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DATE March 29, 1977

FROM: DE: Chairman,
University Research Support
Fund Committee.

Our file Notre référence

TO: A: Mr. J.A. Keith, Mr. J.E. Bryant,
Mr. H.J. Boyd, Mr. D.C. Surrendi,
Mr. A.D. Smith, ✓ Mr. G. Staines.
Mr. P. DesMeules,

Your file Votre référence

SUBJECT: SUJET: Contract KL210-6-5664 - "To conduct a study on aspects of the breeding ecology of the Eastern Willet, Catoptrophorus semipalmatus".

Enclosed for your retention is a copy of a report "Aspects of the Breeding ecology of the Eastern Willet Catoptrophorus semipalmatus." This report resulted from a study conducted by Acadia University under the direction of Dr. Peter C. Smith. The student involved is Gay Hansen-MacInnis. The contract was financed by funds from our University Research Support Fund.

Mrs. S. Normand

Encl.

for J.-P. Cuerrier

ASPECTS OF THE BREEDING ECOLOGY OF THE EASTERN WILLET CATOPTROPHORUS SEMIPALMATUS

A Report submitted to the Director General of the Canadian Wildlife Service with respect to Contract Number KL210-6-5664

March, 1977

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Introduction

Little is known of the adaptive significance of the territorial system of the Eastern Willet Catoptrophorus semipalmatus with respect to the breeding ecology of this species.

This study was initiated to investigate these aspects of the biology of willets. With reference to Contract Number KL210-6-5664, Canadian Wildlife Service, Environment Canada, the specific aims were: to note changes in territorial size and the intensity and nature of territorial defence both on and off the feeding and nesting territories in relation to the phase of the breeding cycle.

Study Area

The study area was on the estuary of the Gaspereau River at Horton Landing, 2.5 km from Avonport (45°07'N, 64°17'W), Kings County, Nova Scotia. It consisted primarily of a salt marsh, 50 to 135 and 650 m in width and length, respectively (Figure 1). This marsh was bounded on one side by a dyke wall, approximately 4 m in height and, on the other, by mud banks which descended some 20 m to the river bed. The area was almost completely covered by Spartina alterniflora and a narrow band of S. patens along the base of the dyke. A strip of gravel occurred at one end of the marsh, next to the dyke. Tides covered the marsh twice daily.

Hayland and pastures comprised the flat, reclaimed terrain behind the dyke.

Materials and Methods

Observations were carried out from 1 May until 1 August 1976. Four pairs of willets were observed throughout the breeding season. Another pair commenced establishment of territory on the marsh but moved elsewhere after several days.

The marsh was marked off in a 25 X 50 m grid with color-coded, wooden stakes. This was to enable accurate plotting of the locations of birds.

Observations were conducted from a car situated on top of the dyke. This provided an excellent vantage point and caused little disturbance. One stationary submersible blind of haybales was constructed at the river edge of the marsh. However, it had to be

abandoned as the willets were disturbed by the observer moving to and from the blind.

Most observation periods ranged from one to three hours in length. Two observers conducted observations simultaneously, each looking at one member of a pair. Every five minutes the location of each observed bird was plotted on the grid-map. All activities and movement of the birds within the consecutive five-minute periods were recorded. The birds were observed with 7 X 35 binoculars and X15 to X60 zoom telescopes.

At low tide the willets often left the marsh to feed in the river bottom or on the mudflats beyond. At these times the birds were often too distant to conduct detailed observation. The rising tide forced the willets back onto the marsh where they remained until the mudflats were exposed again. For this reason, most observations were undertaken three hours before and after high tide. When young were present, the parent birds remained on the marsh during low tide. This permitted observation at all stages of the tide. Individual birds were recognized by variation in plumage color until they were individually color-marked.

The willets nested in the hayfields behind the dyke. Nests were found in the following manner. The field was thoroughly searched by walking strips 5 m in width. Two people walking abreast beat the hay and grass thickets with long wooden sticks. Incubating birds were flushed thus revealing the nest locations. All nests were marked with tall wooden stakes. These stakes were narrow at the top to prevent crows and other potential predators from perching on them.

Seven adults and seven young were banded and individually color-

marked. Adult birds were trapped on the nest with a handnet. Trapping was conducted at low tide when the mates of the incubating birds were feeding in the river bottom. Trapping was never undertaken less than two hours before sunset or in wet weather so as to avoid egg-chilling. The nest was approached by walking quietly upwind. The net was quickly lowered over the site containing the nest and sitting bird. Only one willet was trapped each day.

Measurements of body weight, wing span and total-, wing-, tail-, culmen-, and tarsus-length were recorded for each bird. The adults were banded with a metal U. S. Fish and Wildlife Service band on one leg and a plastic-colored band on the other. Members of one pair were given color bands of the same color. These were placed on opposite legs so that the sexes could be readily distinguished.

Young willets were caught by hand on the marsh just before they fledged. This was undertaken at high tide when they were concentrated at the base of the dyke. The color and metal bands were placed on the same leg. The birds were banded and released as quickly as possible to reduce disturbance so measurements were not taken.

The shape and size of the defended area and home range were determined for individuals on the marsh with a planimeter. Polygons were constructed which encompassed all relevant locations where a willet had been observed. The defended area was based on observations of the locations of a bird which emitted the "pill-willet" call (territorial in function ; Tomkins 1965), the point where chases

initiated, and those of physical encounters. All observations of the locations of an individual with the exception of those concerned with "defended area" served as the basis for determining home range.

The defended area and home range were determined for each of the birds of the four pairs during each of three phases of the breeding season. The phases are: before incubation, incubation and young on marsh. The first phase includes the periods of pre-nesting and egg-laying.

Results

A. Pattern of the breeding season.

In spring, willets are among the first shorebirds to arrive in Nova Scotia. The first willet was seen briefly at Horton Landing on 28 April. Flocks were observed on 1 May.

During the first few days following arrival, the major activities of the willets involved feeding, and the establishment and defence of marsh territories. Being unfamiliar with the distribution of breeding willets in previous years, I could not select a specific study area and locate the necessary grid system until the birds arrived and had begun establishing territories. Thus, I was unable to gain quantitative data for the critical period of territorial establishment.

The behavioral displays associated with territory and mating have been discussed by Tomkins (1965) and Vogt (1938) and will not be described here. At Horton Landing the mating displays, copulation and nest seeking behavior commenced about 15 May.

The nests of the pairs studied were in the hayfields directly behind the salt marsh and dyke. Egg laying commenced about 20 May. An egg is laid every two or three days so eight or nine days are required to complete the normal clutch of four.

Incubation began during the period of a few days in late May and early June. The eggs were incubated almost continuously for 23 to 29 days. Both members of the pair participated.

Two pairs were successful in hatching their eggs. During incubation, two pairs abandoned their nests. One pair commenced renesting two days later. The other pair began copulating five days following the abandonment. They may have attempted to renest but were not successful.

Upon hatching, the young were taken to the marsh by the adults. The first and second broods appeared on the marsh on 17 and 22 June, respectively.

Both adults brood and defend the young. Irregardless of weather, brooding was particularly frequent during the first several days after the young arrived on the marsh. Subsequently, brooding occurred only on overcast, wet or relatively cold days. The female spent a much larger proportion of time defending the young and hence, less time feeding than the males.

The young of one pair fledged by 14 July while those of the second pair dissappeared on 10 July prior to fledging.

All females flocked together and had left their mates and broods by 16 July. They remained in the area for several days but were never observed on their respective territories.

The males remained with their broods. By 27 July, two trends were evident. The fledged young had formed a loose feeding flock and returned to the marsh territories infrequently. Secondly, the males fed individually and also seldom returned to their territories.

All willets that bred or had been reared in the study area left by 29 July. Although willets were observed subsequently, these were probably migrants from elsewhere.

The chronology of events for each of the pairs during the breeding season is summarized in Table 1.

B. Territory

At Horton Landing, the willets had separate feeding and nesting territories. Overall, three types of territory existed in these two areas.

1. A saltmarsh territory was used by the adults for feeding and loafing and later, for rearing the young. This was vigorously defended against conspecifics by both members of the pair.

2. During the period of low tide, the willets often fed on the mudflats or river bottom. The male of each pair defended an area around the female and, later in the season, an area around the fledged young. An actual territory was not maintained regularly although pairs often returned to the same general area.

3. An area around the nest was defended by both sexes but mainly by the male. Such areas were small as nests of adjacent pairs were as close as about 20 m. Defence ceased at the end of incubation.

I concentrated my observations on the salt marsh territories for the following reasons. Of the three types, they were the largest and were utilized most frequently throughout the season. Furthermore, they were adjacent to the dyke wall which afforded me an excellent vantage point for observation.

Hitherto, I have used "territory" in its broadest sense. Initial observation indicated that a distinction should be made between "defended area" and "home range". As mentioned previously, the home

range of a pair encompassed the locations of occurrence of the birds on the marsh. The locations where behavior associated with territorial defence was exhibited are not included when considering home range. With respect to conspecifics, defended area is defined on the basis of three criteria: vocalization, chase and physical encounter. Descriptions of these follow:

1. Vocalization. Vocalization pertains to the well documented "pill-willet" or "pill-will-willet" call. This is repeated loudly until intruding willets have left. Both sexes emit this vocalization although the female may often do so in response to her mate. The call of the female is flatter in tone and thus is readily distinguishable from that of the male.

2. Chase. Frequently, a chase follows the "pill-willet" call if an intruder does not respond appropriately to the vocalization. The resident willet flies after the conspecific and chases it. Males are involved in this activity more than females. Until the onset of incubation, the male returning from a chase frequently gains altitude and descends over his territory while performing the territorial wing-wave display (Vogt 1938, Tomkins 1932).

3. Physical Encounter. Type I encounters occurred during the prenesting period between territorial and unpaired males. An encounter is initiated by the presence of an intruder. The resident male gives the "pill-willet" call and subsequently either struts in erect posture or flies towards the conspecific. When facing and immediately adjacent to one another, the birds "bite" each other on the neck, bill, wings

and legs with their mandibles. They often attempt to get on each

and legs with their mandibles. They often attempt to get on each other's back. These encounters frequently terminate in water. One bird stands on top of the other and alternately "bites" and bobs him under. The resident male was observed to be successful in driving away the intruder in all such encounters.

Females do not participate in Type I physical encounters. They may feed, stand alert, or stand on one leg with head under wing.

Once nesting commenced, Type II encounters occurred along territorial boundaries held in common by adjacent pairs. In erect posture, the two birds strut parallel to one another back and forth along the boundary. Frequently, one will crouch and run at the other who in turn jumps away; parallel strutting is then resumed. Usually, the encounters end with both birds moving away a few meters and preening or feeding. Male v. male encounters were most frequent. Female v. female and mixed-sex encounters did occur but less frequently.

Willets on territory responded interspecifically as well. This occurred in two forms, vocally and by mobbing. The vocalization was a rapid "kleek-kleek" call. The first mobbing occurred just prior to the hatching of the eggs. The Willets fly to the intruder chasing and harrassing it while emitting the "kleek-kleek" call. Often the alarm call, "pwhe-who" is given as the willets start to mob. The female of the pair invariably initiates mobbing and does so more intensely than the male. Pairs with young mob most frequently but they may be joined by other conspecifics.

Using the polygon method described previously, the home range and defended area were determined for each pair during the phases of before incubation, incubation, and young on marsh. Figures 2 through 7 show the outlines of the home ranges and defended areas during the different phases. The data in Table 2 represent the maximum areas of home range and defended area during each phase for birds of each pair .

Willets commonly fed and loafed well into a neighbour's home range and defended area if the residents were not present or were at the far side of that area. If the residents were absent for a long period, the adjacent pair would temporarily defend a large section of the area of the former pair.

A salient feature shown by the outlines of the home ranges is in the great overlap in area utilized by adjacent pairs.

With the exception of pair 3, there was much more overlap and hence a larger area of home range and defended area of both sexes in the first phase than during incubation. During incubation, less time was spent on the marsh. Although the data are not completely analyzed, the non-incubating member of each pair appeared to spend a larger proportion of time feeding and loafing away from the marsh than during the phase before incubation.

Changes in size and location of home range and defended area occurred when the young appeared on the marsh. Only two broods were reared on the study area, those of Pair 3 and Pair 5. The territories of both pairs underwent a southeastward shift in location. This is

related to the fact that the gravel section of the southeastern half of the marsh remained exposed at high tide. The young could hide in the vegetation on the gravel beach instead of being driven up the exposed dyke wall at high tide.

When Pair 3 first brought their young to the marsh, the two adjacent pairs (Pairs 2 and 5) were still incubating eggs and were often absent from the marsh. Pair 3 used the northwestern end of the territory until the arrival of Pair 5 and their brood (Figure 6). At this time, Pair 3 moved to the eastern end of the territory. The overlap of territories shown in Figure 7 is a little misleading. When Pair 5 appeared on the marsh after 22 June, Pair 3 ceased to use the area that overlapped with Pair 5 (Figures 6 and 7).

This shift of territory displaced Pair 2. One physical dispute did occur between the males of Pairs 2 and 3. The male of Pair 3 was apparently successful and then occupied the entire northwestern end of what previously had been claimed by Pair 2. Pair 2 in turn, moved southeastward. Unfortunately, this was off the gridded area of the marsh so that their home range and defended area could not be determined.

Although females did defend large areas of the salt marsh, the ratios of defended area to home range are smaller than those of the males. This relationship of defended area to home range for each individual during each of the 3 phases of the breeding season is shown in Figure 8.

Future Work

Information is required on the initial period of territorial establishment. This period must be considered very important to subsequent territorial behavior. For this reason, additional field-work is planned for the last two weeks of April and the month of May, 1977.

Acknowledgements

Financial assistance was provided by the University Research Support Fund, Canadian Wildlife Service, for which grateful thanks are tenured.

Miss L. Hansen provided valuable field assistance.

References Cited

Tomkins, I. R. 1932. Some Observations on the Eastern Willet at Nesting Time. The Wilson Bull., 44:46-47.

Tomkins, I. R. 1965. The Willets of Georgia and South Carolina. The Wilson Bull., 77: 151-167.

Vogt, W. 1938. Preliminary notes on the behavior and ecology of the Eastern Willet. Proc. Linnaean Soc. New York, 49:8-41.

TABLES

Table 1. Cronology of Events for each Pair of Willets during the Breeding Season

Event	Pair 2	Pair 3	Pair 4	Pair 5
Arrival	(1 May)*	(1 May)	(1 May)	(1 May)
Copulation	(15 May)	(15 May)	(15 May)	(15 May)
First egg	20 May	(15 May)	(21 May)	(20 May)
Incubation	29 May	(24 May)	(30 May)	(29 May)
Desert nest	7 June		8 June	
Resume copulation	16 June		13 June	
Renest & incubation	(20 June)			
Young on marsh	15 July	17 June		22 June
Young fledged		14 July		
Female leaves	16 July	16 July		
Male & young leave marsh		20 July		
Male & young separate		27 July		
Leave breeding grounds		29 July		

* Dates in parentheses are approximate.

Table 2. Maximum Area (m^2) of Home Range and Defended Area for Birds of each Pair during different Phases of the Breeding Cycle

		Area of Home Range			Area of Defended Area		
Pair	Sex	Phase 1*	Phase 2	Phase 3	Phase 1	Phase 2	Phase 3
Pair 2	F	10789	8337		583	3386	
	M	13603	10500		10988	13073	
Pair 3	F	6615	7476	14962		872	14789
	M	6221	1396	16721	772	1738	14338
Pair 4	F	7214	7948		1228	2090	
	M	6080	12831		6977	3932	
Pair 5	F	9765	10957	10216	5082	5376	5644
	M	9492	13797	13503	9429	10369	7618
Refer to Figure		1	3	5	2	4	6

* Phase 1: Before Incubation

Phase 2: Incubation

Phase 3: Young on Marsh

FIGURES

Figure 1

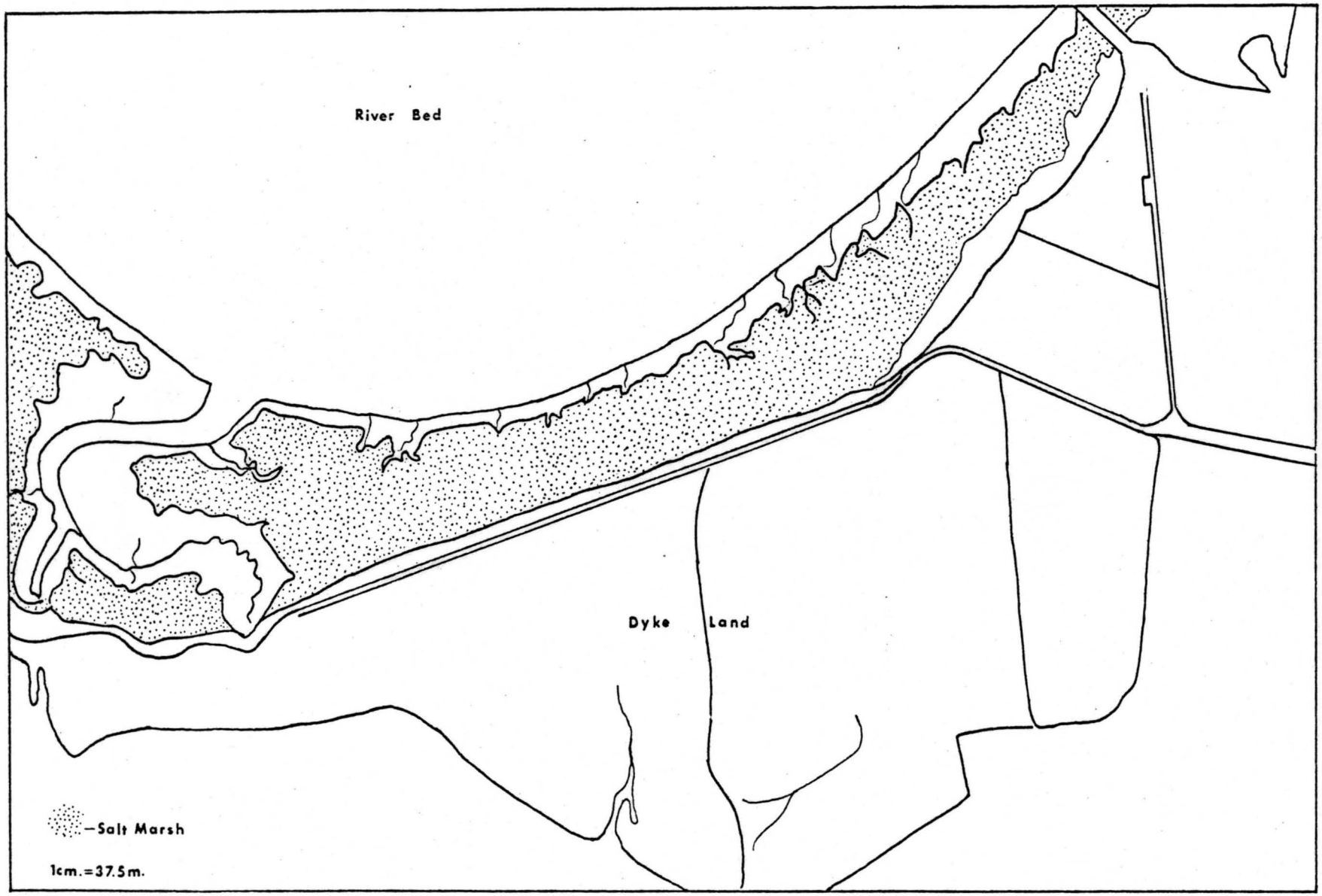
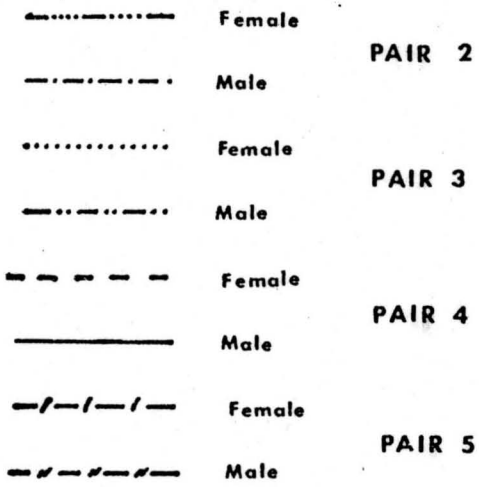
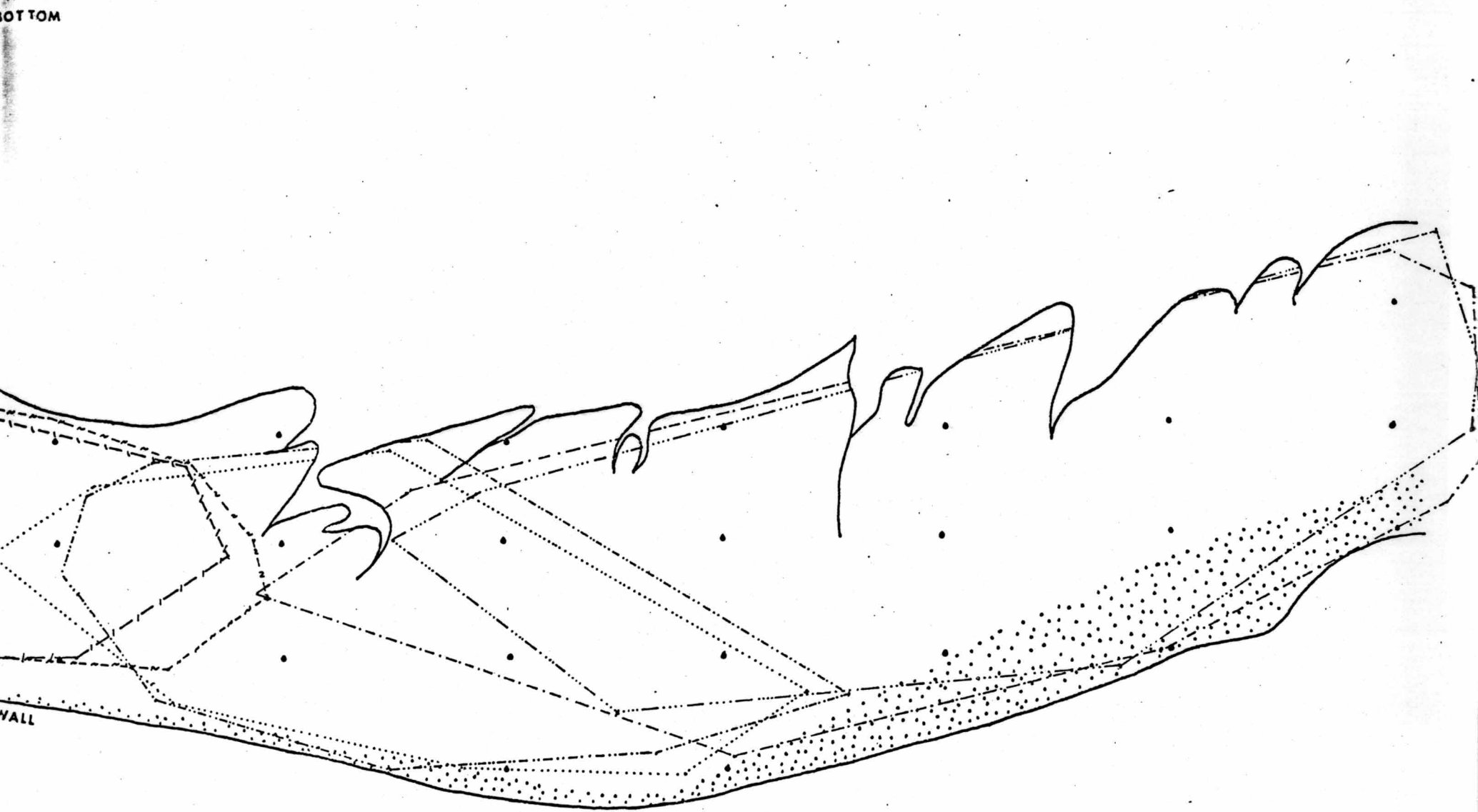


FIGURE 1: The Study Area.

Figure 2

FIGURE 2. Home Range of each Willet in the Phase Before Incubation.

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VALL

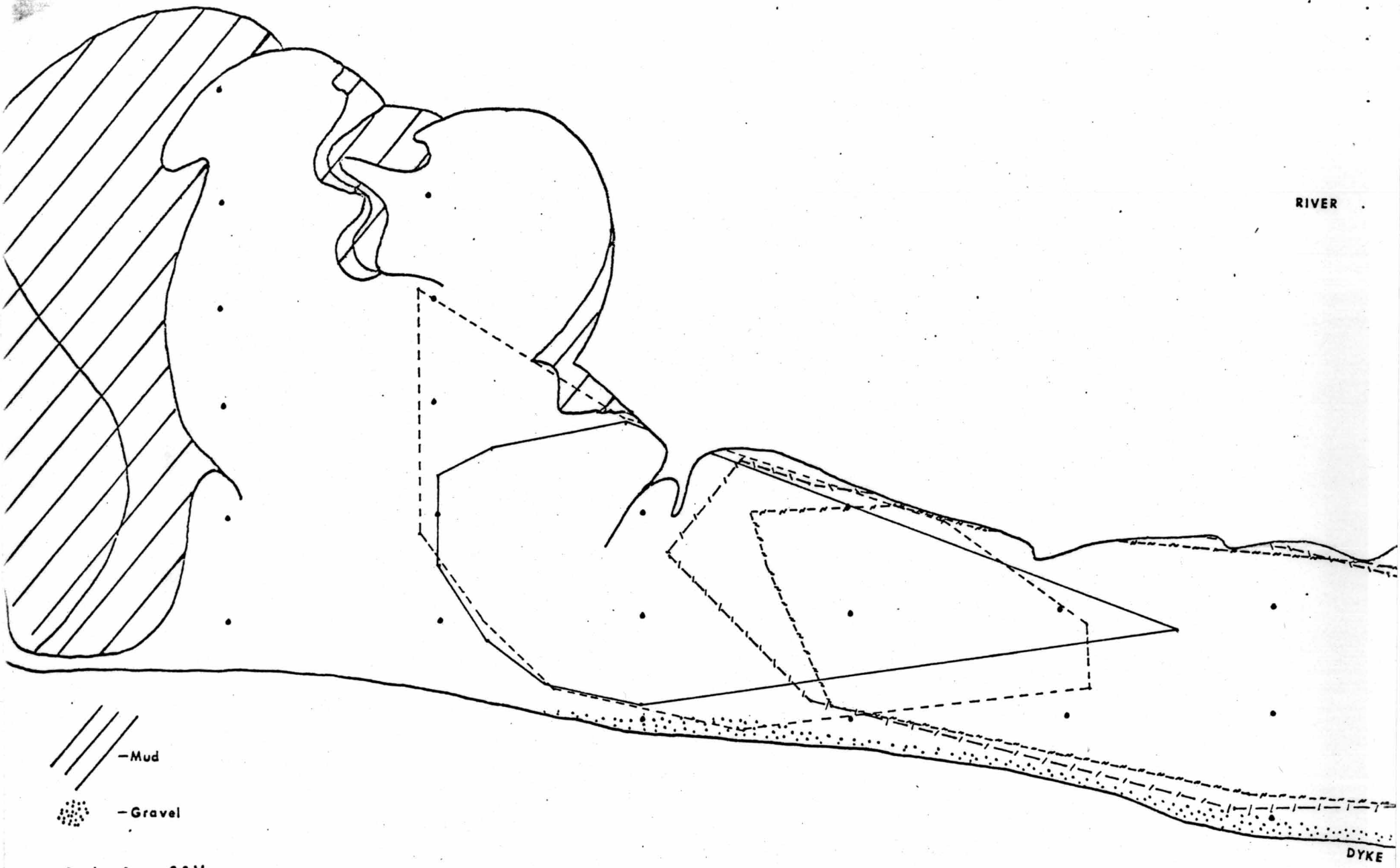

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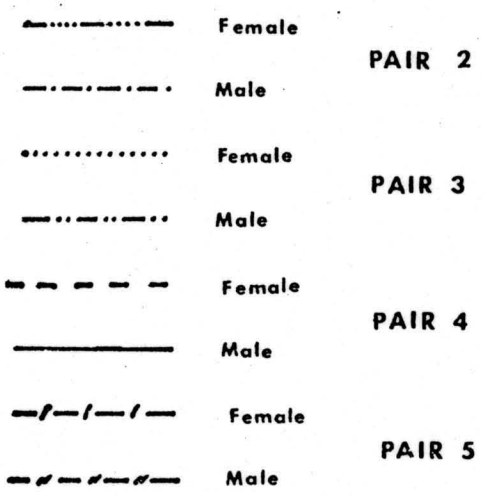
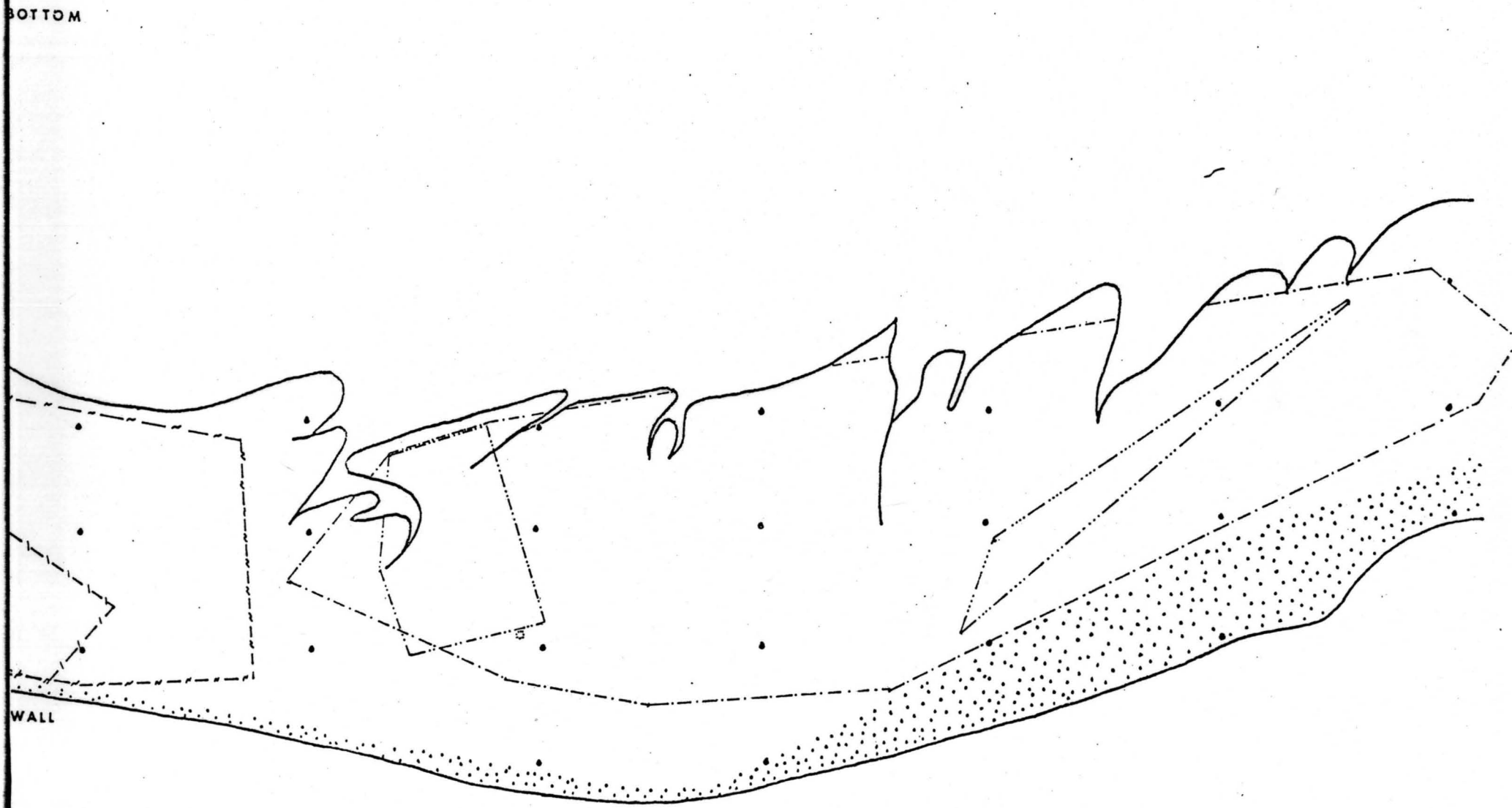
Figure 3

FIGURE 3. Defended Area of each Willet in the Phase before Incubation.

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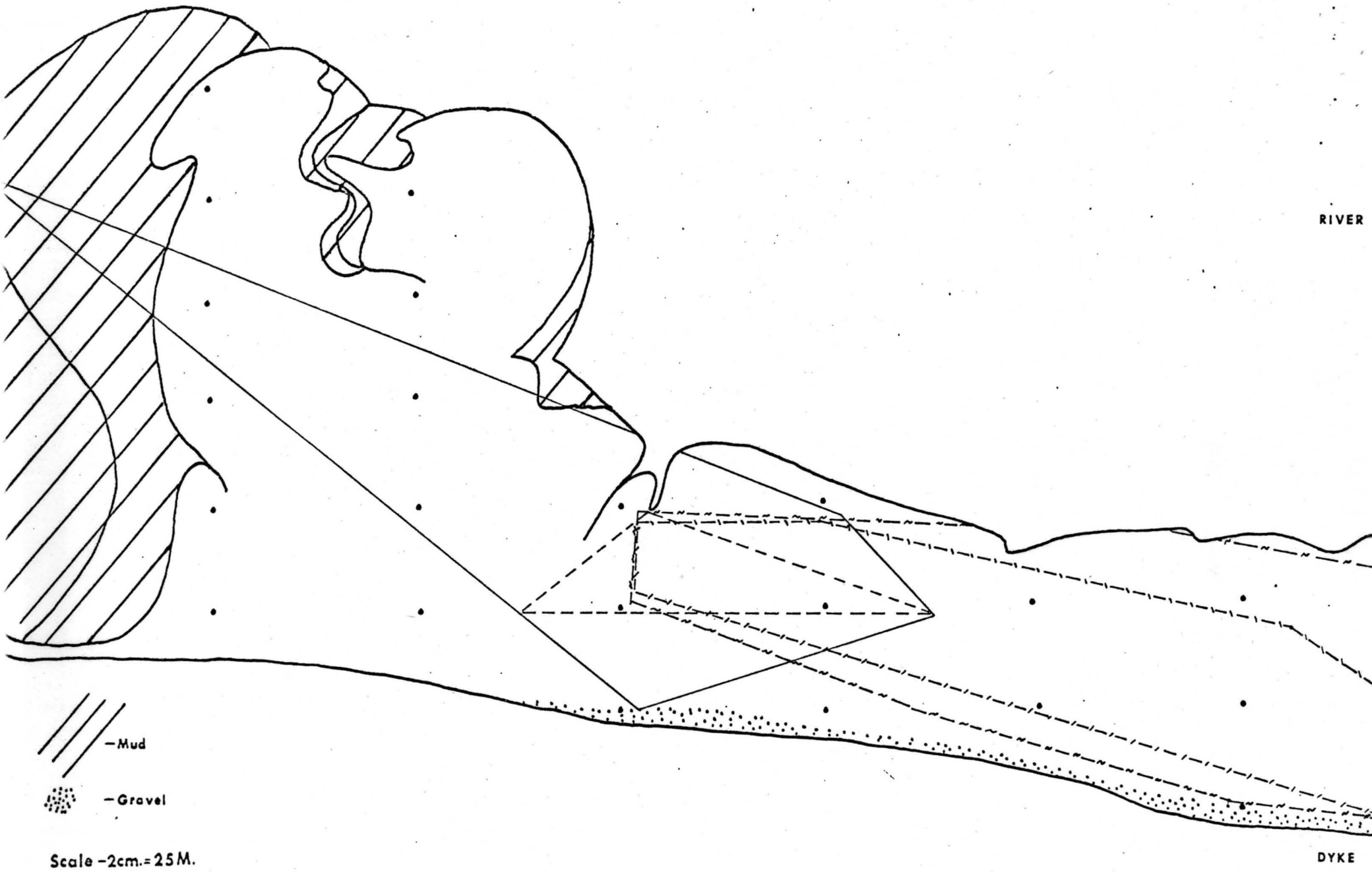
RIVER
—Mud
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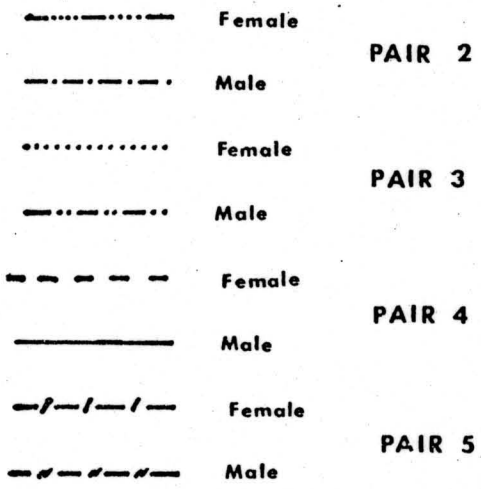
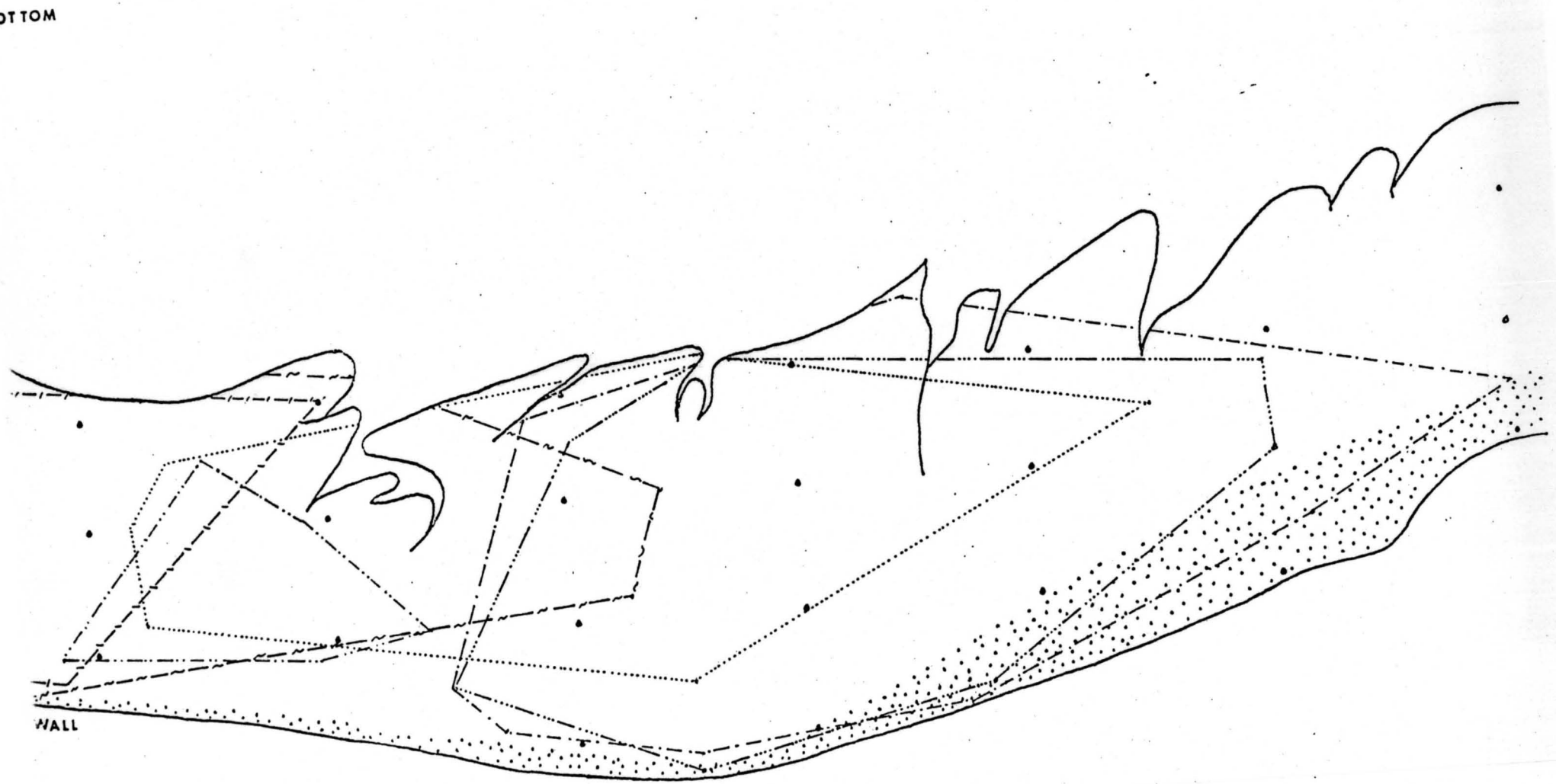
Scale –2cm.= 25M.
DYKE

Figure 4

FIGURE 4: Home Range of each Willet in the Phase Incubation.

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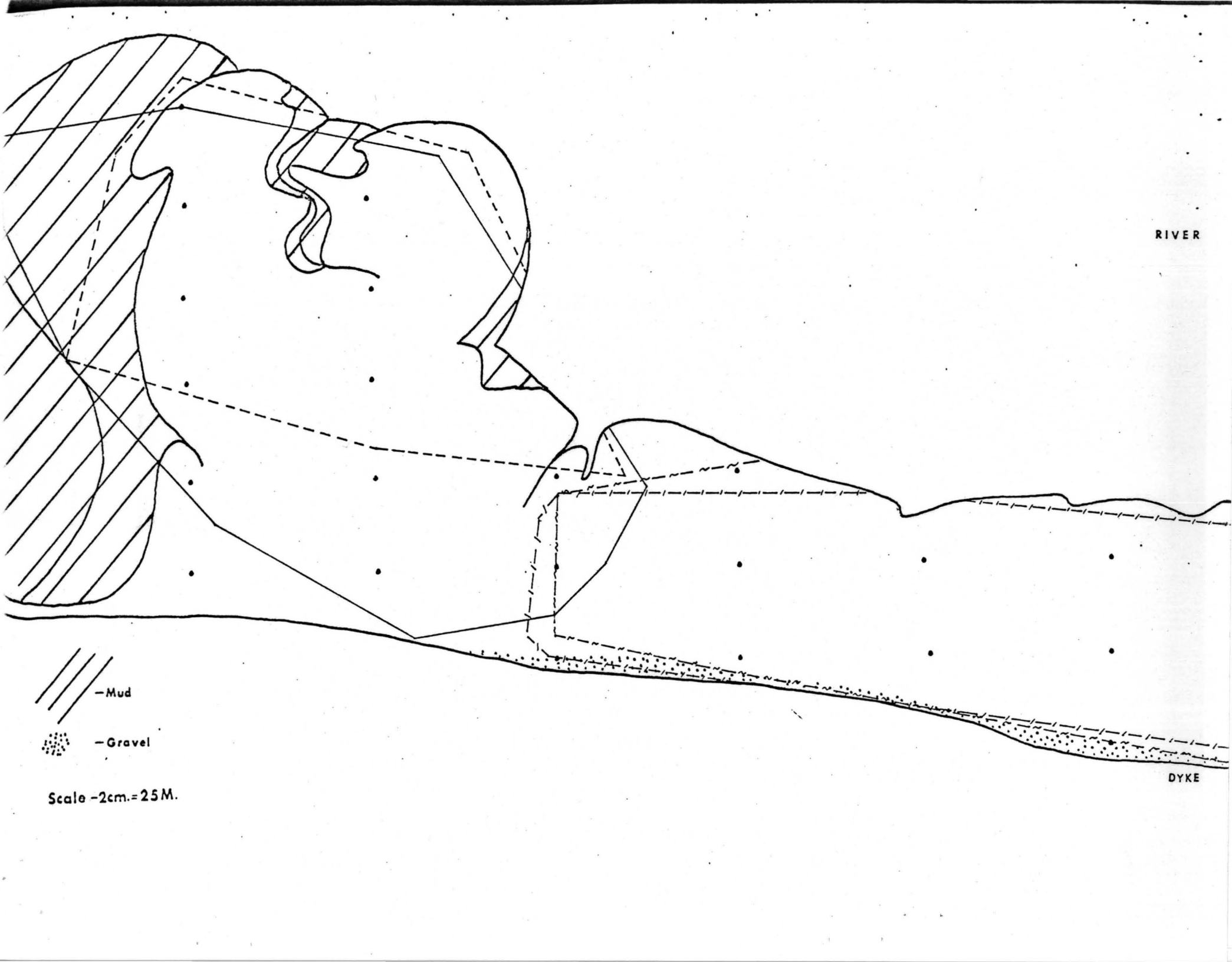
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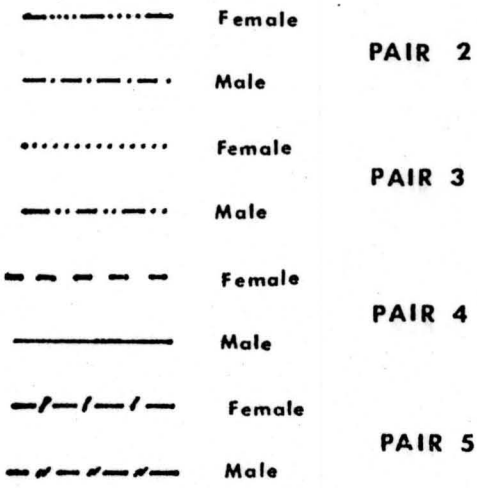
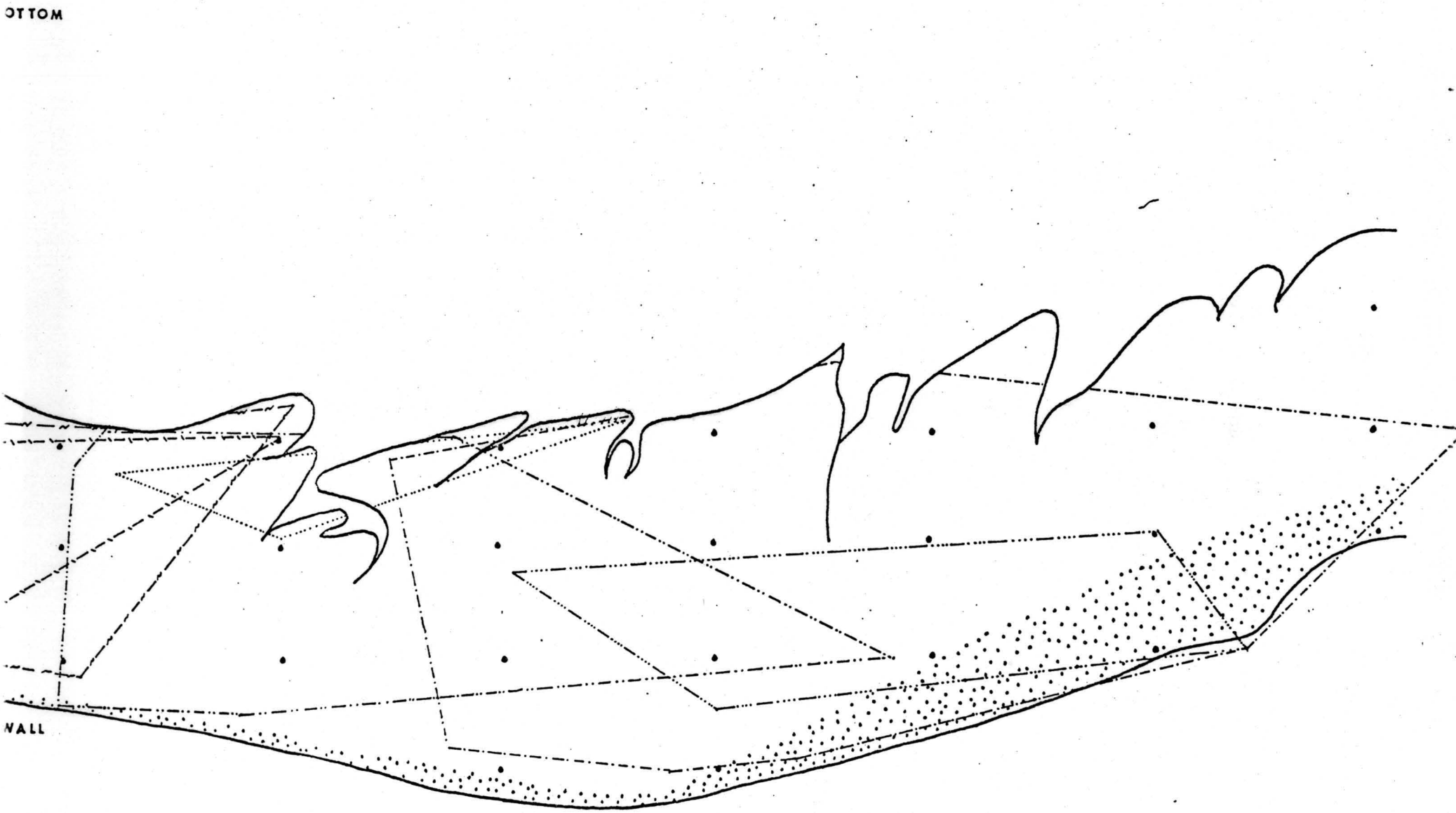
Figure 5

FIGURE 5: Defended Area of each Willet in the Phase Incubation.

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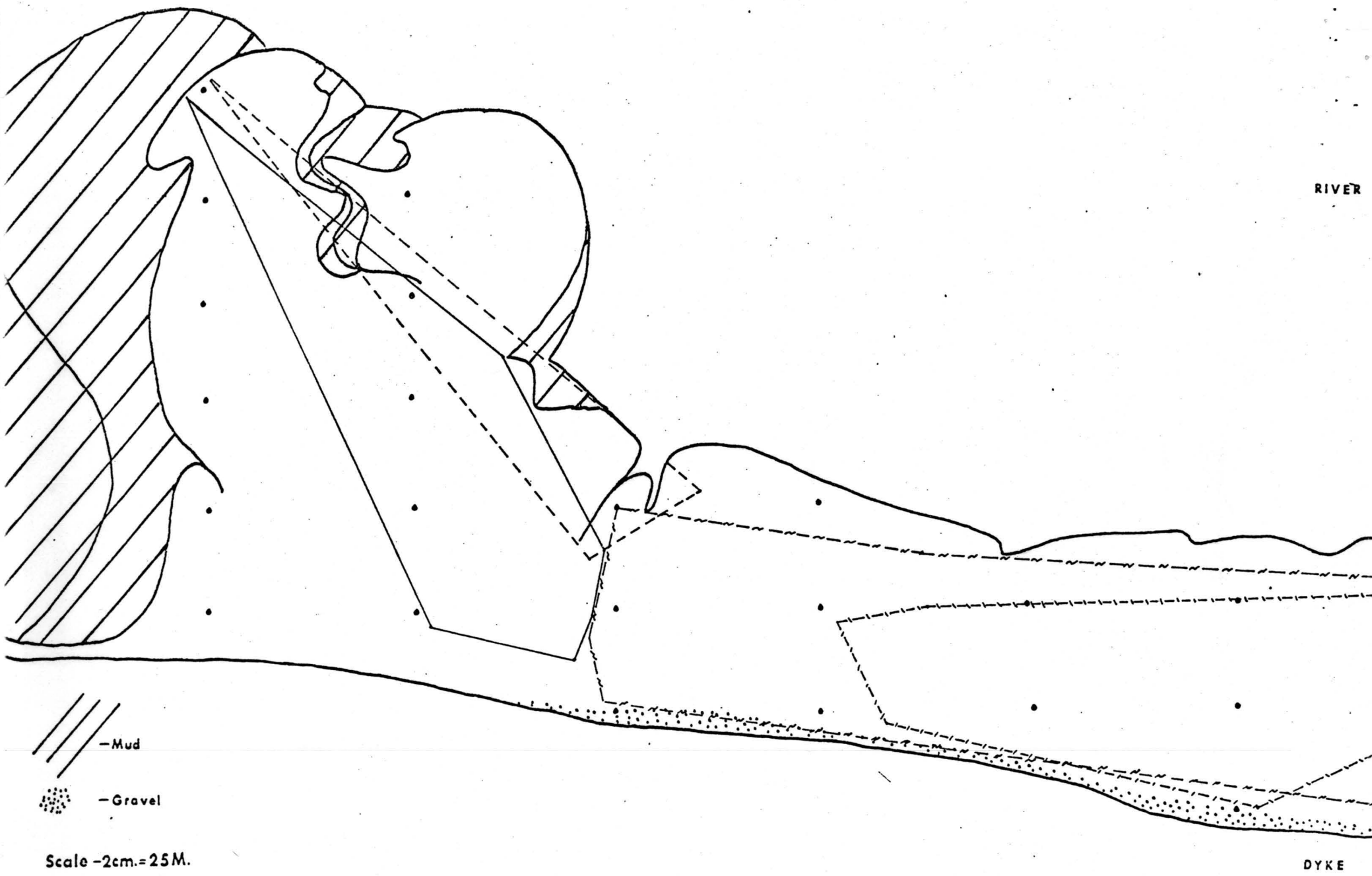
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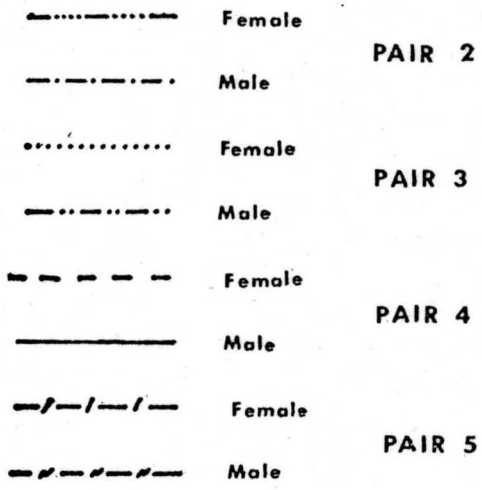
Figure 6.

FIGURE 6. Home Range of each Willet in the Phase Young on Marsh.



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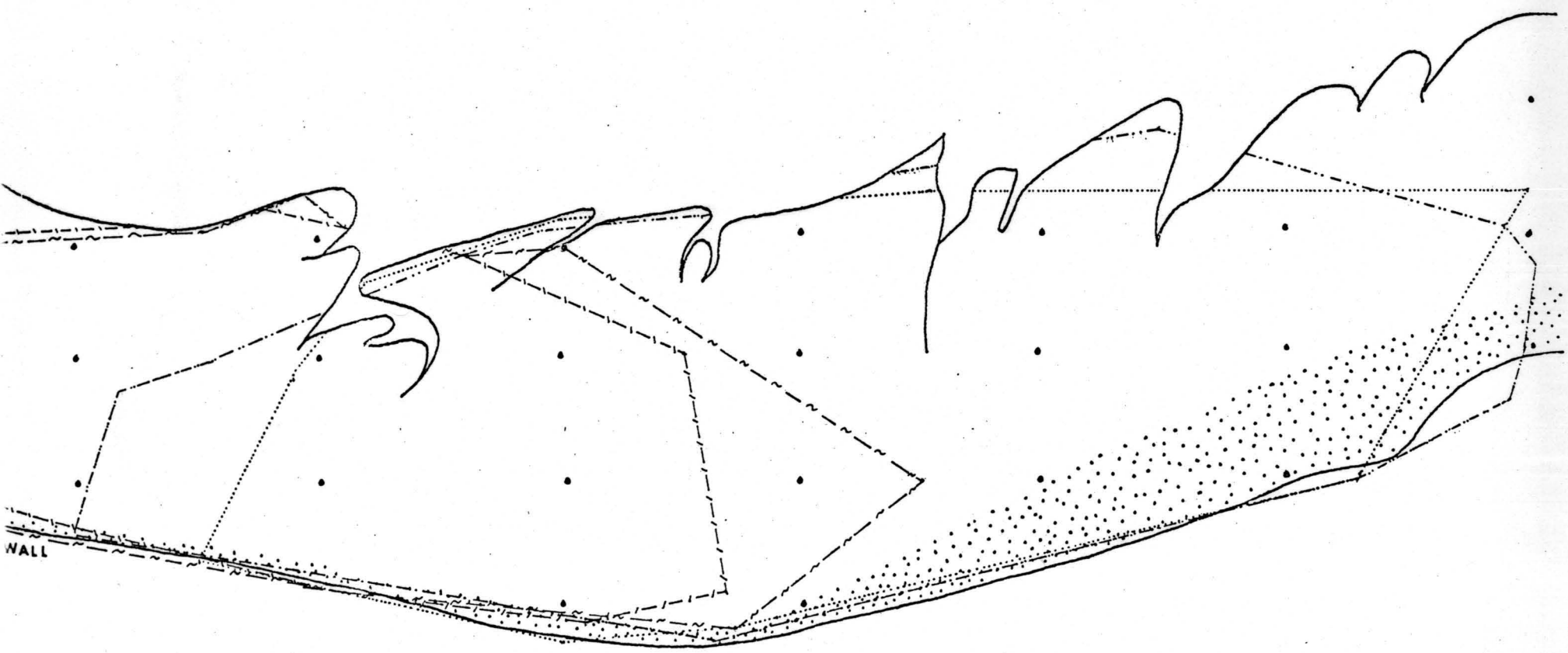

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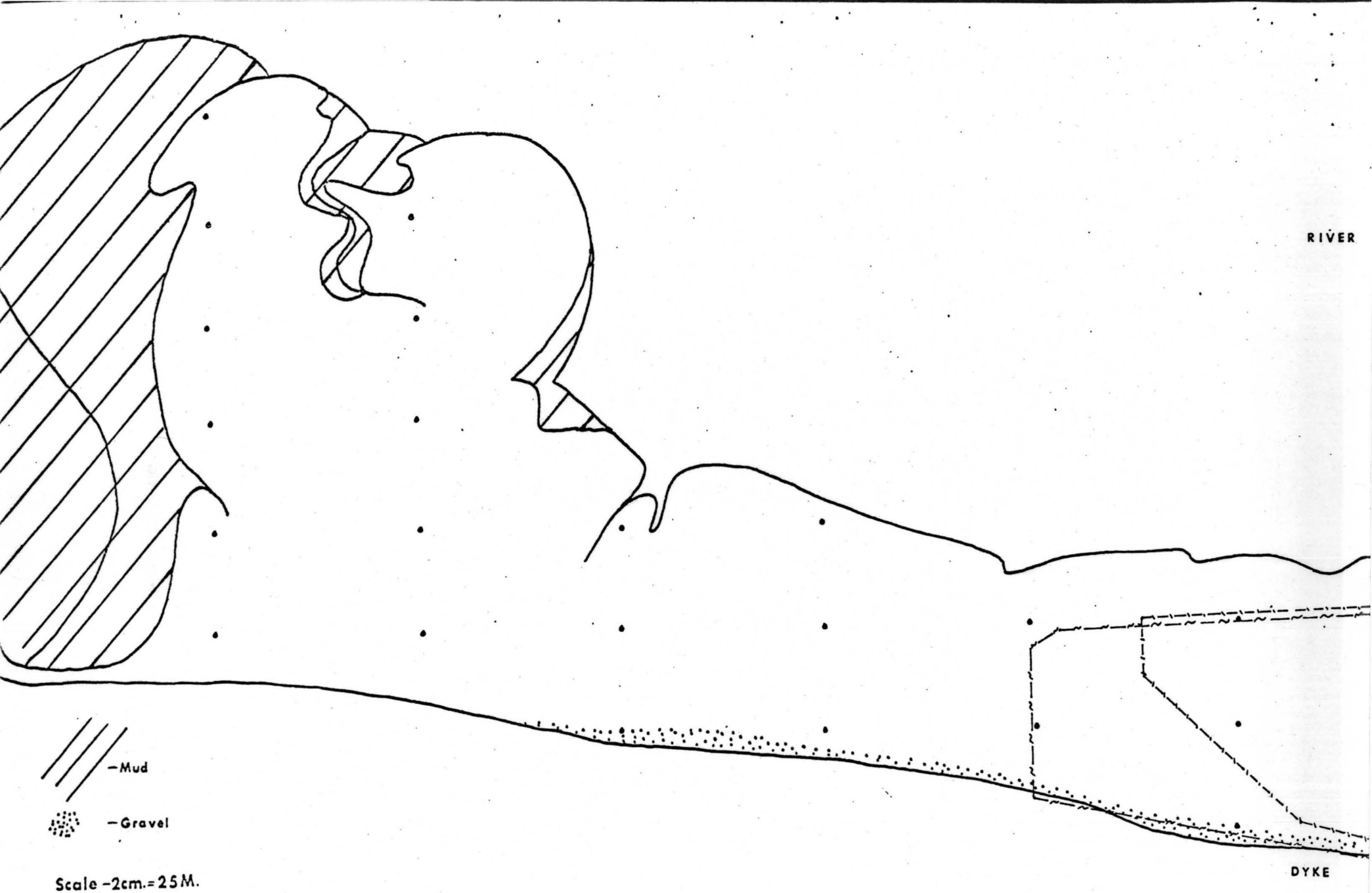
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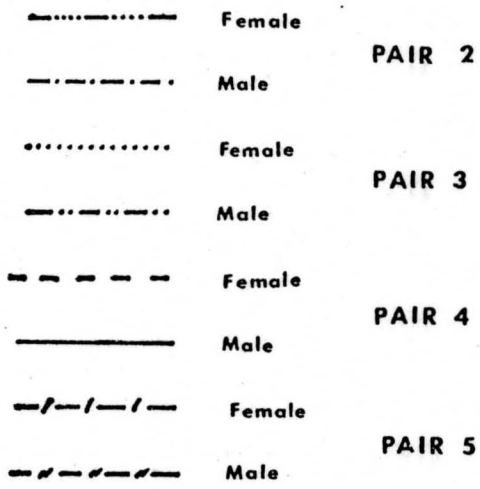
Figure 7

FIGURE 7: Defended Area of each Willet in the Phase Young on Marsh.



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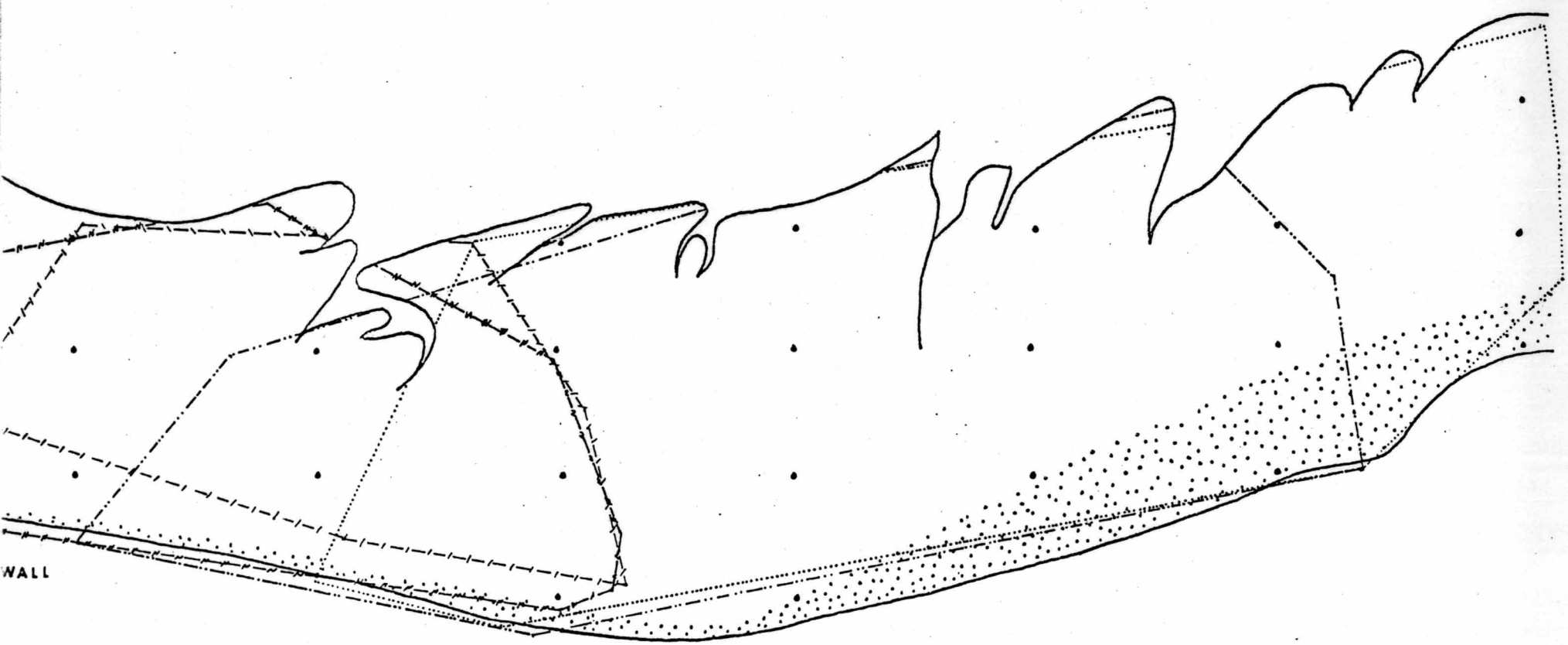

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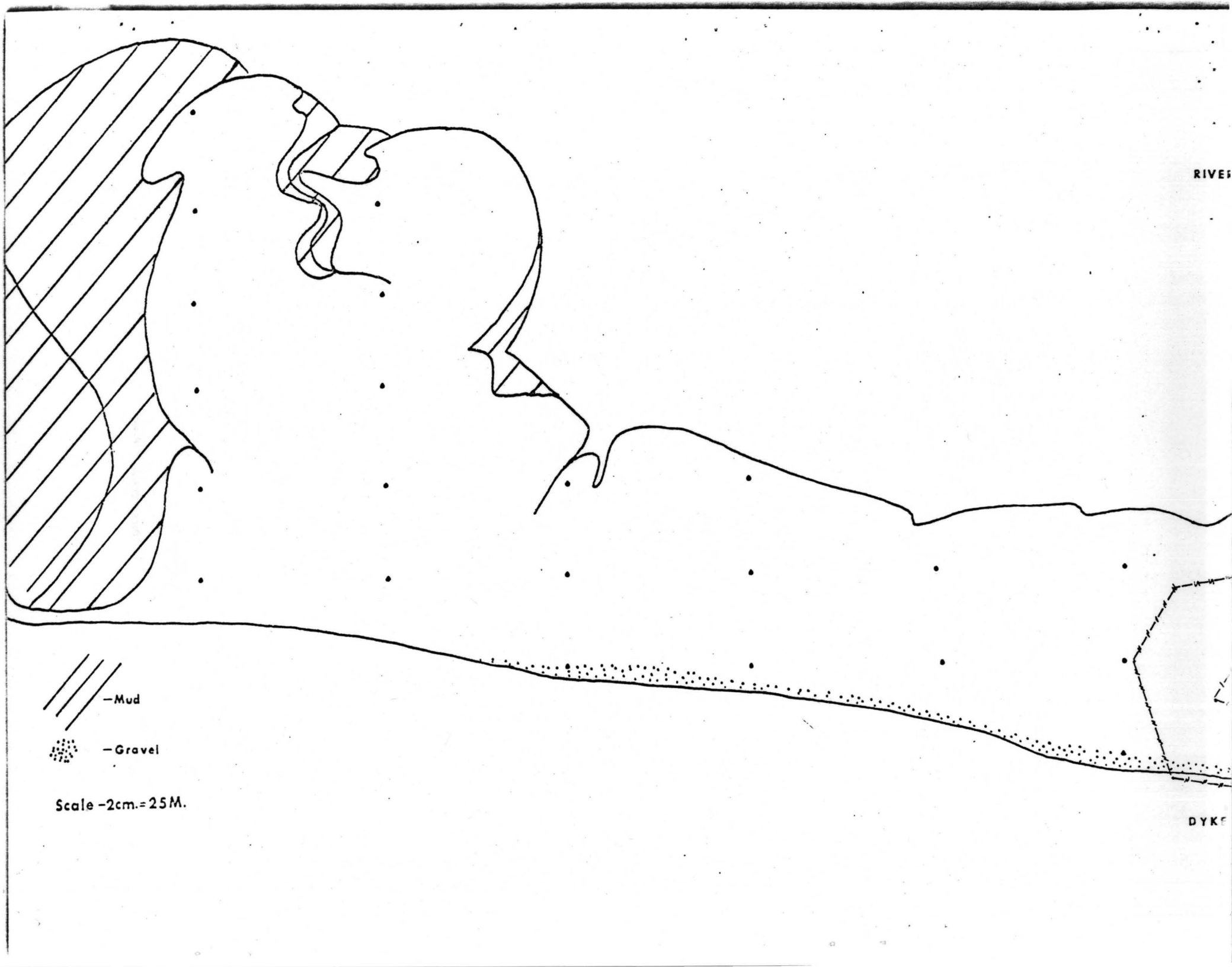
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Scale –2cm.= 25M.
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Figure 8

Figure 8. The Relationship of Home Range to Defended Area for Male and Female Willets in three Phases of the Breeding Cycle.

Phase 1: Before Incubation

Phase 2: Incubation

Phase 3: Young on Marsh

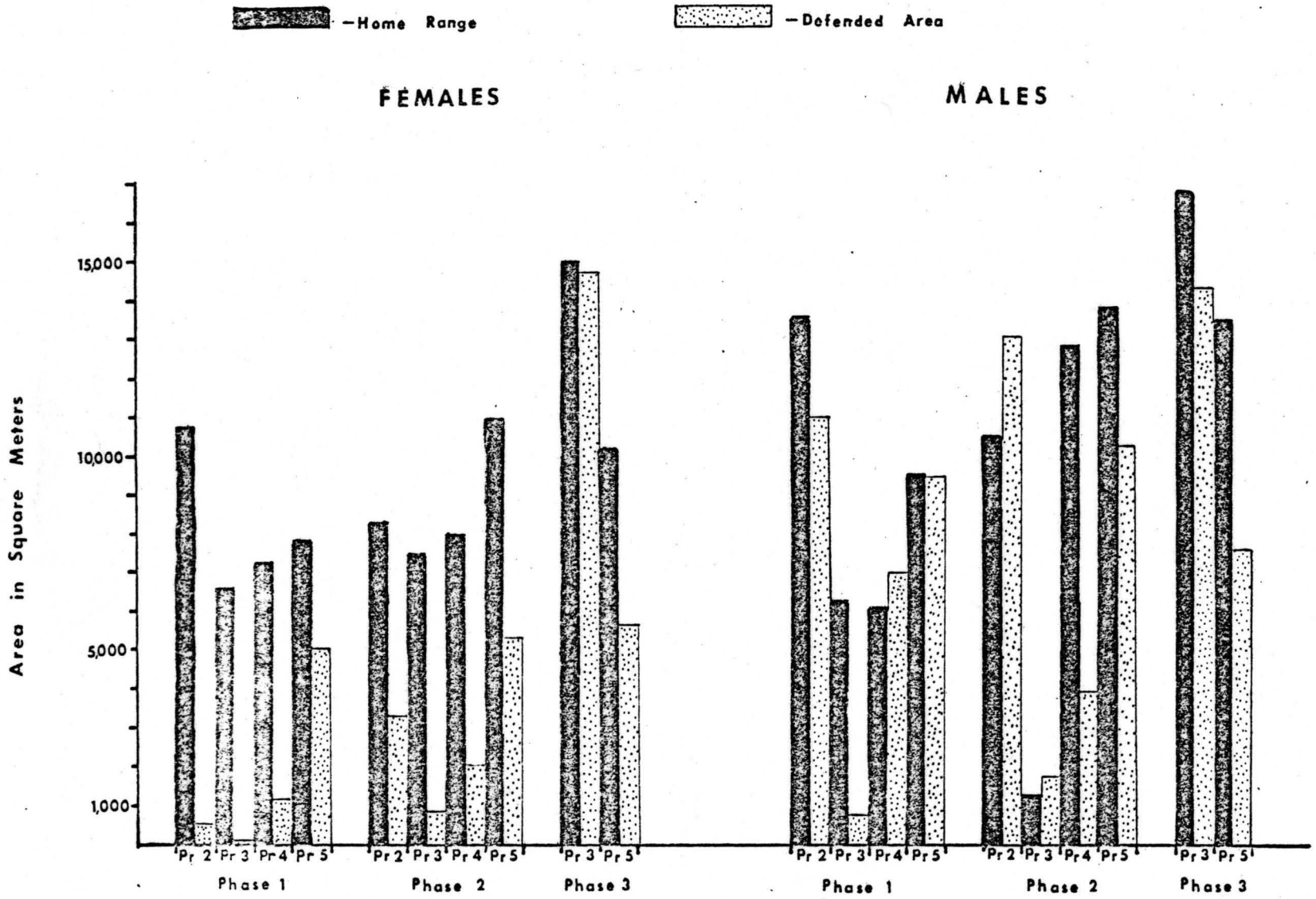

FIGURE 8: The Relationship of Home Range to Defended Area.