes will be collected to justify the time expended. It is preferable to collect the mosquitoes attracted during a landing collection survey so that they can be identified. This can be done with an aspirator, a chloroform tube, or with the simple collection device shown in Figure VI-1.

FIGURE IV-1:



Mosquitoes enter through the hole in the paper, but seldom find their way back out. Many mosquitoes can be captured in this manner with very few escaping through the hole in the paper cone.

b. Biting Collections.

Biting counts are similar to landing counts except that only those mosquitoes that bite are collected by one of the methods described in the preceding paragraph. The mosquitoes can be collected from the torso of an individual serving as bait by a second individual, or the collector can sit on a chair, remove his shoes and socks, roll up his trouser legs, and collect the mosquitoes that bite his legs and feet. This procedure is not recommended in areas where a vector-borne disease outbreak is in progress, or where vector-borne disease is known to be endemic, unless suitable vaccination or prophylaxis is available and used.

c. Resting Collections.

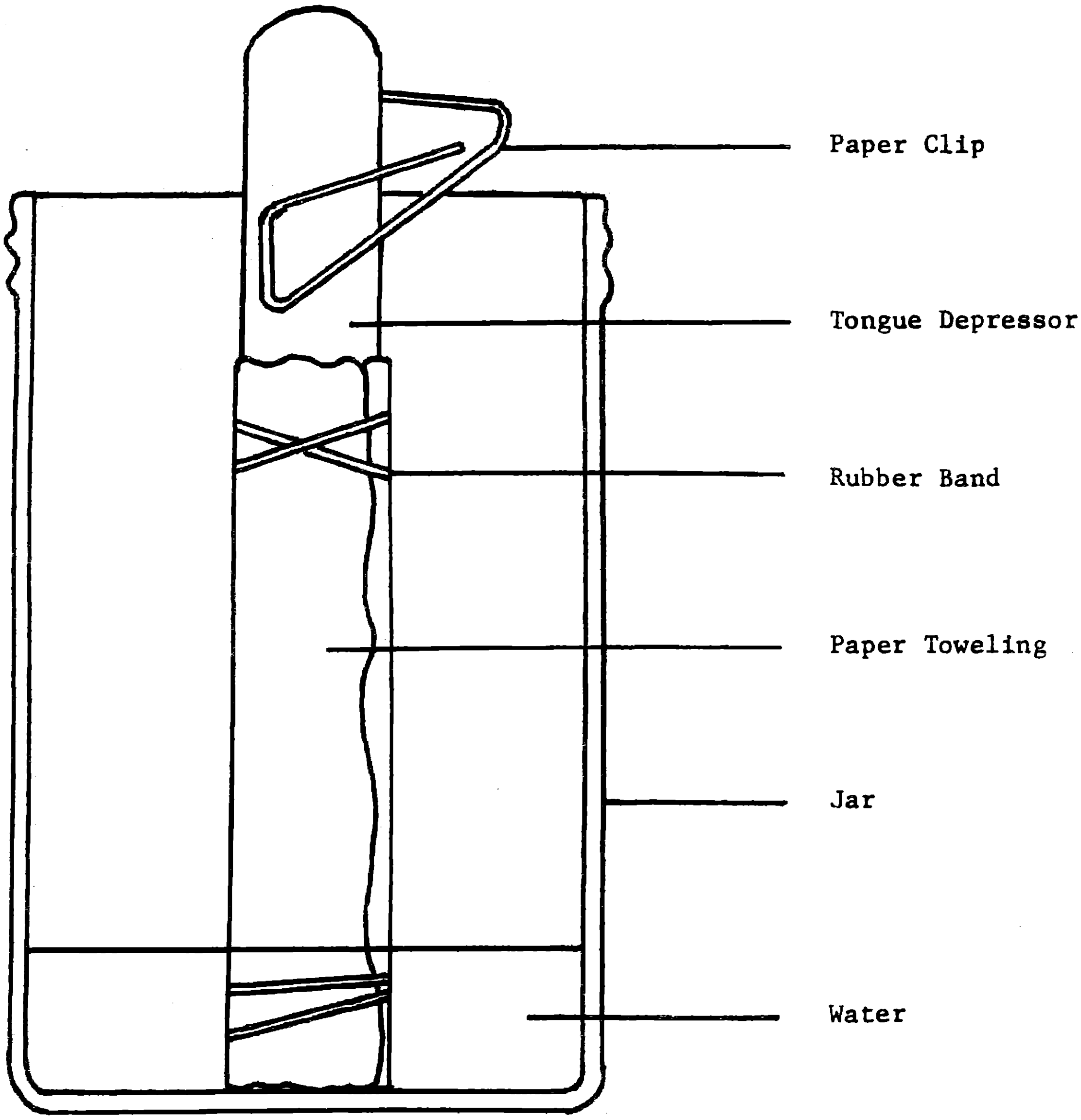
Many mosquitoes are active only during the night and seek shelter in dark, quiet resting places during the day. If these resting places can be discovered, it is possible to collect mosquitoes, often many mosquitoes, with a minimum of effort. Places where mosquitoes normally rest include animal burrows, brush piles, between exposed tree roots, under tree bark, in holes in trees, in the vegetation and roots along streams, klongs, or benjos, privies, pigsties, bunkers, human habitations, under bridges and culverts or in almost any other type of dark, sheltered, undisturbed area. A flashlight is useful for optimum collection of mosquitoes in their resting sites, as most of these sites are dark. If the flashlight is held at an angle to the resting site, the mosquito will cast a larger shadow and be easier to detect.

d. Ovitrap Collections.

Aedes aegypti and *A. albopictus* are extremely important disease vectors in the PACAF area, due to their role in the transmission of dengue, hemorrhagic fever, and chikungunya in Thailand and the Philippines. Neither of these species is attracted to light and their collection in light traps is unusual even when they occur in the trap area in large numbers.

Detection of the presence of these two mosquitoes is desirable. Since the use of the conventional light trap is precluded, a new method for their surveillance has been developed. The procedure is based on the egg-laying habits of both species, combined with their preference for darkness. Both species prefer to lay their eggs in small artificial containers filled with water, with the eggs deposited on the container surface at the water line. Based on these facts, the Ovitrap, otherwise known as the LBJ (Little Black Jar) was developed by the US Public Health Service in the middle 1960s for use in the *Aedes aegypti* Eradication Program then in progress in the United States. The Ovitrap consists of a one-pint, wide-mouth jar, coated on the outside with glossy black paint. For use, the jar is filled to a depth of approximately one inch with water. A paddle made by wrapping paper toweling around a tongue depressor and securing with rubber bands is then fastened to the side of the jar with a large paper clip, as depicted in Figure IV-2.

FIGURE IV-2: Ovitrap



Ovitraps are set out in sheltered, dark areas such as under bushes and under houses, but close to the edge of such areas. Enough Ovitraps should be set out to offer a large number of oviposition areas to the Aedes mosquitoes--a minimum of 10 per city block is recommended--and at least 100 per base at one time. The location of all Ovitraps set out should be carefully documented so that all are found. The traps should be visited every seven days, the water replenished and the paddles exchanged for new ones.

The paddles should be sent to 1st MSEW for examination for mosquito eggs. The water in the traps should also be examined for the presence of mosquito larvae and any larvae found should be preserved in MacGregors Solution (see Section VII-3) and sent to 1st MSEW for identification. As several mosquitoes in addition to Aedes aegypti and A. albopictus oviposit in this habitat, it is necessary to identify the eggs and larvae rather than to automatically assume that any eggs or larvae found are of these two species.

Ovitraps are not a stocklisted item and probably cannot be locally obtained; however, 1st MSEW has a large stock of Ovitraps and will be happy to issue them, along with more complete instructions, to any PACAF installation on request.

e. Carbon Dioxide Baited Traps.

Mosquito traps baited with carbon dioxide (CO_2) have several advantages over conventional New Jersey light-baited traps. These advantages include the following:

(1) Several species of mosquitoes that are not attracted to light are attracted to CO_2.

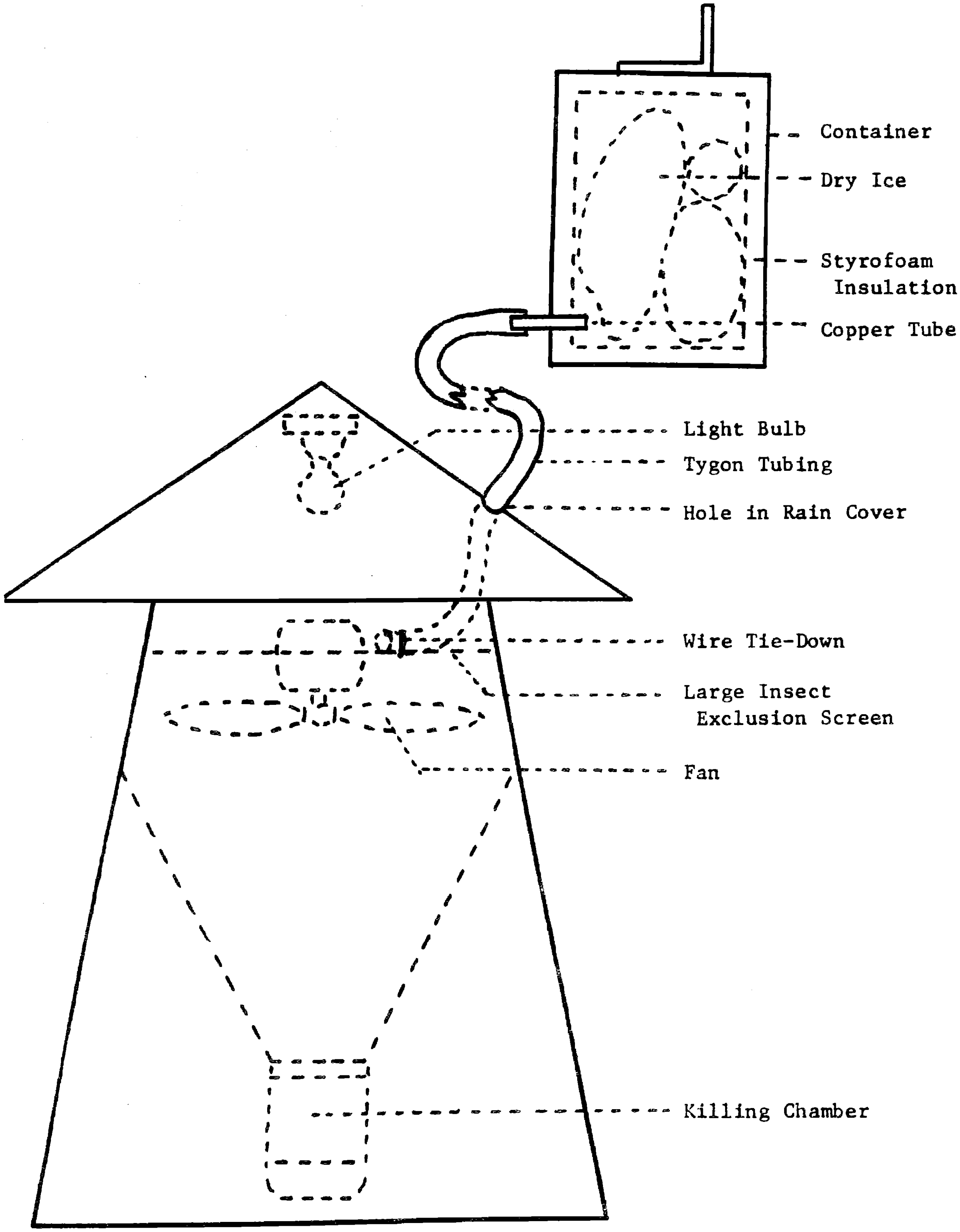
(2) Much higher numbers of mosquitoes are normally attracted to CO_2 baited traps than to light traps.

(3) CO_2 is not attractive to "trash" insects as light is. The catch in a CO_2 baited trap is almost 100 percent mosquitoes. This feature saves a significant amount of time otherwise spent in sorting mosquitoes out of the trash insects.

The standard New Jersey light trap can easily be modified into a CO_2 baited trap, as diagrammed in Figure IV-3. The only modification of the trap itself is that a hole is drilled in the rain cover of the trap approximately one-third of the distance from the edge of the cover to the top. A length of Tygon or rubber tubing of a size to fit snugly through the hole is then inserted through the hole and tied securely to the large insect exclusion screen of the trap with string or wire. The other end of the tubing is attached to the CO_2 source.

The CO_2 can be supplied in several ways. The easiest way under field conditions is to use blocks of dry ice in an insulated container. The container diagrammed in Figure IV-3 is a steel ammunition box which has been lined with one-half inch thick styrofoam or polyethylene foam insulation to prevent the dry ice from evaporating too rapidly. A small copper tube runs through the hole in the box and into the dry ice chamber, and extends 1 or 2 inches on the outside of the box to form a nipple for attachment to the tubing. This tube can be secured in place if desired by solder or hot melt glue. The evaporating dry ice builds up enough vapor pressure to force the CO_2 through the hose.

FIGURE IV-3: New Jersey Light Trap Modified as a CO_2-Baited Trap



Another dry ice container that works quite well is a styrofoam dry ice shipping container (FSN 8115-682-6525); however, this will not take the abuse that the steel ammunition box will.

It is possible to use CO_2 directly from a tank, in which case the tubing is connected directly to the outflow nipple of the pressure gauge on the tank. This method is the best from an experimental viewpoint, as the CO_2 flow can be precisely regulated and measured, but normally this method is of little use to the field, particularly in high pilferage areas.

For use, the trap can be operated from sundown to sunup as the unmodified light trap is, but it is preferable to operate it continuously, as CO_2 is attractive to day-flying mosquitoes during the daylight hours as well as to night-flying species. If the CO_2 baited trap is operated around the clock, it may be necessary to replace the dry ice every 12 hours. If desired, the light bulb may be unscrewed or removed so that trash insects are not attracted to the trap.

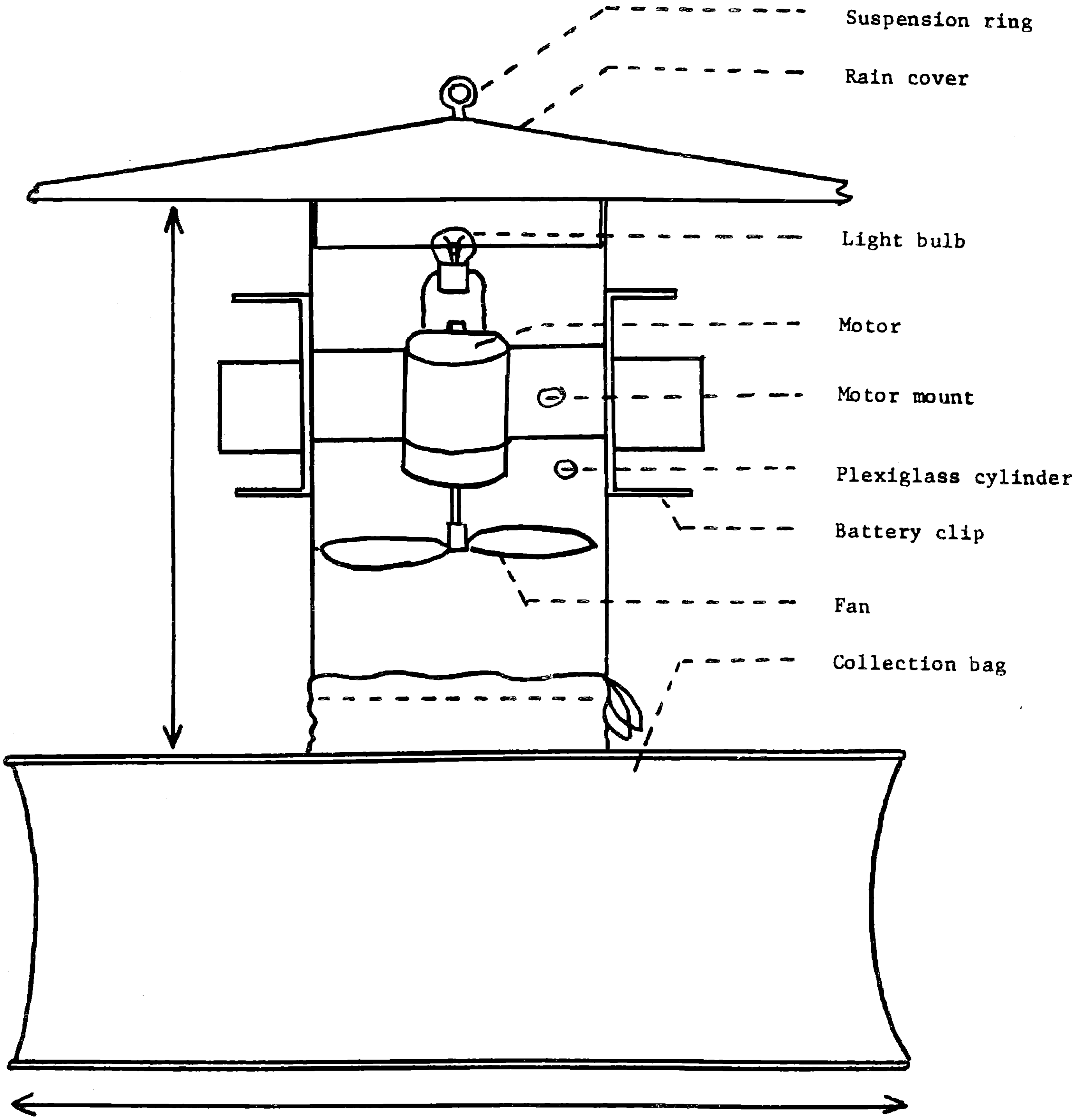
All installations are urged to try the CO_2 baited traps, as data on the attractiveness of these traps to Asian mosquito species is scanty, although such data for American species are available. It is predicted that vector species not particularly attracted to light will be attracted to CO_2, and that the time expended in filling dry ice containers would be saved by the amount of time not needed to separate mosquitoes from trash insects.

1st MSEW/SGE has personnel assigned who are familiar with CO_2 trapping and should be contacted for more complete advice by any base planning to use CO_2 baited traps in their mosquito surveillance program.

f. CDC Miniature Light Trap.

The CDC miniature light trap was developed by the Center for Disease Control to fill a requirement for a small, light weight, easily transportable light trap which was not dependent on ground power. The CDC trap (Figure IV-4) consists of a transparent plexiglass cylinder, with an aluminum rain cover and a nylon mesh collection bag. Within the plexiglass cylinder are a flashlight bulb and a small electric motor which operates the fan. The principles of operation are identical to those of the New Jersey light trap. Power is supplied by 4 D-cell (flashlight) batteries which are held in aluminum clips attached to the side of the cylinder, or can be supplied by any 6-volt wet or dry cell battery. The flashlight batteries will operate the trap for approximately 12 hours. The rain cover is 14 inches in diameter and 1 inch high, the cylinder is 3-1/2 inches in diameter by 6 inches high, and the collection bag is 11 inches in diameter by 5 inches high when expanded but is less than 1 inch high when collapsed. The assembled unit, with batteries, weighs less than 5 lbs. The rain cover, cylinder, and collection bag disassemble to increase portability and storage ease.

FIGURE IV-4: CDC Miniature Light Trap



1st MSEW has a number of CDC traps which can be made available to the field for periods of up to 3 months. These traps are available through the medical supply system (NSN 3740010108578), and 1st MSEW supports the acquisition of several of these traps by each PACAF base for sampling of areas which lack ground power for the operation of New Jersey light traps.

V. MAJOR MOSQUITO DISEASE VECTORS IN THE PACIFIC AREA:

The PACAF area referred to in the following list is restricted to Thailand, Republic of the Philippines, the Mariana Islands, Hawaii, Taiwan, Korea, and Japan. Many of these species are also found in other areas of Asia and the Pacific.

Species	Disease Vectored
Aedes aegypti	Dengue and hemorrhagic fever (Thailand, Philippines) Chikungunya (Thailand, Philippines)
Aedes albopictus	Dengue and hemorrhagic fever (Thailand, Philippines)
Aedes poecilus	Malayan filariasis (Philippines)
Aedes togoi	Malayan filariasis (Korea)
Anopheles balabacensis	Malaria (Thailand)
Anopheles flavirostris	Malaria (Philippines) Malayan filariasis (Philippines)
Anopheles minimus	Malaria (Thailand)
Anopheles sinensis	Malaria (Korea, Japan) Malayan filariasis (Korea)
Culex annulus	Japanese B encephalitis (Taiwan)
Culex bitaeniorhynchus	Sindbis virus (Philippines)
Culex fuscocephala	Japanese B encephalitis (Taiwan) Bancroftian filariasis (Philippines)
Culex gelidus	Japanese B encephalitis (Taiwan)
Culex quinquefasciatus	Bancroftian filariasis (Entire PACAF area)
Culex tritaeniorhynchus	Japanese B encephalitis (Japan, Korea, Taiwan)
Culex whitmorei	Bancroftian filariasis (Japan)
Mansonia bonneae	Bancroftian filariasis (Philippines)
Mansonia uniformis	Bancroftian filariasis (Philippines)

VI. BIOLOGICAL DATA FOR SELECTED MOSQUITOES:

A basic knowledge of the life histories and habits of the more common mosquitoes is necessary for the effective planning of base vector surveillance and control programs. With this idea in mind, basic information pertaining to the geographic range, larval and adult habitats, periods of peak biting activity, flight range, host preference, and disease and pest importance of several of the most important disease vectors and pest species in the PACAF area are summarized below:

Aedes aegypti (Linneus) 1762

Aedes aegypti breeds freely between 45°N and 35°S latitudes, which includes the entire PACAF area. It has been eradicated at one time or another from Okinawa, Guam and Oahu, but has become reestablished in Okinawa and Guam. Larvae are found primarily in water impounded in artificial containers such as cans, bottles, fire barrels, snail shells, etc., but this species will also breed in tree holes, rock pools and ground pools, provided that the water is clean. One of the most favored breeding places is in water impounded in rubber tires, and this habitat should always be included in base larval surveys, if available. The eggs of A. aegypti are quite resistant to drying out, and can remain out of water for six months or more without dying. The favored adult resting place is indoor habitations, although they may be found outdoors in shady places. A. aegypti is primarily an indoor, daytime biter throughout most of its range. Outdoor and nighttime biting occurs, but is unusual, except perhaps in the Marianas. Bites are quite painful. Aedes aegypti feeds almost exclusively on man, and is seldom found more than 100 meters from human habitations or working areas. It is not a strong flyer, and most of its flights are short and characterized by frequent resting. Aedes aegypti is the primary vector of dengue and dengue hemorrhagic fever in Thailand and the Philippines, as well as in portions of Africa, Southern Europe and the Americas. It is also the classical vector of yellow fever, although this disease does not occur in the PACAF area.

Aedes albopictus (Skuse) 1894

Aedes albopictus is widely distributed throughout the warmer regions of the world, and is found in all of the PACAF countries. Larvae have been collected in tree and rock holes, bamboo stumps, coconut shells and leaf axils, as well as in water impounded in virtually any type of artificial container. A. albopictus is more likely to be found in rural than in urban environments, where it is normally replaced by Aedes aegypti, but is capable of inhabiting urban, rural, and forested environments from sea level to 6000 feet. Adults rest on stream banks, groves, thickets, undergrowth, caves, and inside and outside houses. This species is not attracted to light and is rarely recovered from light traps. A. albopictus is a weak flyer, and seldom flies beyond one-half kilometer. It is a persistent and painful biter, preferring to bite in shady areas. Peak biting activity is during the daytime, from shortly after sunrise until sunset, but biting also occurs after sundown. Man is the preferred host, but domestic animals are also fed upon, as are primates in forested areas. It is a vector of dengue and dengue hemorrhagic fever primarily in rural areas, as contrasted to A. aegypti which is the major dengue vector in urban situations. It has also been implicated as a vector of chikungunya and tropical eosinophilia, and has been considered as a vector of Japanese B encephalitis, although this association has yet to be proven.

Aedes (Aedimorphus) vexans vexans (Meigen) 1830

Aedes (Aedimorphus) vexans nipponii (Theobald) 1907

These two subspecies of Aedes vexans are closely related, with A. v. vexans found in the warmer portions of the PACAF area (Thailand, Philippines, Guam, Hawaii) and A. v. nipponii in the colder portions (Japan, Korea). Larvae of both subspecies prefer similar breeding habitats, and are found in such places as brackish and fresh water swamps, marshes, ditches, ground pools, abandoned post holes, hoof prints, and artificial containers. They prefer unshaded water, but can occasionally be found in shaded areas. Little is known about the daytime resting preferences of either subspecies, but both are readily collected in light traps at night. A. v. nipponii overwinters as hibernating adults in Japan; A. v. vexans is found throughout the year in its range. A. v. vexans feeds during the night, from approximately 1800 to 0600, with peak biting activity around midnight. A. v. nipponii will feed both day and night, with feeding activity normally starting in mid-afternoon and extending to approximately 2200. Both subspecies are strong flyers, with flight ranges up to 48 kilometers. Both subspecies will feed both on man and on domestic animals. Studies performed in Hawaii with A. v. vexans indicated a feeding order of preference for bovine, horse, dog, and human bood, in that order. A. vexans vexans may be involved in the transmission of certain strains of bancroftian filariasis, and A. v. nipponii has been suspected of complicity in the transmission of Japanese B encephalitis, although the latter has not been proven. Both subspecies are persistent and painful biters, and their major importance is probably as pests rather than disease vectors.

Anopheles balabacensis balabacensis (Baisas) 1936

Anopheles balabacensis is found in areas of the Philippines, Malaysia, Indonesia, Thailand, Burma, Laos, the Khmer Republic, Vietnam, Taiwan, Northeast India, and Southern China. The larvae favor shaded streams and seepage pools in heavily wooded and foothill areas, but are also found in swamps, pools, hoofprints, if these non-typical sites are partially shaded or sunny, with clear water and silty bottom. Changes in the natural vegetation of jungle areas made by man, such as clearing jungle for agricultural purposes, may favor an increase in A. balabacensis populations. Adults normally rest in jungle foliage in areas with subdued light. They have also been collected in palm hedges, mining pits, among shrubs under dead leaves, in stream banks, and inside houses. A. balabacensis bites throughout the night, and prefers to bite inside habitations rather than outside. It will characteristically rest on the outside of houses prior to entering them to feed, and after feeding, leaves the house to rest under the eaves before leaving at dawn. Peak biting periods vary from early in the evening in portions of Indonesia to 0200-0300 in Thailand and Malaysia. Daytime biting is infrequent but has been observed in Thailand, Indonesia, and Malaysia. The flight range of this species is unknown. It appears to feed primarily on man, but females have been attracted to traps baited by bovines and monkeys. *Anopheles balabacensis* is a primary malaria vector in Thailand, India, Indonesia, Malaysia, and the Khmer Republic, and may also be a vector of simian malaria.

Anopheles flavirostris (Ludlow) 1914

Anopheles flavirostris is widespread on the larger islands of the Philippine Archipelago, and may be present in eastern Java. Its presence in Australia and India is more uncertain. Larvae favor the grassy edges of clear, partially shaded, slowly flowing streams, and can best be found among the exposed roots of trees along the banks or inside pools where water movement is minimal. They can also be found in slightly turbid, slightly polluted streams with submergent aquatic plants, and along the edges of lakes among water hyacinth plants if there is an undercurrent water flow. Adults rest outdoors during the day in cool crevices along stream banks and dugouts where there is vegetation and the earth is moist, or in crab burrows, moist tree holes, cracks in rotten logs, underneath roots and in bamboo thickets. A few may remain in housing during the day, but this is not common. This species bites indoors, with peak biting activity between 2300 and 0100. The normal flight range varies between 0.2 to 2.0 kilometers, with an average range of about 1 km. *A. flavirostris* would much rather feed on domestic animals, such as cattle and carabao, than on man, but in areas where domestic animals are scarce, man is used as an alternative food source. This preference becomes important in areas where new land is developed, but domestic animals are absent and the females have no choice but to feed on man to survive. *A. flavirostris* is the most important malaria vector in the Philippines, and is a possible vector of bancroftian filariasis.

Anopheles minimus minimus (Theobald) 1901

Anopheles minimus is widely distributed in Asia, being found in portions of India, Pakistan, Burma, Thailand, Laos, the Khmer Republic, Vietnam, Southern China, Indonesia, and Malaysia. Favored larval breeding areas are streams in hillside and foothill areas where water is slow flowing, clear and with partially shaded grassy edges. Larvae can also be found in the margins of swamps, drains, irrigation canals, shallow earth wells, and in marshes and in rice fields with slowly running water. Adults prefer to stay indoors in any dark corner or area that is dark, humid, and undisturbed such as under beds and in cupboards. They are also found in the dark lower portions of the walls in cattle sheds or among bundles of straw. The period of peak biting activity is 2200 to 0200, although some biting occurs throughout the night. Anopheles minimus much prefers to feed on man, but is able to survive in wooded areas where man is not present, and will feed on cattle. The flight range is unknown. Anopheles minimus is a very efficient malaria vector, and with Anopheles balabacencis is responsible for the majority of the malaria cases in Thailand.

Anopheles sinensis (Wiedemann) 1828

The range of Anopheles sinensis includes China, Taiwan, Burma, Vietnam, Thailand, Korea, Japan, Malaysia, Indonesia, India, and Afghanistan. The larvae are normally found in clean water with low organic content, such as that in rice fields, natural ground pools, lakes with marginal vegetation, and newly cleared jungle areas. Adults prefer to rest during the day in cow stables and vegetation near the breeding places, or in habitations or storage areas adjacent to habitations. Biting takes place during the night, and starts approximately two hours after sunset. Most biting occurs inside. Flight range is unknown. A. sinensis prefers to feed on domestic animals, particularly cattle, but will readily bite man if mosquito populations are large or animals are scarce. A. sinensis is the major vector of malaria in Korea, Taiwan, and north and central mainland China. Adults have been found naturally infected with Brugia malayi (malayan filariasis) in Korea, and it also vectors filariasis in portions of mainland China.

Culex annulus (Theobald) 1901

Culex annulus is found in Thailand, the Philippines, Taiwan, and Japan, as well as in other areas of Asia. Larvae breed in fresh and brackish water, and are common in tidal swamps, farm reservoirs, rice fields, streams, lakes, ground pools, pot holes, and bamboo stumps. Adults readily enter and rest in buildings and are also found resting outdoors in habitats such as straw and wood piles, and vegetation along ditchsides, pathways, orchards and fencelines. Biting activity peaks at sunset, but continues throughout the night. The ratio of outdoor to indoor biting is 10 to 1 in Taiwan. C. annulus prefers to feed on large domestic animals, such as swine and water buffalo, rather than man, but in the absence of such animals, man is readily bitten. C. annulus is a vector of Japanese B encephalitis on Taiwan.

Culex bitaeniorhynchus (Giles) 1901

Culex bitaeniorhynchus is common throughout the PACAF area except Hawaii. Larvae are found in open weedy pools, ravines, swamps, rivers, streams, rice fields, ditches, fish ponds, hoof marks, artificial containers, and plant axils. Adults rest both indoors and outdoors. Peak biting activity varies from area to area, as this species has a number of forms. In China and India it bites only at night, but in Korea it bites both day and night. The order of feeding preference in Japan is chicken, dog, goat, rabbit, and man, and this species will also feed on wild birds and large domestic animals. Man is normally fed upon only in the absence of a more preferred host. C. bitaeniorhynchus has been found naturally infected with bancroftian filariasis in several areas in the South Pacific.

Culex fuscocephala (Theobald) 1907

This species is found throughout the warmer countries of Asia and the Pacific, including Thailand, the Philippines, and Taiwan. Larvae breed in rice fields, streams with emergent vegetation, ditches, pools, swamps, sewage contaminated ponds, artificial containers, and tree holes. Adults rest in vegetation, and in houses during the day but become active at dusk. Peak biting activity is during the first two hours after sunset, although sporadic biting occurs throughout the night. Both sexes are readily attracted to light. *C. fuscocephala* prefers to feed on large domestic animals, to a lesser extent on birds, and feeds infrequently on man. This species is a vector of Japanese B encephalitis on Taiwan and vectors bancroftian filariasis in some areas of the Philippines.

Culex gelidus (Theobald) 1901

Culex gelidus is common in Southern Asia and the Pacific. Larvae are collected in open, weedy, or marshy pools, swamps, rivers, streams, artificial containers, and in almost any water with a high concentration of organic matter. Adults rest in houses and sheds. Biting occurs both inside and outside dwellings, with peak biting activity approximately 1830 to 1930. Domestic animals are the preferred host, but man is bitten if suitable animals are not available. *C. gelidus* is a vector of Japanese B encephalitis in Taiwan and Thailand, and is also a minor vector of chikungunya and Getah virus. Although it has yet to be implicated as transmitting filariasis in any of the PACAF countries, it is a filariasis vector in other Asian countries.

Culex quinquefasciatus (Say) 1823

Culex quinquefasciatus is widely distributed throughout all tropical and semitropical countries. Larval breeding sites are in ground water or in containers, and water with a high degree of organic pollution is preferred, as is shade. Larvae are often found in open sewers, sewage pools, poorly closed cesspools, and dirty wells, as this species can tolerate very high amounts of organic contaminants in its breeding waters. Larvae are often more abundant during dry months, as rainfall will flush them out of their breeding places. Periods of dry weather also concentrate the organic content of standing water and make it more attractive for breeding. Adults are often found resting in dwellings and other man-made structures. *C. quinquefasciatus* is a vicious biter and is a major pest species, particularly in urban situations. Biting activity begins at dusk, reaches its peak in the early morning hours, and ends at dawn. Although flights of up to five kilometers have been recorded, distances of 0.5 kilometers or less are much more common, and it is not considered a migratory species. In addition to being a severe pest, *C. quinquefasciatus* is the chief vector of urban periodic bancroftian filariasis throughout much of its range. There is a possibility that it is also a minor vector of chikungunya and Japanese B encephalitis.

Culex tritaeniorhynchus (Giles) 1901

Culex tritaeniorhynchus is widely distributed throughout large areas of Africa, southern Europe, the Middle East, and Asia, including the Philippine Islands, Thailand, Taiwan, Japan, Korea, and Vietnam. It breeds in a wide range of waters and may be found in fresh or polluted water, temporary and permanent pools with or without vegetation, ditches, ponds, and particularly in rice fields. It can also tolerate brackish water and is found in tidal marshes. Adult daytime resting places include cowsheds, pigsties, on damp rocks in the forest, ground vegetation, and inside houses. It is more commonly found in rural than in urban areas. Biting occurs mainly outdoors soon after sunset, and continues until 2000 or 2100, although this mosquito will also bite inside if attracted there by light. Biting rate is high at ground level but decreases with increasing altitude. The usual flight range is about one kilometer; however, dispersals of over eight kilometers have been recorded. The preferred hosts of C. tritaeniorhynchus are swine and cattle with some avian feeding noted, but in the absence of preferred hosts, they will readily feed on man. This species is the primary vector of Japanese B encephalitis (JE) in Japan, Korea, and Taiwan. The feeding preference of C. tritaeniorhynchus for swine is of interest in the epidemiology of JE, as swine are an amplifying reservoir for JE. When JE reaches a high endemicity in the swine populations, it can spill over into the humans in the area.

Culex whitmorei (Giles) 1904

Culex whitmorei is found throughout Asia and the Pacific, including Korea, Japan, Thailand, and the Philippines. Larvae have been collected in ground pools, pools with emergent vegetation in stream beds, rice fields, submerged grasslands, clear fresh water pools with decaying vegetation, and along the margins of slow flowing streams. Information on adult biology is scanty, but adults have been reported to enter houses and bite vigorously in the early evening and throughout the night. They also feed readily on water buffalo. C. whitmorei may be a low potential vector of bancroftian filariasis in Japan; it can be a severe pest due to its biting.

Mansonia uniformis (Theobald) 1901

Mansonia uniformis is widespread throughout the tropical and sub-tropical areas of the Old World, as far north as Okinawa. Mansonia larvae are unique in that rather than floating free in the water, they attach themselves to aquatic vegetation with their siphons, and derive their oxygen from the plant. Thus they are seldom detected in routine larval surveys. Mansonia uniformis larvae have been collected from a wide variety of water plants growing in tanks, ponds, marshes, and swamps, but are particularly often associated with water hyacinth. Adults rest under dead leaves, in bushes and weeds, as well as along stream banks and in dwellings. Biting occurs during the day in forested areas, and they are common biters both indoors and outdoors in the late afternoon and early evening. They are easily attracted to light. *M. uniformis* feeds readily on man and a variety of animals. It is a vector of malayan and bancroftian filariasis in a number of areas.

VII. PACKING AND SHIPPING SPECIMENS:

1. General Instructions.

All insect specimens submitted to 1st MSEW for identification should be prepared for shipment as specified in the next paragraphs. Unless specific instructions to the contrary are given, only dead arthropods should be submitted for identification. If it is necessary or desired to ship live insect specimens, 1st MSEW must be contacted for specific instructions prior to shipment, as there are international laws which govern the shipment of living organisms.

All specimens submitted to 1st MSEW must be properly labeled so that the following data are included:

a. Locality - Place of collection (Clark AB, R. P.)

b. Source - Host or environment at time of collection (Light trap No. 3, Larval Station 5, inside Bldg 555, etc.)

c. Collector - (SSgt Jones, Envmt Health Svcs)

d. Date - (Day, month and year of collection--NOT date mailed).

e. Remarks - Any additional pertinent information. (The inclusion of weather data is no longer requested).

All shipments should be addressed to the following address:

Vector Taxonomy Service
HQ 1st Medical Service Wing (PACAF)
APO 96528

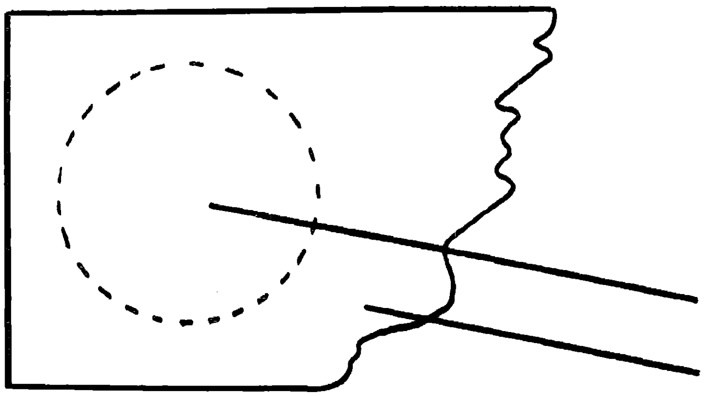
** PLEASE NOTE THAT THIS IS A DIFFERENT APO THAN THAT USED FOR THE REST OF 1ST MSEW.**

2. Adult Mosquitoes.

Specimens captured in light traps should be collected on the morning after they have been captured, separated from the "trash" insects in the light trap and packed for shipment as soon as possible. If the time between the end of the collection period and the time the mosquitoes are packed exceeds six hours, the specimens begin to dry up and become brittle. When such 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, to mold formation, and to excessive killing time because the killing agent used cannot penetrate the large layer of insects accumulated.

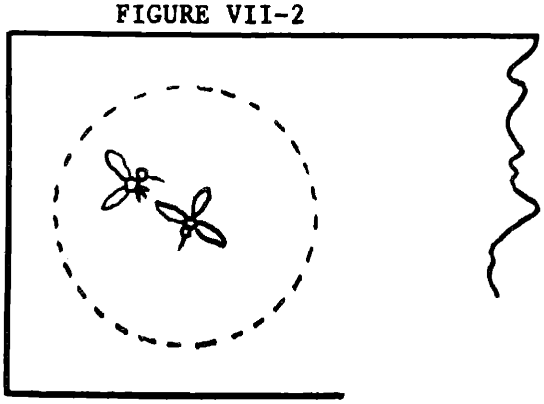
If mosquitoes are packed for shipment in the manner depicted in Figures 1 through 4, they almost always arrive in excellent condition so that all specimens are identifiable. The necessary packing materials are available to all Environmental Health Services Offices, and consist of facial tissues such as Kleenex (do not use toilet tissue) and Petri dishes for Millipore water cultures. (Dish, culture, Petri, top and bottom complete, FSN 6640-299-8689).

FIGURE VII-1



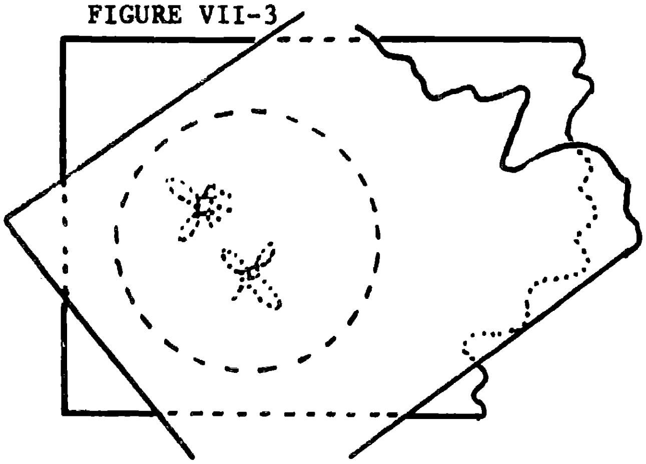
Place a piece of tissue over the bottom half of the culture dish, as diagrammed. The tissue must be large enough to completely cover the dish, with 1 inch of overlap on all sides.

FIGURE VII-2



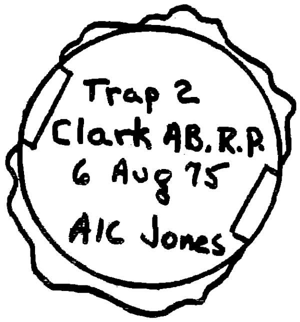
Place mosquitoes on the tissue covering the culture dish. Mosquitoes should be spread out so that they do not touch each other.

FIGURE VII-3



Cover the mosquitoes with a second piece of facial tissue.

FIGURE VII-4



Place the top of the culture dish on the bottom. Press the two halves together and tear off excess tissue. Tape the halves of the culture dish together so that they cannot separate in shipment. Write necessary data on the culture dish with a china marking pencil.

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

3. Larval Mosquitoes.

Ship all larvae from a single collection site in one container, but do not mix larvae from two or more collection sites. If possible, it is best to kill the larvae by placing them in hot, but not boiling, water. The water from a hot water tap is normally hot enough for this purpose. The hot water prevents the larvae from turning black and becoming difficult to identify. Drain the hot water from the mosquitoes before adding the preservative. If hot water is not available, the larvae can be placed directly in the preservative.

In the past, most larvae have been preserved and shipped in 70 percent ethyl or isopropyl alcohol. These preservatives cause hardening and distortion of the larvae so that identification was made much more difficult. 1st MSEW strongly recommends that MacGregors Solution, rather than alcohol, be used for preserving and shipping mosquito larvae. This is made by dissolving five 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). All of these chemicals should be available through the hospital pharmacy or the clinical laboratory.

(Sodium borate, USP, 6505-00-141-9000, 1 lb bottle @ $0.31 per bottle)

(Glycerine, USP, 6505-00-153-8220, 1 lb bottle @ $0.81 per bottle)

(Formaldehyde solution, USP, 6505-00-264-6199, 1 qt bottle @ $0.89 per bottle)

The collection data specified in the General Instructions paragraph should be written on a small piece of paper and inserted into the preservative along with the larvae. It is important that only pencil or water-proof India ink be used to write the collection data, as any other type of ink will dissolve in the preservative.

The bottles or vials used to ship the mosquitoes should be completely filled with preservative, with no air bubbles apparent. A screw-cap vial or bottle is easier to fill completely than is one that has a cork stopper.

For shipment each vial should be wrapped individually in several layers of paper towel, cellucotton, or similar substance. These wrapped vials can then be packed by the same method as described for packing adult mosquitoes, and mailed to 1st MSEW for identification.

4. Other Insects and Arthropods.

1st MSEW will attempt identification on any other insect or insect relative which may be of possible medical or economic importance, but pretty beetles, butterflies, etc., which are obviously of no medical or economic importance, will not be identified. Types of insects and arthropods which 1st MSEW will attempt to identify include flies, fleas, lice, ticks, spiders, and scorpions. Insects found infesting stored food products will also be identified upon request. Insects other than mosquitoes should not be sent to the Vector Taxonomy Unit for identification, but directly to:

1st Medical Service Wing/SGE
APO 96274

All hard-bodied insect specimens other than mosquitoes which are submitted for identification should be preserved in 70 percent ethyl alcohol or 70 percent isopropyl alcohol. Soft-bodied insects, fly larvae, etc., should be shipped in MacGregors solution. Labels should be placed in each vial or bottle with the same data supplied as described in the General Instruction section. The vials should then be packed in the same manner as vials of mosquito larvae and mailed to 1st MSEW.

5. Rodents and Snakes.

Please do not mail rodents or snakes for identification without first contacting 1st MSEW. There is normally no reason to mail rodents or snakes to 1st MSEW.