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TRAPPING OF AIR-BORNE INSECTS ON SHIPS ON THE PACIFIC, PART 5[1]

By J. C. Harrell and C. M. Yoshimoto

BISHOP MUSEUM, HONOLULU, HAWAII

Abstract: Trapping was done during 1963 aboard military transport vessels between North America and Asia on 3 separate cruises. Several thousand specimens were collected, of which 20 were taken more than 500 km down wind from a continent or island. The majority of specimens trapped were Homoptera, Diptera, Hemiptera and Hymenoptera.

This fifth report of the series of trapping articles presents preliminary data on results of three trips aboard military transport vessels. In 1963, Harrell made two round trips aboard MSTS vessels. The first trip aboard the U. S. S. Mann in April and May, was from Honolulu, to Guam, South Korea, Philippines, Guam, and return to Honolulu. The second trip, aboard the U. S. N. S. Gaffey from 23 September to 2 October, was from Honolulu to Japan, Okinawa, South Korea, Japan, Adak (Alaska), and terminated in San Francisco. In June 1963, Yoshimoto collected for one trip aboard the U. S. S. Mann between Honolulu and Japan. A more comprehensive report will be presented later, after precise identification of the specimens have been made by specialists.

Methods: Nylon nets of 75 cm ring diameter were used on all three trips. As nets with detachable cones proved to be a liability in previous cruises, only nets without detachable cones were used. The rings, however, were modified with a locking hinge allowing easy replacement of damaged nets. The rings were cut in half. A 1/2 inch sleeve with an 1/8 inch hole bored and threaded in one end, was welded to one end of the ring. The other half of the ring had an 1/8 inch hole bored and threaded in it. The ring is locked by placing an 1/8 inch screw through the ends. The nets were strung in series on steel cables suspended from the mast and secured to the deck (Yoshimoto, Gressitt & Mitchell, 1962)[2]. As many nets as possible were used day and night, weather permitting.

The large suction trap (Yoshimoto, Gressitt & Mitchell, 1962; Yoshimoto & Gressitt, 1963)[2] was used by Harrell on both trips. Yoshimoto used only nylon nets on his trip aboard the U. S. S. Mann. The suction trap was modified, so that the net inside could be changed at sea if it became damaged. A small hinged door (25 × 25 cm) was cut in the aluminum cylinder so the operator could replace the nylon net which attaches on to the

1. Results of a project supported by a grant to Bishop Museum by the Biology Branch, Office of Naval Research (through Pacific Science Board, National Academy of Sciences). Previous parts of this series were by Gressitt & Nakata (1) and Yoshimoto & Gressitt (2-4).

2. Yoshimoto, Gressitt & Mitchell, 1962, Pacific Ins. **4** (4): 847-58, 1 fig.; Yoshimoto & Gressitt, 1963, *op. cit.* **5** (4): 873-83.

plastic receptacle. The door is then held shut by a wing bolt. At distances of 560 km or less from land, the equipment was checked three times a day. At greater distances the equipment was checked for specimens twice a day.

Results: Results are presented in Tables 1–7. The map indicates the various positions at which specimens were collected during the three trips. A total of 3748 specimens representing 59 different families were collected. The order Homoptera (2125 specimens representing 4 fam.) was the largest group collected. Diptera (22 fam. represented by 482 specimens) was the most diversified order collected. It must be noted that of the total number of specimens collected, 3527 were collected within a period of 11 hours in the Yellow Sea area. And of a total of 2891 live specimens collected during the three trips, 2821 were collected during this 11-hour period. The 3527 specimens collected in the Yellow Sea area probably originated in China near Shantung or the Liaotung Peninsula. The wind at that time was from the direction of the Chinese coast and was blowing with considerable force. Excluding this 11 hour period, a total of 221 specimens, of which 70 were alive, was collected. Twenty specimens were caught at distances over 500 km from land. A live fly collected 1800 km from the Oregon coast was the most distant specimen from land.

Weather was generally favorable for collecting, and all equipment was used continually except during local storms. Yoshimoto's trip, however, was hampered because the wind constantly blew at right angles to the ship's course causing the nets to blow in and out, discharging their contents.

The trip of the U.S.N.S. Gaffey to Adak, Alaska offered the Museum its first chance to do ship trapping in the North Pacific. The 19 specimens collected in this area are significant from the standpoint of the dispersal of air-borne insects in the Pacific region. Specimens collected at the port of Adak for the first time by Bishop Museum will be reported upon after further identification.

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Key to Tables 1, 2 and 5

* ship time	: caught in suction trap
+ caught alive	⊕ caught in bridge alive
¢ caught in net	& probable land area based on direction of prevailing wind

Table 1. Trapping aboard USS MANN (Harrell)

Date 1963	Wind Direction (Degrees)	Wind Velocity (Knots)	Starting Lat. (N)	Starting Long.	Ending Lat. (N)	Ending Long.	Approx. dist., nearest land, in km	No. Specimens	Order	Family
30.IV *0800	085°	23	21°15′	159°37′W	21°87′	165°20′W	610 km, Kauai, Hawaii	4	Diptera	Sciaridae
30.IV 1300	110°	26	21°87′	165°20′W	21°20′	167°00′W	240 km, French Frigate Shoal	+1	Diptera	Chloropidae
								1	〃	Agromyzidae
30.IV 1800	116°	11	21°20′	167°00′W	21°20′	168°45′W	430 km, French Frigate Shoal	: +1	Diptera	Sciaridae
								1	〃	Drosophilidae
1.V 0800	130°	13	21°20′	168°45′W	21°02′	173°42′W	550 km, Johnston I.	: 1	Diptera	Sciaridae
1.V 1200	314°	3	21°02′	173°42′W	21°00′	175°05′W	620 km, Lisianski I.	1	Diptera	Sciaridae
								1	〃	Fragment
1.V 1800	355°	4	21°00′	175°05′W	20°45′	177°04′W	900 km, Lisianski I.	1	Diptera	Fragment
2.V 0800	040°	4	20°45′	177°04′W	20°22′	177°48′E	1200 km, Lisianski I.	♀1	Hemiptera	Nabidae
6.V 1600	060°	13	16°18′	153°49′E	15°37′	151°14′E	1030 km, Marcus I.	1	Araneida	?
8.V 1200	087°	15	14°12′	145°54′E	14°14′	143°52′E	390 km, Rota I.	1	Coleoptera	Scolytidae
12.V 0800	075°	8	32°45′	126°30′E	36°24′	125°51′E	10 km, Inchon, S. Korea	: 2	Diptera	Fragments
13.V 0800	205°	13	36°24′	125°51′E	32°42′	124°32′E	275 km, Cheju-do I., S. Korea	+ : 1	Diptera	Ephydridae
								: 3	〃	Chironomidae
								: 1	Homoptera	Aphididae
13.V 1700	115°	19	32°42′	124°32′E	30°00′	123°55′E	140 km, Ning Po Coast, China	+ : 1	Diptera	Agromyzidae
								2	Coleoptera	Fragments
14.V 0800	192°	23	30°00′	123°55′E	25°51′	123°00′E	170 km, Keelung Coast, Taiwan	: 1	Homoptera	Aphididae
								1	Diptera	Agromyzidae
								1	〃	Chironomidae
14.V 1700	175°	12	25°51′	123°00′E	23°00′	122°18′E	55 km, Taitung Coast, Taiwan	: 1	Diptera	Chironomidae
								: 2	Homoptera	Aphididae
15.V 1200	calm		19°40′	120°30′E	18°13′	119°53′E	50 km, Vigan Coast, Philippines	2	Diptera	Ceratopogonidae
								1	〃	Cecidomyiidae
								5	Homoptera	Aphididae
								1	〃	Delphacidae/Fulgoridae
								1	〃	Cicadellidae
								1	Hemiptera	Lygaeidae
								2	Lepidoptera	Microlepidoptera
								+1	Araneida	?
								1	〃	? Fragment

								2	Hymenoptera	Agaontidae
								1	Thysanoptera	Thripidae
15.V 1900	019°	8	18°13′	119°53′E	16°40′	119°53′E	15 km, Cape Bolinao, Philippines	1	Lepidoptera	Microlepidoptera ?
18.V 1800	008°	5	12°35′	124°10′E	13°03′	127°10′E	200 km, Oras Coast, Samar I., Philip.	2	Thysanoptera	Thripidae
19.V 0800	070°	9	13°03′	127°10′E	13°20′	131°27′E	690 km, Oras Coast, Samar I., Philip.	1	Diptera	Fragment
24.V 0800	076°	20	16°05′	154°04′E	17°04′	157°34′E	800 km, Eniwetok Atoll	: 2	Hymenoptera	body-wing, fragments
25.V 1800	079°	24	18°11′	164°27′E	18°40′	167°30′E	170 km, Wake I.	: 2	Coleoptera	body-leg, fragments
26.V	070°	21	19°58′	178°26′E	20°23′	178°24′W	910 km, Johnston I.	: 1	Hymenoptera	Wing-fragment

Table 2. Trapping aboard USS MANN (Yoshimoto)

18.VI 0600	070°	15	21°20′	158°40′W	22°09′	162°20′W	210 km, Niihau I, Hawaii	♀ 2	Araneida	
								♀ 1	Diptera	Chloropidae

Table 3. Trapped material arranged by families (Compiled from Tables 1 & 2)

	No. specimens		No. specimens		No. specimens
Araneida	5	Cecidomyiidae	1	Cicadellidae	1
Diptera		Hemiptera		Lepidoptera	
Sciaridae	7	Nabidae	1	Microlepidoptera	3
Chloropidae	2	Lygaeidae	1	Hymenoptera	
Agromyzidae	3	Coleoptera		Agaontidae	2
Drosophilidae	1	Scolytidae	1	Thysanoptera	
Ephydridae	1	Homoptera		Thripidae	3
Chironomidae	5	Aphididae	9	TOTAL FAMILIES—17; TOTAL SPE-	
Ceratopogonidae	2	Delphacidae, Fulgoridae	1	CIMENS—49 (62 including fragments)	

Table 4. Insects trapped most distant from land (Compiled from Tables 1 & 2)

Date	Area	Distance from nearest land in km	Family	Date	Area	Distance from nearest land in km	Family
30.IV.1963	Kauai, Hawaii	610	Sciaridae	6.V.1963	Marcus Island	1030	Araneida (?)
1.V.1963	Lisianski Island	620	Sciaridae	19.V.1963	Samar I., Philippines	690	Diptera (?)
1.V.1963	Lisianski Island	900	Diptera (?)	24.V.1963	Eniwetok Atoll	800	Hymenoptera(?)
2.V.1963	Lisianski Island	1200	Nabidae	26.V.1963	Johnston Island	910	Hymenoptera(?)

Table 5. Trapping aboard USNS GAFFEY (Harrell)

Date 1963	Wind Direction/Velocity (Degrees) (Knots)	Starting Lat. (N)	Starting Long.	Ending Lat. (N)	Ending Long.	Approx. dist., nearest land, in km.	No. Specimen	Order	Family
23.IX *1800	090° 5	21°20′	157°40′W	21°30′	160°21′W	225 km, Oahu Hawaii	2	Hymenoptera	Agaontidae
							1	〃	Formicidae
							4	Psocoptera	Fragments ?
							1	Homoptera	Aphididae
							1	Hemiptera	Miridae
							1	Lepidoptera	Microlepidoptera
25.IX 1800	115° 7	25°23′	173°51′W	26°23′	177°50′W	430 km, Lisianski I.	1	Psocoptera	Ectopsoiidae
1.X 0900	095° 16	34°41′	145°52′E	34°44′	140°06′E	50 km, Ō Shima I. Japan	2	Diptera	Fragments?
2.X 1600	150° 6	34°44′	140°06′E	34°38′	139°05′E	50 km, Miyake I. Japan	⊕1	Hymenoptera	Ichneumonidae
							⊕1	Diptera	Dolichopodidae
							⊕1	〃	Drosophilidae
							⊕1	〃	Phoridae
							⊕1	〃	Chloropidae
3.X 0800	040° 25	34°38′	139°05′E	32°07′	133°36′E	40 km, Kochi Coast, Japan	1	Hemiptera	Miridae
							1	Homoptera	Aphididae
							2	〃	Immature ?
							5	Diptera	Phoridae
							1	〃	Ceratopogonidae
							1	〃	Drosophilidae
3.X 1300	355° 20	32°07′	133°36′E	31°39′	132°15′E	75 km, Miyazaki Coast, Japan	+14	Homoptera	Aphididae
							+1	〃	Delphacidae
									Fulgoridae
							+1	〃	Psyllidae
							+1	Hymenoptera	Proctotrupidae
							+1	〃	Bethylidae
							+1	Lepidoptera	Geometridae (larva)
							+2	Diptera	Mycetophilidae
							+12	〃	Ceratopogonidae
							+3	〃	Chironomidae
							+1	〃	Agromyzidae
							+1	〃	Leptoceridae
							1	〃	Fragment ?
3.X 1800	060° 12	31°39′	132°15′E	30°50′	130°50′E	7 km, Tanega I. Japan	1	Psocoptera	Ectopsocidae
							+1	Hymenoptera	Eulophidae
							+9	Homoptera	Aphididae
							+1	〃	Psyllidae
							1	Hemiptera	Fragment ?
							1	Diptera	Fragment ?
							+2	〃	Ceratopogonidae
							+1	〃	Chironomidae

									+1	〃	Ephydridae
4.X 0800	035°	12	30°50′	130°50′E	29°55′	127°53′E	300 km, Kagoshima Coast, Japan		2	Lepidoptera	Microlepidoptera
									8	Homoptera	Aphididae
									3	〃	Delphacidae
											Fulgoridae
									3	〃	Psyllidae
									4	〃	Immature ?
									1	〃	Fragment ?
									2	Thysanoptera	Thripidae
									3	Diptera	Ephydridae
									2	〃	Opomyzidae
									1	〃	Drosophilidae
									5	〃	Ceratopogonidae
									3	〃	Fragments ?
5.X 1800	040°	16	26°43′	127°30′E	28°15′	126°56′E	230 km, Tori Shima I. Japan		: 1	Hymenoptera	Torymidae
									: 1	Diptera	Drosophilidae
6.X 0800	290°	8	28°15′	126°56′E	32°29′	125°38′E	190 km, Cheju-do I. S. Korea & (430 km, Liaotung Penn. China)		: 1	〃	Drosophilidae
									: 1	〃	Ephydridae
6.X 1700	302°	18	32°29′	125°38′E	34°45′	124°58′E	150 km, Mokpo, S. Korea & (400 km, Shantung Pen. China)		+6	Diptera	Anthomyiidae
									+59	〃	Chironomidae
									+68	〃	Ceratopogonidae
									+5	〃	Chloropidae ?
									+30	〃	Ephydridae
									+9	〃	Agromyzidae
									+23	〃	Opomyzidae
									+2	〃	Canaceidae
									+1	〃	Cecidomyiidae
									+2	〃	Leptoceridae
									+1	〃	Tipulidae ?
									146	〃	Fragments ?
									+478	Homoptera	Cicadellidae
									+686	〃	Aphididae
									+55	〃	Aphididae (immature)
									+439	〃	Delphacidae
											Fulgoridae
									+3	〃	Immature
									267	〃	Fragments ?
									+43	Hemiptera	Miridae
									+1	〃	Lygaeidae
									+2	Coleoptera	Coccinellidae
									+7	〃	Staphylinidae
									+1	〃	Hydrophilidae
									+4	〃	Nitidulidae
									+28	Hymenoptera	Pteromalidae
									+14	〃	Eulophidae
									+5	〃	Braconidae

Date 1963	Wind Direction (Degrees)	Wind Velocity (Knots)	Starting Lat. (N)	Starting Long.	Ending Lat. (N)	Ending Long.	Approx. dist., nearest land, in km.	No. Specimen	Order	Family
								+3	Hymenoptera	Cynipoidea
										Eucoilinae
								+3	〃	Mymaridae
								+7	Lepidoptera	Pyralidae
								+5	〃	Microlepidoptera
								+2	Thysanoptera	Thripidae
								+158	Araneida	?
7.X 0600	335°	22	34°45′	124°58′E	37°04′	125°16′E	110 km, Sosan, S. Korea & (380 km, Liaotung Pen., China)	2	Neuroptera	Chrysopidae
								♀+3	〃	Chrysopidae
								+1	Thysanoptera	Thripidae
								+15	Araneida	?
								1	Acarina, Mesostigmata	Aceosejinae
								+8	Diptera	Phoridae
								+45	〃	Drosophilidae
								+54	〃	Ephydridae
								+3	〃	Opomyzidae
								+2	〃	Coelopidae
								+8	〃	Chloropidae ?
								+8	〃	Leptoceridae
								+2	〃	Canaceidae
								+28	〃	Culicidae
								+5	〃	Tipulidae
								+6	〃	Mycetophilidae
								+2	〃	Anthomyiidae
								+6	〃	Ceratopogonidae
								+8	〃	Agromyzidae
								+1	〃	Sepsidae
								+4	〃	Lauxanidae
								+1	〃	Trypetidae
								+2	〃	Chironomidae
								162	〃	Fragments ?
								+1	Coleoptera	Staphylinidae
								+200	Homoptera	Aphididae
								+41	〃	Delphacidae
										Fulgoridae
								+168	〃	Cicadellidae
								+23	〃	Immature ?
								103	〃	Fragments ?
								+2	Hemiptera	Lygaeidae
								+6	〃	Miridae
								4	〃	Fragments ?
								+7	Hymenoptera	Pteromalidae
								+3	〃	Eulophidae
								+1	〃	Braconidae
								21	Lepidoptera	Microlepidoptera

								+5	〃	Pyralidae
								+1	〃	Noctuidae
								+1	〃	Hesperiidae
8.X 0800	057°	14	37°04′	125°16′E	33°30′	125°30′E	130 km, Cheju-do I. S. Korea	: 1	Hemiptera	Immature ?
								: 1	Diptera	Dolichopodidae
								: 1	〃	Drosophilidae
8.X 1800	040°	12	32°23′	127°01′E	31°46′	128°35′E	280 km, Kagoshima Coast, Japan	: 1	Homoptera	Aphididae
								: 1	Coleoptera	Cryptophagidae (♂)
								: 1	Diptera	Ceratopogonidae
								1	Lepidoptera	Noctuidae
9.X 0700	090°	40	31°46′	128°35′E	32°00′	132°00′E	50 km, Miyazaki Coast, Japan & (130 km, Nakamura Coast, Japan)	+1	Orthoptera	Tettigoniidae
								: 1	Homoptera	Aphididae
								: 3	〃	Delphacidae Fulgoridae
11.X 1700	030°	20	35°15′	139°46′E	34°55′	140°16′E	10 km, Tateyama Coast, Japan	+1	Lepidoptera	Noctuidae
12.X 0800	350°	38	34°55′	140°16′E	38°22′	142°18′E	200 km, Sendai Coast, Japan	1	Orthoptera	Tettigoniidae
								1	Odonata	Libellulidae
								2	Lepidoptera	Noctuidae
								: 4	Diptera	Phoridae
								: 1	〃	Ceratopogonidae
12.X 1735	010°	35	38°22′	142°18′E	40°46′	144°17′E	210 km, Hachinohe Coast, Japan	: 1	Diptera	Dolichopodidae
13.X 1800	340°	25	43°13′	149°03′E	44°42′	152°42′E	245 km, Urupp-To I. Kuril I.	+ : 1	Diptera	Phoridae
14.X 1800	305°	20	49°09′	168°01′E	50°14′	172°55′E	320 km, Agattu I. Aleutian Isl. & (920 km, Kamchatka Penn. U.S.S.R)	+1	Orthoptera	Tettigoniidae
15.X 0800	275°	10	50°14′	172°55′E	51°19′	179°51′E	50 km, Amchitka I. Aleutian Isl.	+1	Diptera	Ephydridae
18.X 1600	305°	30	52°03′	168°54′W	51°34′	164°34′W	430 km, Umnak I. Aleutian Isl.	1	Diptera	Phoridae
								1	Coleoptera	Coccinellidae
20.X 0800	235°–285	40	49°24′	154°14′W	45°27′	151°13′W	1500 km, Unalaska Aleutian Isl.	+1	Orthoptera	Tettigoniidae
20.X 1600	255°	35	45°27′	151°13′W	44°28′	146°40′W	1800 km, Oregon Coast	⊕1	Diptera	Empididae
21.X 1600	240°	30	43°07′	140°50′W	42°12′	138°34′W	1200 km, Calif. Coast	1	Diptera	Phoridae
								1	〃	Fragment ?

Table 6. Trapped material arranged by families
(Compiled from Tab. 5)

Family	No. Specimen	Family	No specimen
Hymenoptera		Chrysopidae	5
Agaontidae	2	Coleoptera	
Formicidae	1	Coccinellidae	3
Proctotrypidae	1	Staphylinidae	8
Ichneumonidae	1	Hydrophilidae	1
Bethylidae	1	Nitidulidae	4
Eulophidae	18	Cryptophagidae	1
Torymidae	1	Diptera	
Pteromalidae	35	Dolichopodidae	3
Braconidae	6	Drosophilidae	51
Mymaridae	3	Phoridae	21
Psocoptera		Chloropidae	14
Ectopsocidae	2	Mycetophilidae	8
Homoptera		Ceratopogonidae	96
Aphididae	976	Chironomidae	65
Delphacidae Fulgoridae	487	Agromyzidae	18
Psyllidae	5	Leptoceridae	11
Cicadellidae	646	Ephydridae	90
Hemiptera		Opomyzidae	28
Miridae	51	Anthomyiidae	8
Lygaeidae	3	Canaceidae	4
Lepidoptera		Cecidomyiidae	1
Microlepidoptera	29	Tipulidae	6
Geometridae (larva)	1	Coelopidae	2
Pyralidae	12	Culicidae	28
Noctuidae	5	Sepsidae	1
Hesperiidae	1	Lauxanidae	4
Odonata		Trypetidae	1
Libellulidae	1	Empididae	1
Orthoptera		TOTAL FAMILIES	56
Tettigoniidae	4	TOTAL SPECIMENS (Excluding fragments)	2954
Thysanoptera			
Thripidae	5	TOTAL FRAGMENTS	729
Acarina (Mesostigmata)		TOTAL	3686
Aceosejinae	1	Total specimens caught alive	2886
Araneida	173	Total caught in suction trap	21
Neuroptera		Caught on bridge	6

Table 7. Insects trapped most distant from land
(Compiled from Tab. 5)

Date	Area	Distance from nearest land in km	Family
14.X.1963 1800	Kamchatka Pen., USSR	920	Tettigoniidae
20.X.1963 0800	Unalaska, Aleutian Is.	1500	Tettigoniidae
20.X.1963 1600	Oregon Coast	1800	Empididae
21.X.1963 1600	California Coast	1200	Phoridae