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TRAPPING: A CONTINUOUS INTEGRAL PART OF A RODENT CONTROL PROGRAMME

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ABSTRACT: Trapping is usually considered a rodent control technique of minor importance. Due to the economic situation in the Dumaguete, Philippines programme from which this report is drawn, regular trapping was a biological necessity. Four species of rodents and a shrew were of concern. A continuing daily trapping programme was developed from a field study of trap bait acceptability. Trap baits were reused every 23 days. Alternate baits were selected. Trap usage techniques were designed to optimize the results. Trap-bait shyness and trap shyness effects were observed but were not a major problem.

Trapping, a centuries-old means of rodent control, is recommended in many papers (e.g., N.P.C.A., 1971; Rowe, 1968; U.S.D.I., 1960). Live traps and sometimes snap (breakback) traps are essentially indispensable tools in certain kinds of rodent populations studies and some papers have noted that improved techniques can increase the results (e.g., Beer, 1964; Fomushkin, 1963; Johnson, 1969). Trapping remains a minor technique little investigated. No reference was found to a similar trap bait study.

In Dumaguete City, Philippines, due to limited funds, the use of snap (and live) traps was planned as a part of the integrated control programme. From inferences in the literature (e.g., U.S.P.H.S., 1949) and the senior author's previous experience in the U.S.A., it was obvious that trap shyness was likely to be a problem. This shyness was assumed to be based upon memory of: (1) a "real" injury; (2) a "near-miss"; and possibly (3) observing the death of another rodent, with the relative "strength" in the order listed.

Poison shynesses (Barnett, 1948), though pronounced shortly after the initial sublethal exposure, diminish greatly after about three weeks. Poisoned bait shyness develops more readily than poison shyness. Bait-base shyness is inferred (Barnett, 1948) and it is implied that this likely would be intermediate in form (Shuyler, 1950).

Feed thus was postulated as more important to rodent memory strength than the trap. So, reexposure after less than 22 days to a different trap bait will lead to less trap shyness than the same bait; reuse of the same bait after more than 21 days will lead to less shyness than at shorter intervals.

Trap bait acceptability was studied while trapping (one of 26 control subtechniques practiced), reusing baits as seldom as practical. The aim was to use the results of this field study to design and use a practical trapping regimen as a part of a continuing control programme.

Several species cause damage in the urban-rural municipality of Dumaguete (Raber, 1967, pers. comm. and Barbehenn, et. al., 1972). The senior author, responsible originally for identification, gradually turned this study over to the technicians. Based on the identifiable animals recovered in the first 13 months, the population was:

Norway rat	Rattus norvegicus	65.9%
Shrew	Suncus murinus	13.2%
House mouse	Mus musculus	12.9%
Black rat	Rattus rattus rattus	6.0%
Mindanao rat	Rattus rattus mindanensis	1.6%
Unidentified spp.	(2)	0.4%

We wish to thank the hundreds of individuals who assisted in making this study and these control programmes possible. Most especially we wish to express gratitude for the help of The Honorable Joe Pro Teves, Mayor, Dumaguete City; the Members of the Municipal Board; Dr. Onesimo de Mira, City Health Officer; the Pest Control Technicians, City Health

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METHODS

Two rodent control programmes were conducted. The first was on the Silliman University campus near the city's edge with its considerable "green space." Dormitories, cafeterias, storerooms ("bodegas"), instruction and administration buildings, etc., were included. This original area was less than 28 ha. (ca. 69 A) of which only about 1/5 was subject to control at first (Figure 1). Later, fully coordinated with the University work, a programme began for part of the City's urban-rural area. It was initiated in the heart of the "poblacion" (urbanized area) at the City Market. As significant control was achieved, the control area boundaries were successively enlarged. Farming areas of coconut, vegetables, maize (corn), and rice, in that order of magnitude, gradually were included. By the end of the testing programme the area was about 100 ha (247 A) and it continued enlarging from time to time.

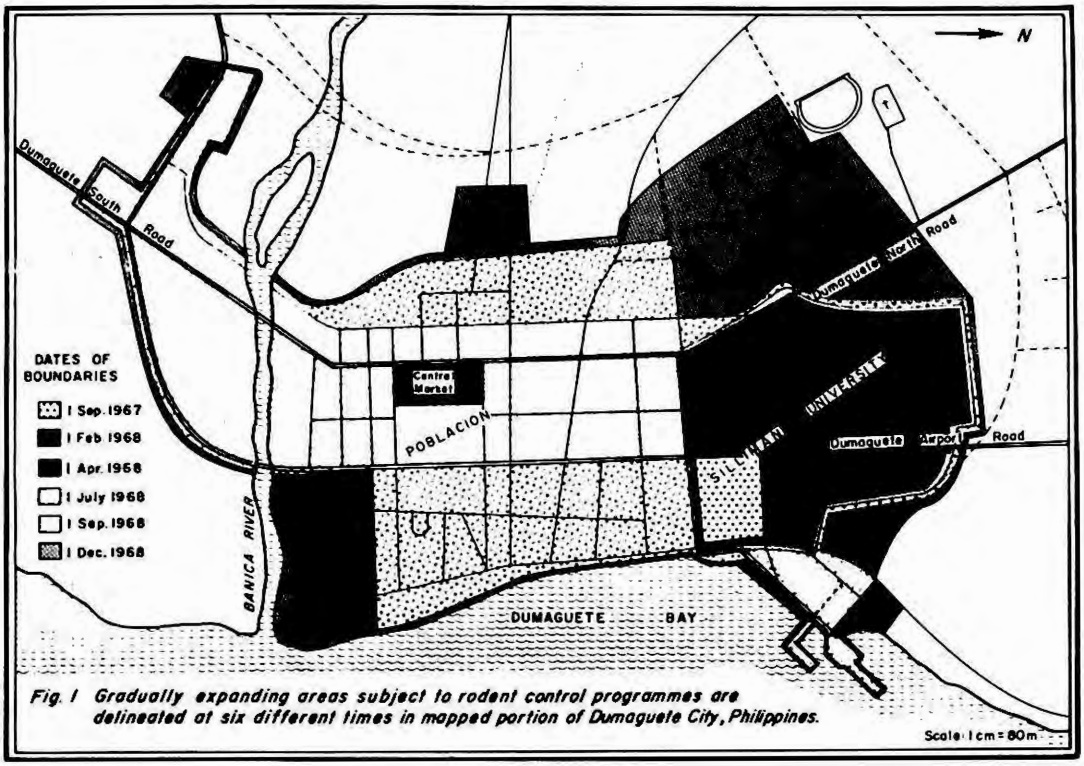

Fig. 1 Gradually expanding areas subject to rodent control programmes are delineated at six different times in mapped portion of Dumaguete City, Philippines.

All available control techniques were employed to the extent appropriate for each premise and each area. On average, five through six pest control technicians, trained by the senior author, were employed full time. Some changes in personnel occurred. The areas in which each technician (except the one on campus) worked was changed rather frequently.

Test baits usually were used six nights per week. Successive baits were generally of different groups. The quality of materials was that of human food or equivalent.

Numbered, wooden base snap traps for rats and mice were used, mostly the former. The quantity used varied. Daily, traps were washed, oiled with coconut oil, and maintained. Traps lost were counted as traps without catch. Generally each trap placement was different each night; with "change" being the "routine," "new object reaction" (Barnett, 1948) might be minimized, and "shyness" toward the trap placement spot reduced.

Each technician recorded daily, among other data, the number, location bait of traps placed and the number of animals trapped by species and sex, specifying adult or young. The data are expressed in numbers of animals trapped per 100 trap nights. The bait study was from 24 August 1967 to 22 September 1968. Each of 80 baits was tested one through 16 times. Most of the 200 nights of test baiting were after 24 March 1968. The trapping data extend to 31 March 1969. Judgmental decisions mainly were applicable, but the "chi-square" test was used to assist in deciding the significantly and judgmentally more acceptable baits (Bliss, 1967). The numbers of traps with catch were compared to those with no catch in a 2x2 or 2xk table.

The 13 trap bait groupings were:

Main Group	Subgroup
Vegetables	Fresh Cooked
Fruits	Fresh Cooked
Meats	Fresh Cooked
Miscellaneous	Sweet Products Animal Products Grain Products
Salt-water Products	Dried Dried, Toasted Fresh Fresh, Cooked

RESULTS

The bait test results are summarized within subgroups. Appropriate comparisons are made among baits of different groups and subgroups. For brevity, acceptability to the individual species is not noted; differences generally were not germane to trap success.

The single asterisk (*) indicates a bait was significantly better ($P<0.05$) than a lower ranking bait when compared using the null hypothesis with the chi-square test. The double asterisk (**) is used similarly; the probability is greater ($P<0.01$). The degree sign (°) indicates judgmental decisions of bait rank differences. Baits not shown to be different from the bait with the best trap success of a given rank are considered to be of the same rank as that best accepted bait. Significant variations among the tests of a bait are shown by the plus sign(s) ($^{+}$ or $^{++}$) indicating the degree of probability ($P<0.05$ or $P<0.01$, respectively) the unexplained differences are due to more than random variation. The results of the chi-square test (asterisk[s]) for bait differences are shown in parenthesis in front of the degree sign when the tests of one or both of the baits being compared showed significant "internal" variations.

Fresh carrots gave the highest trap success of six fresh vegetables (Table 1). Cabbage leaves were second rank to carrots, squash and camote. Eggplant ("talong"), dipped in whole beaten eggs-wheat flour batter and fried moderately (purchased ready-to-eat), was the cooked vegetable bait with the highest trap success (Table 2). The undercooked dried Baguio beans were judged less acceptable than fried eggplant. The three first-rank cooked vegetables were each highly significantly better than fresh carrots.

Table 1. Acceptability of fresh vegetables as snap trap baits (animals trapped/100 trap nights).

Bait Rank	Vegetable	No. Tests	Acceptability Range	Ave. Acceptability
1st	Carrots (roots)	4	8.3-14.1	10.8**
	Squash, Red (local variety)	1		10.6**
	Camote (local variety)	3	6.7-11.0	9.1*
	Potatoes, White (Irish)	1		7.6
	Gabi (tuber)	1		5.3
2nd	Cabbage Leaves	1		4.1

Table 2. Acceptability of cooked vegetables as snap trap baits (animals trapped/100 trap nights).

Bait Rank	Vegetable	No. Tests	Acceptability Range	Ave. Acceptability
1st	Fried Eggplant (see text)	4	15.0-21.6	18.1(**)°
	Boiled Peanuts (ground-nuts) in the shell	1		16.5
	Boiled Young White Corn (maize) on the cob	4+	13.0-26.3	16.0
2nd	Undercooked Dried Baguio Beans	2++	4.1-9.2	7.9

Among three cooked fruit baits, toasted mature coconut gave the highest trap success (Table 3), but there were no significant differences among the three. Breadfruit, eaten as a vegetable, was highly significantly inferior to fried eggplant. A fresh, immature coconut bait gave the best trap success of nine fresh fruit materials (Table 4). "Bolongon" bananas were judged to be a second rank bait. Mangos were judged to be a rank below bananas.

Table 3. Acceptability of cooked fruit materials as snap trap baits (animals trapped/100 trap nights).

Bait Rank	Fruit	No. Tests	Acceptability Range	Ave. Acceptability
1st	Toasted Mature Coconut	2	16.0-17.9	17.3
	Toasted Immature Coconut (early stage) ("lalug")	1		15.6
	Undercooked Breadfruit	2	10.3-15.2	12.2

Table 4. Acceptability of fresh fruit materials as snap trap baits (animals trapped/100 trap nights).

Bait Rank	Fruit	No. Tests	Acceptability Range	Ave. Acceptability
1st	Immature Coconut (late state) ("sino")	4++	13.4-32.9	19.3 (*)°
2nd	Bananas ("bolongan") ripe	10++	0.0-32.9	15.7(**)°
	Winesap Apples, ripe	3	9.4-16.8	13.3
	Guavano, ripe ("atis")	1		10.6
	Jackfruit, ripe	1		10.2
3rd	Mangos, ripe	2+	7.3-13.3	9.9
	Papaya, ripe	1		9.9
	Watermelon, ripe	1		9.3
	"Mabolo," ripe	1		8.3

Specially prepared cooked meat baits were undercooked, frying them in the minimum of vegetable oil. Pork "adobo" and "lechon," the whole roasted suckling pig, were fully cooked. Fried beef hindquarter yielded the highest trap success (Table 5). It was judged a higher ranking bait than fried chicken gizzards. The next highest success was with pork "adobo," the recipe for which is in many cookbooks. It was also judged a higher ranking bait than fried chicken gizzards. The Norway rats caught one night were skinned, cleaned, refrigerated, fried, and used as bait the next day. Pork trimmings showed the highest trap success of the fresh meat products (Table 6). Not being uniform, it is listed only to show its possibilities. Horse and chicken meat were judged higher ranking baits than fresh Norway rat meat. Beef and pork hindquarter baits each were highly significantly more acceptable than Norway rat meat.

"Combo" gave the highest trap success among the eight miscellaneous sweet products tested (Table 7) and was judged a higher ranking bait than "bokayo" candy, which, in turn, was judged a higher ranking bait than bubble gum. Of the four miscellaneous animal products, the highest trap success was with hard scrambled whole eggs (with added finely ground white (native) field corn) (Table 8.) The test data were lost for coagulated whole chicken blood prepared like the scrambled eggs. It is shown as a second rank bait. Five miscellaneous grain products were tested. "Binangkal" hard bread rolls were judged higher in acceptability than soft (loaf) bread (Table 9). Soft bread was judged more acceptable than rice "dokot." "Dokot" is the crusty, sticky rice that clings to the edge of the cooking pot. "Dokot" was judged more acceptable than mildly sweet "bibingka" rice cake. "Binangkal" rolls were judged more acceptable than scrambled eggs, which were judged more acceptable than "combo" or horsemeat.

Table 5. Acceptability of cooked meat materials as snap trap baits (animals trapped/100 trap nights).

Bait Rank	Meat	No. Tests	Acceptability Range	Ave. Acceptability
1st	Fried Beef Hindquarter	1		19.0°
	Pork "adobo"	4	15.7-37.5	17.1(*)°
	Fried Horse Liver	1		16.3
	Fried Norway Rat Meat	4++	11.4-26.3	16.0
	Suckling Pig, roasted whole ("lechon")	1		12.5
2nd	Fried Chicken Gizzards	3++	2.5-17.4	11.6
	Fried Chicken Liver	1		8.8
	Fried Bacon	1		6.4
	Fried Pork Liver	1		2.5

Table 6. Acceptability of fresh meat materials as snap trap baits (animals trapped/100 trap nights).

Bait Rank	Meat	No. Tests	Acceptability Range	Ave. Acceptability
1st	Pork Trimmings	1		20.0
	Horsemeat	16++	12.4-46.0	19.1(**)°
	Beef Hindquarter	4	16.5-22.3	18.2**
	Pork Hindquarter	3	15.0-22.9	17.9**
	Chicken	6++	6.8-27.3	16.9(**)°
2nd	Norway Rat Meat	1		7.4°
3rd	Pork Skin	1		0.0

Table 7. Acceptability of miscellaneous sweet products as snap trap baits (animals trapped/100 trap nights).

Bait Rank	Product	No. Tests	Acceptability Range	Ave. Acceptability
1st	"Combo" (fried sugared "San Pablo" bananas)	4++	14.7-57.9	18.4(*)°
	Cassava "bud-bud"	6++	0.0-26.8	17.2
2nd	"Bokayo" Candy	2++	6.2-14.8	13.4(*)°
	"Carmelitos" Candy	2	9.7-15.9	12.0
	"Orange slice" Candy	1		11.2
3rd	Bubble Gum	1		8.2
	Marshmallows	1		8.1
	"Serg's" Chocolate Bar (with peanuts [ground-nuts])	1		7.3

Table 8. Acceptability of miscellaneous animal products as snap trap baits (animals trapped/100 trap nights).

Bait Rank	Product	No. Tests	Acceptability Range	Ave. Acceptability
1st	Scrambled eggs (see text)	4++	14.1-31.4	22.9°
	Cheddar Cheese (Kraft)	1		18.9
	Process Cheese (Velveeta, Kraft)	1		17.2
2nd	Coagulated Chicken Blood (see text)	1		(see text)

Table 9. Acceptability of miscellaneous grain products as snap trap baits (animals trapped/100 nights).

Bait Rank	Product	No. Tests	Acceptability Range	Ave. Acceptability
1st	"Binangkal" (bread) Rolls	2	31.5-33.8	$32.7^{(**)\circ}$
2nd	Soft (loaf) Bread	9^{++}	15.6-51.7	$25.1^{(**)\circ}$
	"Liwayway" (bread)	1		21.7
3rd	Rice "dokot" (see text)	5^{+}	15.4-22.7	$18.3^{(*)\circ}$
4th	"Bibingka" Rice Cake	1		8.6

Of the four dried saltwater products the highest trap success was with dried squid (Table 10); dried cuttlefish resulted in highly significantly less trap success. Only dried squid and cuttlefish were tested after being toasted and there was no significant difference between them (Table 11).

Table 10. Acceptability of dried saltwater products as snap trap baits (animals trapped/100 trap nights).

Bait Rank	Product	No. Tests	Acceptability Range	Ave. Acceptability
1st	Squid	3	16.3-22.4	20.2**
	"Malalangsi" Fish	9^{++}	0.0-34.4	20.0
	Swordfish	1		9.1
2nd	Cuttlefish	3	8.0-8.8	8.5

Table 11. Acceptability of toasted dried saltwater products as snap trap baits. (Animals trapped/100 trap nights).

Bait Rank	Product	No. Tests	Acceptability Range	Ave. Acceptability
1st	Squid	1		31.7
	Cuttlefish	2	18.9-25.3	21.1

Tuna fish spleen, the most acceptable of 13 fresh saltwater products used (Table 12), was judged a higher ranking bait than tuna fish (muscle). Tuna fish was judged a rank above milkfish. The difference was significant between toasted dried and fresh cuttlefish and between fresh and dried cuttlefish. Tuna fish spleen yielded significantly more trapped animals than did dried squid. Of four fresh saltwater products cooked before testing, toasted squid yielded the best trap success (Table 13). Cooked clams were judged second in rank to both squid and toasted "bagis" fish. Fresh squid was significantly less acceptable than toasted fresh or dried squid. Toasted "bagis" was significantly more acceptable than the fresh product. Cooked clams were judged more acceptable than fresh ones.

Table 12. Acceptability of fresh saltwater products as snap trap baits (animals trapped/100 trap nights).

Bait Rank	Product	No. Tests	Acceptability Range	Ave. Acceptability
1st	Tuna Fish Spleen	1		$31.9^{(*)\circ}$
	"Ito" Fish	2	24.6-25.4	24.9
	"Pagi," Sting Ray	3	14.3-24.7	23.5
	"Cuyampao," Sting Ray	4	16.8-24.8	21.3
2nd	Tuna Fish ("panit")	3^{++}	5.1-25.7	$20.6^{(*)\circ}$
	"Bagis" Fish	2	15.7-23.3	20.1
	Shark	4^{++}	11.8-80.0	19.4
	Swordfish	3	16.4-25.0	18.6
	Saltwater Eel	2	16.5-20.5	18.4
3rd	Milkfish ("bangus")	3	12.6-18.6	16.4
	Cuttlefish ("dalupapa")	2	10.7-16.5	14.0
	Clams	1		12.5
	Squid	1		12.2

Table 13. Acceptability of fresh saltwater products as snap trap baits when cooked. (Animals trapped/100 trap nights.)

Bait Rank	Product	No. Tests	Acceptability Range	Ave. Acceptability
1st	Toasted Squid	1		35.0°
	Toasted "bagis" Fish	1		28.2(**)°
	Toasted Swordfish	2++	21.7-73.3	24.5
2nd	Cooked Clams	3++	8.6-26.9	18.0

The entire bait study is summarized diagrammatically (Figure 2), using blocks to represent rankings of each subgroup. Blocks to the right and/or above another generally represent increasingly more acceptable baits. Connecting lines show relationships within and between subgroups, the latter particularly among the more acceptable baits. Lines between the tops of two blocks indicate no difference is known between the baits of the blocks. Lines connecting the bottom of one block with the top of another indicate a bait in the former block is higher ranking than one in the latter.

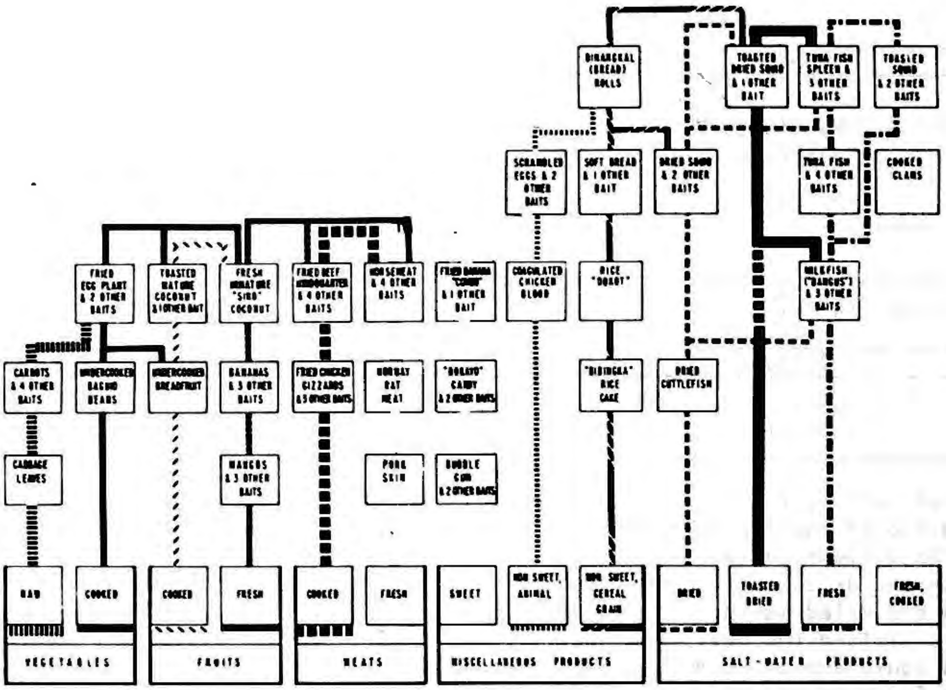

Fig. 2 Diagrammatic representation of the acceptability rankings of various materials as SnapTrap baits. (see text for explanation.)

A highly significantly greater number of females than males were trapped, as in other studies (e.g., Pemberton, 1925). The catch consisted of a similarly greater number of adults than young.

Comparisons were made among the first responses to the various baits over time. The first half of these tests had highly significantly more trap success than the last half. This is interpreted as trap shyness principally, i.e., shyness to the traps themselves. The results of the first compared with the second three-months of the intensive testing period shows a highly singificant degree of difference -- principally a combination of shynesses (Table 14). The average trap success/week and the development of apparent shyness, using a fitted curve, are shown graphically (Figure 3).

The response to each of two subsequent offerings of the same bait, at an interval averaging 27 days during the intensive testing period, were compared using the data of all baits. The average trap success of the earlier of any two uses was 19.0 animals per 100 trap nights, highly significantly greater than the 17.1 animals per 100 trap nights caught in the later of any two uses. This strongly indicates that much of the shyness observed related to the reexposure of animals to a particular bait. The average results of the first test of all baits retested were compared with the average of the second test when further dividing these results into two groups -- a shorter or longer interval between tests. In the intensive testing period the differences in trap success between the first and second test of materials retested at short intervals is highly significant (Table 15), interpreted as principally trap-bait shyness. The difference when the interval is longer is not significant. The effect of trap and/or trap-bait shyness clearly was minimized by less frequent reuse of baits.

Table 14. Average trap success of the first and second three months of intensive testing of snap trap baits.

Time Period	Animals Caught	No. Catch	Total Traps Placed	Animals Trapped Per 100 Trap Nights
Weeks 1-13 (25.3-23.6.68)	2,122	8,787	10,909	19.5**
Weeks 14-26 (24.6-22.9.68)	3,485	18,690	22,175	15.7
TOTAL	5,607	24,777	33,084	16.9

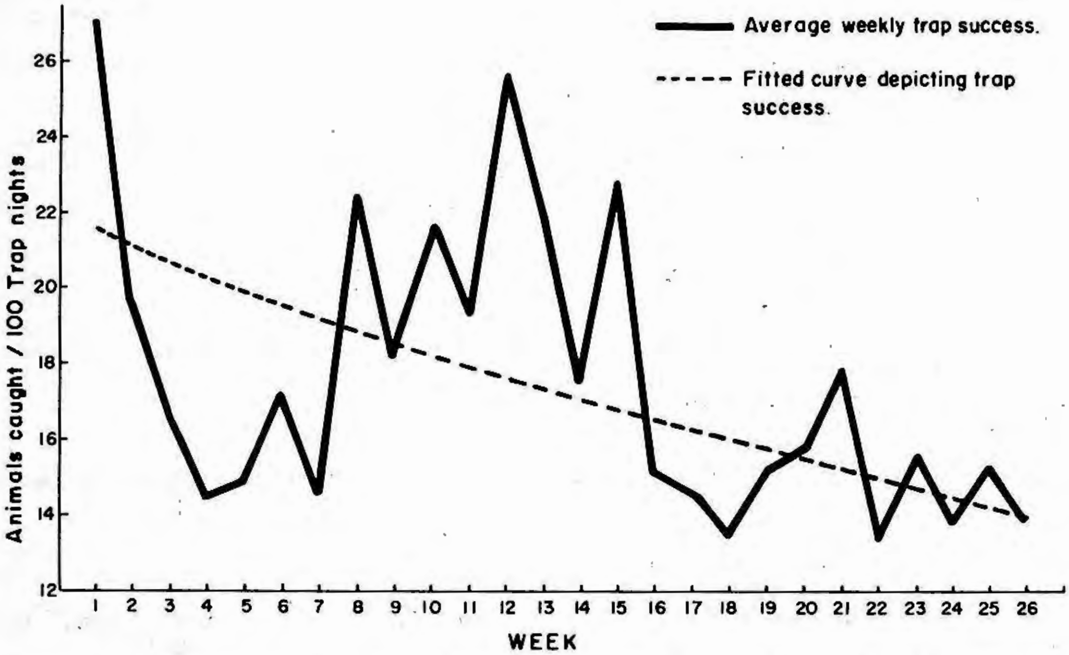

Figure 3. Average weekly trap success during a six-month period of intensive testing of snap trap baits.

Table 15. Comparative trap success of the first and second use of baits as related to the interval between the tests

No. of Test	Animals Caught	No. Catch	Total Traps Placed	Animals Trapped Per 100 Trap Nights
A. Interval < 23 days between tests (average of 19 materials = 11 days)				
1st	571	1,736	2,307	24.8**
2nd	695	2,790	3,485	19.9
TOTAL	1,266	4,526	5,792	21.9
B. Interval > 22 days between tests (average of 23 materials = 48 days)				
1st	582	2,624	3,206	18.2
2nd	842	4,011	4,853	17.4
TOTAL	1,424	6,635	8,059	17.7

From this study, a scheme was drawn for continued use of trapping. The sequence of baits was chosen by restricted randomization of 11 of the subgroups of baits studied. The more acceptable baits were fitted to this sequence with alternates specified (Table 16), also considering price, availability, and ease of use.

Table 16. Repetitive sequence of snap trap baits for use in daily trapping in Dumaguete, Philippines rodent control programmes.

Day	Bait Type	"Bait of the Day"	1st Alternative Bait	2nd Alternative Bait
1	Cooked vegetable	Boiled young white corn (maize) on the cob	Boiled young, yellow corn	Boiled peanuts in the shell
2	Dried saltwater products	Dried cuttlefish ("dalupapa")	Dried cuttlefish ("tostos")	Dried cuttlefish ("nokos")
3	Misc. sweet products	Cassava "bud-bud"	"Bokayo" cand	
4	Fresh meat	Fresh chicken	Fresh pork hindquarter	
5	Raw vegetable	Raw camote	White (Irish) potatoes	
6	Cooked (fresh) saltwater prod.	Toasted (fresh) "bagis" fish	Toasted (fresh) "cuyampao" (sting rat)	
7	Misc. grain products	Rice "dokot"	Corn (maize) "dokot"	
8	Fresh fruit	Immature "sino"	Ripe guavano ("atis")	
9	Cooked meat	Underfried (fresh) Norway rat meat	Underfried (fresh) chicken gizzards	
10	Misc. animal products	Scrambled eggs with ground corn (maize)	Coagulated (underfried) chicken blood with ground corn (maize)	
11	Fresh saltwater products	Fresh milkfish ("bangus")	Fresh tuna spleen	
12	Fresh meat	Fresh horsemeat	Fresh beef hindquarter	
13	Fresh fruit	"Bolongon" bananas	Sweet red ripe apples	
14	Dried saltwater products	Dried "malalangsi" fish	Toasted dried squid	
15	Raw vegetable	Raw carrots	Raw red squash	
16	Misc. sweet products	Fried, sugared, San Pablo bananas ("combo")	"Carmelitos" candy	
17	Cooked meat	Pork "adobo"	Underfried horse liver	Underfried chicken liver
18	Cooked vegetable	Eggplant, dipped in flour-egg batter and fried	Undercooked breadfruit	
19	Fresh salt-water prod.	Fresh tuna fish	Fresh "ito" fish	Fresh "pagi" (sting ray)
20	Misc. animal products	Cheddar cheese	"Velveeta" process cheese	
21	Cooked (fresh) saltwater products	Toasted (fresh) swordfish ("turogho")	Toasted (fresh) sword-fish ("balo")	Toasted (fresh) shark
22	Misc. grain products	Soft (loaf) bread	"Binangkal" (bread) rolls	"Bibingka" rice cake

This sequence was used in both programmes from late September 1968 in the still gradually expanding control area until July 1971. The results of the six calendar months following the end of the bait testing demonstrate the usefulness of a trap baiting sequence (Table 17). There is "recovery" in a trap success due to the use of only better materials, longer intervals between uses, and in February 1969, the inclusion of new control areas. Trap and/or trap-bait shyness was minimized by an extended interval between reuse of trap baits.

One programme continued using this trap bait sequence successfully beyond July 1971 (Café, 1972, pers comm.). With the advent of fiscal problems in mid 1971, the other programme began using some baits more frequently. Trap success deteriorated noticeably; this is interpreted as primarily due to trap-bait shyness as reported earlier (Shuyler, 1972).

Table 17. Average trap success of the first six calendar months use of a bait sequence compared with six months of intensive trap bait testing.

Trap Bait Used	Time Period	Animals Caught	No. Catch	Total Traps Placed	Animals Trapped Per 100 Trap Nights
Bait Sequence	10.68	1,161	5,797	7,118	16.3
	11.68	639	2,877	3,516	18.2
	12.68	1,359	5,545	6,904	19.7
	1.69	2,200	6,988	9,188	23.9
	2.69	2,281	6,467	8,748	26.1
	3.69	1,981	6,463	8,444	23.5
	6 months (1.10.68-31.3.69)	9,621	34,297	43,918	21.9
75 Test Baits	6 months (25.3-22.9.68)	5,607	24,777	33,084	16.9
22 Baits Used in the Sequence	6 months (25.3-22.9.68)	3,714	16,772	20,486	18.1

Trap placement techniques in various environments were developed to enhance the chance of trap success. A technique was developed to protect baits from contamination by ants, cockroaches, and crickets. Traps were adjusted routinely for high sensitivity of the trigger release.

DISCUSSION

Bait materials which are among the more acceptable as trap baits are not necessarily the same as those highly acceptable for use in poison baits (Shuyler, 1954). Odor qualities may be more important in trap baits.

Animals suffering from anticoagulant effects may have been less "trap" cautious. (Conversely, concurrent use of trapping and anticoagulant baits may have reduced the opportunity for the initiation of anticoagulant resistance.)

In addition to trap and/or trap-bait shyness, the gradual reduction in trap success was considered to be caused by a complex of factors among which are: (1) seasonal response changes in the total population; (2) response changes associated with changes in total population densities; (3) varying responses of the different species to the various baits; (4) response changes associated with changes in proportions of the species in the complex due to seasonal cycles and/or control; and, (5) many human factors which contributed positively and negatively to trap success.

In a large Hawaiian trapping programme (Pemberton, 1925), in which a few baits were used daily in different areas, the highest trap success per year during ten years was 18.7 animals trapped per 100 trap nights, compared to 19.8 in the year reported here.

LITERATURE CITED

BARNETT, S. A. 1948. Principles of rodent control. In: Preservation of grains in storage. Rome. F.A.O. Agr. Studies No. 2. pp. 129-148. 174 pp.

BEER, J. R. 1964. Bait preferences of some small mammals. J. Mamm. 45(4):632-634.

BLISS, C. I. 1967. The x^2 distribution. In: Statistics in Biology. Vol. I. New York, McGraw-Hill. pp. 31-52. 558 pp.

FEMUSHKIN, V. M. 1963. [A new type of bait to replace bread in making censuses of rodent populations.] (In Russian). Dekl. Irkutsk. Protivochum. Inst. 6:85-87. (Biol. Abstr. 46:87563. 1965)

JOHNSON, W. W. 1969. Dispensing bait with caulking gun. J. Mamm. 50(1):149.

N.P.C.A. 1971. Good practices in the use of traps for commensal rodent control by the pest control operator. Elizabeth, New Jersey (U.S.A.). National Pest Control Association Technical Release No. TR 23-71. 3 pp.

PEMBERTON, C. E. 1925. The field rat in Hawaii and its control. Honolulu Bull. Expt. Sta. Hawaiian Sugar Pltrs. Assoc. Entom. Ser. No. 17. 46 pp.
ROWE, F. P. 1968. Rat control in the South Pacific. Noumea. S. Pac. Comm. Handbook No. 1 40 pp.
SHUYLER, H. R. 1950. Exploratory methods for use in the study of red squill baits. Lafayette, Indiana (U.S.A.). Purdue Univ. M.S. Thesis. 231 pp.
_____. 1954. The development of baits for Rattus norvegicus, with special reference to initial acceptability. Lafayette, Indiana (U.S.A.). Purdue Univ. Ph.D. Thesis. 560 pp. (available on loan).
_____. 1972. Rodents in the tropics: their effects and control. PANS 18(4):445-451.
U.S.D.I. 1960. Trapping rats and mice. Washington. U.S. Fish and Wildl. Serv., U.S. Dept. Int., Leaflet No. 320. 2 pp.
U.S.P.H.S. 1949. Rat eradication and poisoning programs. In: Rat-borne disease prevention and control. Atlanta. Commun. Dis. Center, U.S. Publ. Hlth. Serv. 292 pp.