

The Effect of Grazing by Feral Horses on American Beachgrass at Assateague Island National Seashore

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METHODS

The effects of grazing on American beachgrass (*Ammophila breviligulata*) were assessed using a series of paired plots, one a fenced enclosure and the other a like area open to the horses, located along a 13 mile stretch of beach that extended from Dune Crossing #1 to the MD-VA line at Dune Crossing #16.

Site Selection - During August 1993, after spending considerable time examining the dunes along Assateague's beach, a sampling strategy was designed and 18 plot pairs were identified and staked. Each pair consisted of two plots that were as similar to each other as we could find. Because the types of dunes and the coverage of American beachgrass was so diverse, selection of the sites was based on dune morphology. Four types of dune formations are obvious on the island and almost all are colonized by American beachgrass, however some dunes are colonized with *Spartina patens* or with a mix of *Ammophila* and *Spartina*. The four types are: 1) sand flats and areas blown out during storms - no dune present; 2) small, rounded, and newly forming dunes that look like grassy knolls; 3) long, continuous dune ridges; and 4) butte-shaped dunes scarped by erosion. Throughout this report, these will be referred to as flats, knolls, ridges, and buttes, respectively. The 18 plot pairs were divided among the dune types as follows: 8 flats (4 *Ammophila* plot pairs + 3 *Spartina* plot pairs + 1 mixed *Ammophila*-*Spartina* plot pair), 4 knoll plot pairs (*Ammophila*), 3 butte plot pairs (*Ammophila*), and 3 ridge plot pairs (*Ammophila*).

Due to the different shapes of these dunes and the area covered by grass, the dimensions of the paired plots varied with dune type. Both the fenced and unfenced plots in the flat sites were 15 x 20 m in size. The knoll and butte plots were 13 x 13 m, and the ridge plots were 8 x 24 m in size. Within the 15 x 20 m plots, 12 subplots were delineated at the time of sampling, 9 subplots within the 13 x 13 m plots, and 12 subplots within the 8 x 24 m plots. Comparisons of growth and cover of American beachgrass between fenced and unfenced plots were made for each dune type. Baseline cover and plant height data were determined for all plots in December of 1993.

During January through March 1994, Elaine Furbish and her assistants put in the fencing around the 18 fenced plots and put labeled carsonite posts in to mark the corners of the unfenced plots. The fencing consisted of wooden posts and three strands of barbed wire.

Field Sampling - During May and September 1994, percent cover, percent flowering, percent grazing, and plant height data were collected within the fenced and unfenced plots. We marked the subplots within the plots temporarily using wire flags each time we sampled and then removed the flags immediately after the data was collected. To mark the subplots, we used a tape measure or a marked rope to put wire flags at every 4 or 5 m, depending on plot dimensions. Thus, there were twelve 25 m² (5 m x 5 m) subplots in each 15 x 20 m plot, nine 16 m² (4 m x 4 m) subplots in each 13 x 13 m plot, and twelve 16 m² (4 m x 4 m) subplots in the 8 x 24 m plots. In the 13 x 13 m plots, flags were set in 0.5 m on all four sides of the plot, delineating essentially a 12 x 12 m plot within the 13 x 13 m plot, so that 4 m x 4 m subplots could be used. Data sheets consisted of one sheet per plot, divided into the subplots (data sheet samples attached). Data for each subplot was recorded in each box and the location of the vegetation was marked on each subplot "map".

Using the Daubenmire cover scale, the estimated percent plant cover was determined for each subplot within the fenced or unfenced plot, thereby sampling the entire plot, not just random samples within. Cover classes were as follows: 0-1%, 1-5%, 5-25%, 25-50%, 50-75%, 75-95%, 95-100%. Probably the best way to estimate cover is to visually cut the 4 x 4 m or 5 x 5 m plot in half and ask yourself if all the plants would fit into one half. If so, then you know that cover is less than 50%. Then visually cut that half again and ask yourself whether or not all the plants would all fit in that quarter. If so then cover is less than 25%. Continually do this until you know which cover class best estimates the cover. Keep in mind what you consider 100% cover to look like. I considered a plant stand to be 100% covered if, when standing looking at it from one end of the plot, you see very little sand surface because the view of the sand is essentially blocked due to the dense vegetation. In natural dunes you rarely see 100 % cover, but in managed fertilized dunes it is not unusual. The 0-1% cover class is useful when there are only a couple or a few stems in a plot. Had the first cover class been 0-5%, it could have indicated anything from a completely bare plot to 5% cover, which is a big range. So if a plot has 0-1% cover you know that it is either bare or has only a few stems in it.

Percent grazing data (the percent of the total number of stems that were grazed) and percent flowering data (the percent of the total number of stems that were in flower) were estimated and recorded for each subplot. I considered plants to be grazed if any leaves on the plant were obviously nipped off. Flowering needs to be determined in late summer or early fall. Note that some grazing evidence was observed in the fenced plots, often along with deer or rabbit pellets, therefore we know that, although they may have been grazed by deer or rabbits, they were not grazed by the horses.

Plant height data were collected by randomly selecting and measuring the height of six mature nonflowering stems and six flowering stems per whole fenced or unfenced plot. The length of the inflorescence was also measured on six plants. Interestingly, the inflorescence was generally shorter in grazed plots than in ungrazed plots, even when that particular inflorescence had not been grazed itself. Additional plant height data was obtained on the samples harvested in 1995 (described below).

Field Photography - At the time of sampling, four photographs were taken of each plot: one from the beach thus getting the whole plot and its dune morphology in the photograph, and three from one corner post, resting the camera on the post and shooting toward the three other corner posts, thus getting the entire plot spread over the three photographs. I've had both prints and slides made from each roll.

Harvest Data - In September 1995, in addition to the same nondestructive collection of data described above, we conducted a harvest of plant material for further measurements in the laboratory. This harvest data included above- and belowground biomass, stem density and morphology, and amount of sand burial. To collect the additional 1995 harvest data, we selected one site in each whole fenced or unfenced plot in which we placed a 0.1 m² quadrat. Since the vegetation density is so diverse in the dunes, even within a single plot, we selected the site for harvest by picking the location where the vegetation looked best in that particular plot. This way we knew that our sample always was indicative of the maximum biomass, etc. for a given plot. Shoots were cut at the sand surface and all the stem bases, roots, and rhizomes were then excavated from the belowground zone in the 0.1 m² plot. Above- and belowground samples were bagged and taken to the laboratory where they were stored in a refrigerator until they could be sorted, measured, and weighed.

In the laboratory, the following measurements were made on the aboveground samples: stem density, plant height, stem diameter, leaf length, leaf width, and shoot wet and dry weights. Belowground samples were separated into stem bases, rhizomes, and roots, and wet and dry weights of each were obtained. Additionally, we determined the amount of sand burial by measuring the amount of stem that extended below the sand surface. Biomass samples were dried in a 60° oven to constant weight.

Recommendation - Because the data collection is a very labor intensive effort, both in the field and in the lab, I'd recommend that sampling be conducted once a year in the late summer or early fall, and if possible for as many years as the plots remain uneroded and intact.

13 x 13

Change in Percent Cover Between May and September 1994
on the Dunes at Assateague Island National Seashore

Dune Type	Unfenced	Fenced	Difference
Flats	1.21 x *	1.85 x	+ 0.64
Knolls	1.16 x	1.49 x	+ 0.33
Ridges	1.11 x	1.93 x	+ 0.82
Buttes	0.96 x	1.65 x	+ 0.69

* This value represents the factor by which the cover increased or decreased between May and September (x = original cover value, i.e. that in May). A value of 1.00 represents no change between sampling dates, values > 1.00 indicate an increase in cover, while values < 1.00 indicate a decrease in cover.

more sand
peeled in this
one - due to plants
hummocky

15 x 20 m

~~un~~fenced

part of grass
on one side was
laying over like
it had been overmowed

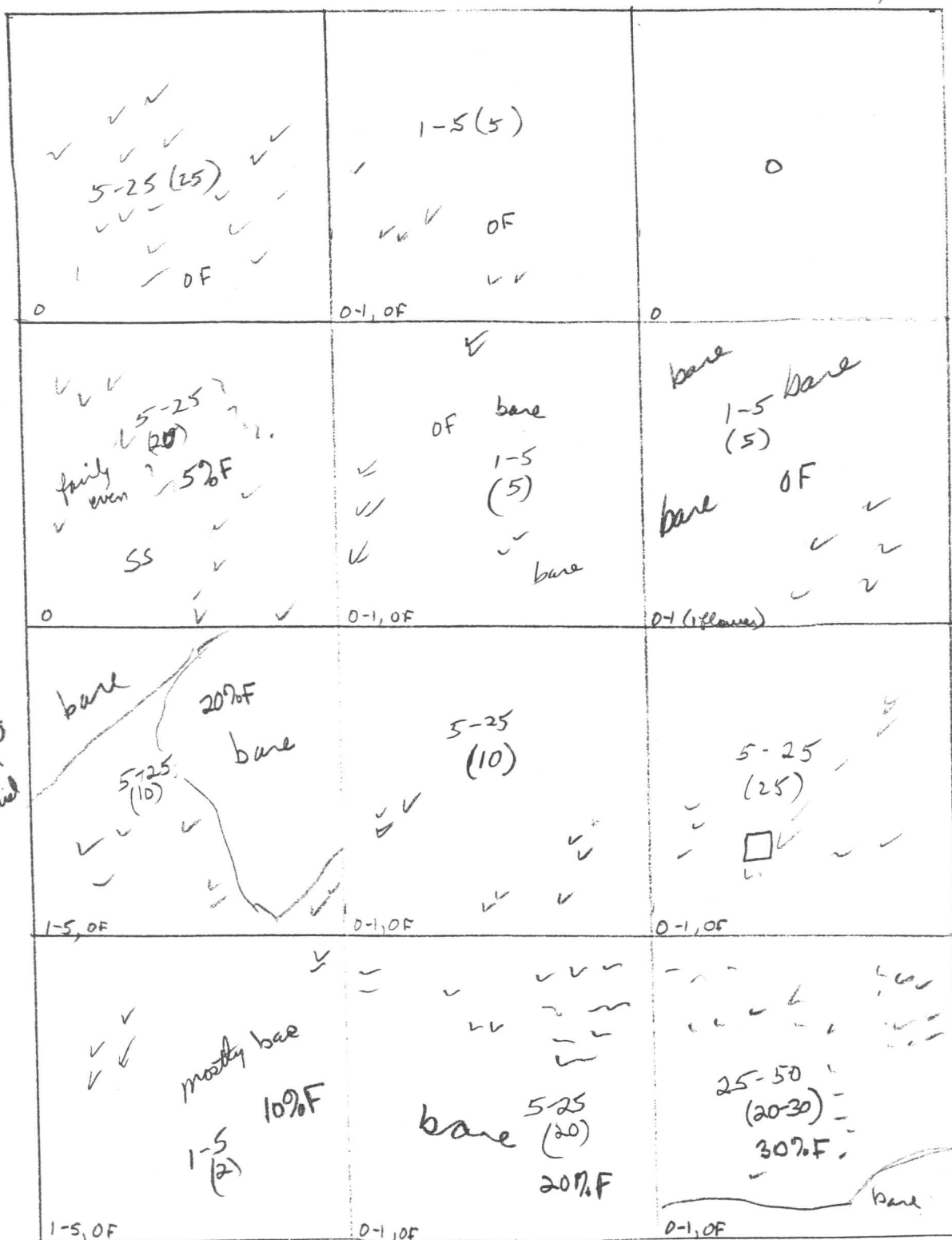
Cover Data

12-13 Sept. 1995

almost
all Amm.

0.1 m²
quads
used
for
biomass
+ roots

collected
tops
+ stem bases
+ roots + rhiz
to 35 cm
and sand buried



□ = 30%
Cover

□ Location of biomass plot (0.1 m²)

Denise Seliskar's Data Sheets - September 1995

flat
no hummocks
apparent wash over on most
of it

15 x 20 m
unfenced

1A B

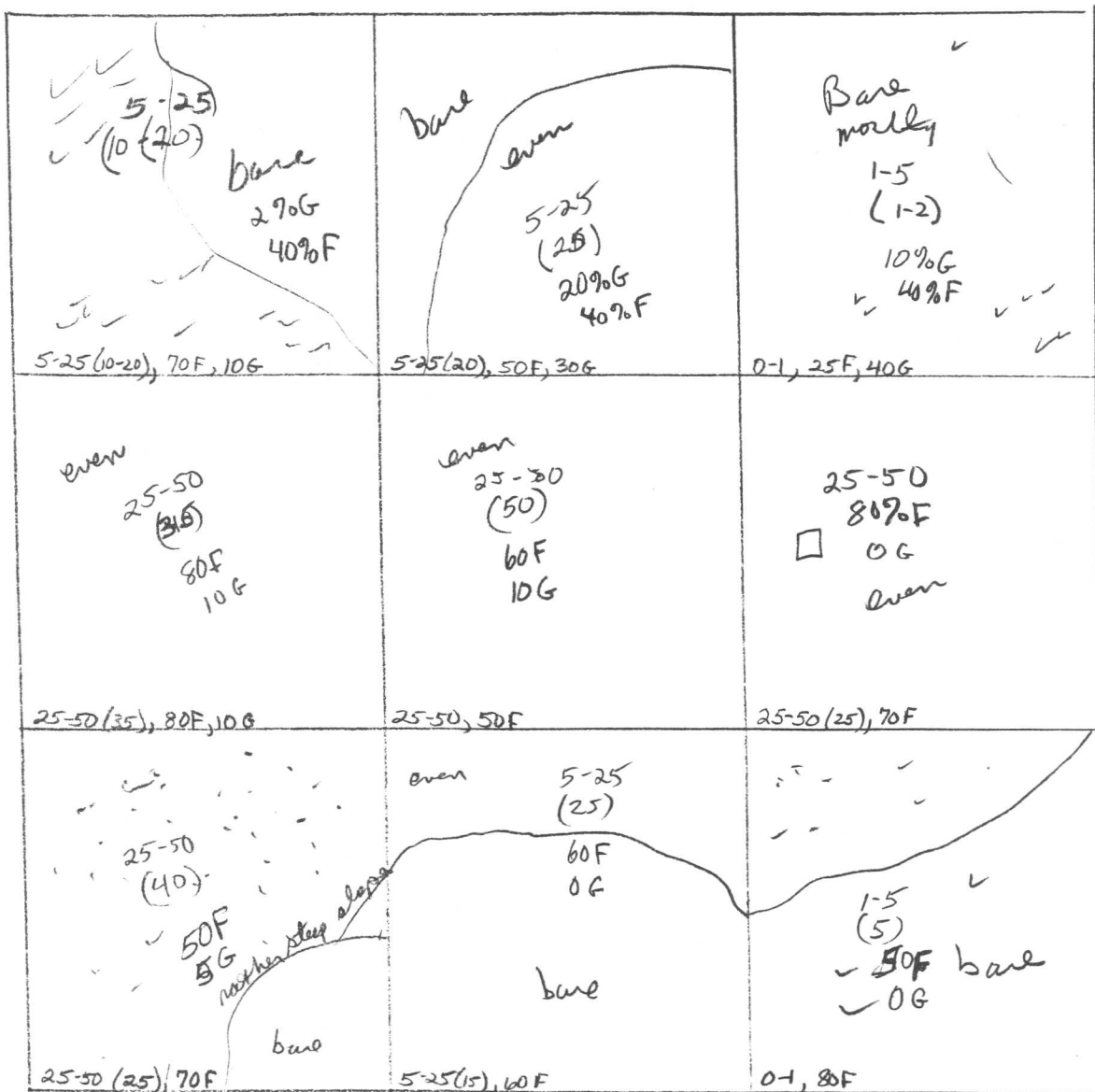
mostly Amm
a few patches

0	0	0
5-25(10), 50F	0-1, 50F	0
0	0-1 1 small clump (Amm) ✓	0
5-25(20), 60F	0-1, 0F	1-5, 50F
0-1(1) ✓ ✓ ✓	0-1(0.2) 80% C □ ✓ ✓	0
1-5(50F)	1-5(70F)	5-25(20), 60F
mostly Amm a few patches ✓ ✓ ✓ 1-5(2) 30% C ✓ ✓ ✓	0	0
0-1, 0F	5-25(12), 70F	5-25(10-20), 80F

□ = 10% cover

fenced

animal pellets
(maybe rabbit)



□: 50%
plants more
robust
than 2B□

no sign
of inundation

unfenced

✓✓✓ 1-5 (2) 20%G 0F ✓ ✓ 1-5(5) 1F, 30G	✓✓ 5-25 (5-10) 30F 0G ✓ ✓ 5-25(5-10), 10F, 30G	✓✓ Bare 5-25 20F (10-20) 5-25(10-20), 50F, 20G
5-25 (25) 5%G 10%F 25-50(20-30), 40F, 30G	5-25 (10-20) 20%F 30%G bare 5-25(20), 10F, 30G	✓ mostly bare 0-1 0F 0G 0-1, 1F, 30G
5-25 (10) 20G 30F 5-25(10-20), 50F, 40G	5-25 (25) 60F 30G 5-25(20-30), 20F, 10G	✓ 0-1(1) 50F 30G 1-5(5), 5F, 30G

40%

no sign of inundation

3A - fenced South ↑

3B - unfenced

S even 25-50 (30) bare 50F 0G 25-50(30-40) 80F	S 5-25 (20) 10F 10G (10-20) 5-25 (50F)
25-50 (25) 26 30F 5-25(20-30) 80F	even 5-25 (60) 10F 2G base 5-25(10) 30F
5-25 (25) 80F 0G □ 25% 25-50(30-40) 60F	S 1-5 30F P S 1-5(1) 5F
even 25-50 (30) 80F P 25-50(30) 80F	S S 25-50 (25) 30F 10G S P 5-25 (20) 70F cynchus
base 25-50 (30) 80F 0G 25-50(30) 80F	base 5-25 (10) 40F 0G P S S
25-50 (30) 60F 25-50(30) 70F	25-50 (30-40) even 80F 0G 5-25(20)

□ = 25-30 20

□ = 20% (0.1m²)

even 5-25 (10) 10G S 5F 5-25(10) 1F, 70G	even 5-25 (25-30) 1-5F (2) 1-5G (3) P S P 5-25(25) 1F, 40G
5-25 (25) 30F even 5G 5-25(20-30) 3F, 50G	SS Bare P 5-25 (10-20) 10F, 20G ~5% S 5-25(10) 50F, 20G
25-50 (25) 10F 10G 5-25(20) 5F, 60G	even 25-50 (30) 5F 20G S P 25-50 (30) 5F 20G 5-25(20) 40F, 25G
even 25-50 (30) 30F 25-50(30) 20F, 40G	even 25-50 (30-40) 20F 20G S S 25-50(30) 10F, 40G
even □ 25-50 (30-40) 20F 10G 25-50(30) 30F, 30G	even 25-50 (40-50) 20F 5G P P 25-50(30) 20F, 40G
even 25-50 (40) 20F 10G 25-50(30) 20F, 20G	even 50-75 (50) 50F 20G some cynchus 25-50(30-40) 20F, 20G

Denise Seliskar's Data Sheets - September 1995

this is the targeted data

South ↑

4A unfenced

South

4B fenced

10%P 5-25 (20) P P 40F OG 5-25(20) 1F, 90G	mostly P 25%P 5%S 1-5 (1) 50F 10G S 0-1, 30F, 50G
20%P 5-25 (10-20) 30F 5G 5-25(5-10) 2F, 60G	10%S 10%P 1-5 (1) 30F 40G 1-5, 10F, 10G
5-25 P even (20) 20F 30G 5-25, 5F, 50G S	10%S 5%P S 5-25 (10) 60F 40G S 5-25(10), 40F, 50G
1-5%S 20P S 5-25 (10) 10F 20G 5-25(20) 20F, 40G	5%P 5-25 (5) 30%G 5F 5-25(10) 10F, 40G S
5-25 even (10) 30F 20G 5-25(10-20) 5F, 60G	5%P P S 5-25 (20) 20%G 30F 5-25(20) 10F, 50G
5-25 (10) 40F 30G 5-25(10) 40F, 40G	5%S 5-25 (20) 40F 20G 5-25(10) 10F, 60G

5-25 bare (10) 60F 5-25(10) 70F	5-25 (20) 50F S 5-25(20) 50F S
2%S S 25-50 (25) 60F 10G 25-50(30-40) 80F	25-50 S (30-40) 5%S 60F 20G 25-50(30-40) 70F
25-50 (30-40) 60F 15G 20G 25-50(30-40) 90F	25-50 S (30-40) 70F 20G 25-50(30) 80F
even 25-50 (40-50) 60F 10G 25-50(40) 90F	even 25-50 (30-40) 60F 10G 25-50(30-40) 90F
even 25-50 (40-50) 70F 5G 25-50(40-50) 90F	5%S S 25-50 (25) S 70F OG 25-50(20-30) 90F
25-50 (30-40) 70F OG 25-50(30-40) 90F	S even 25-30 (25) 60F 5G P P 5-25(20-30) 80F

□ = 30%G

□ 20%G

eroded

inland ↑

15 x 20 m
unfenced

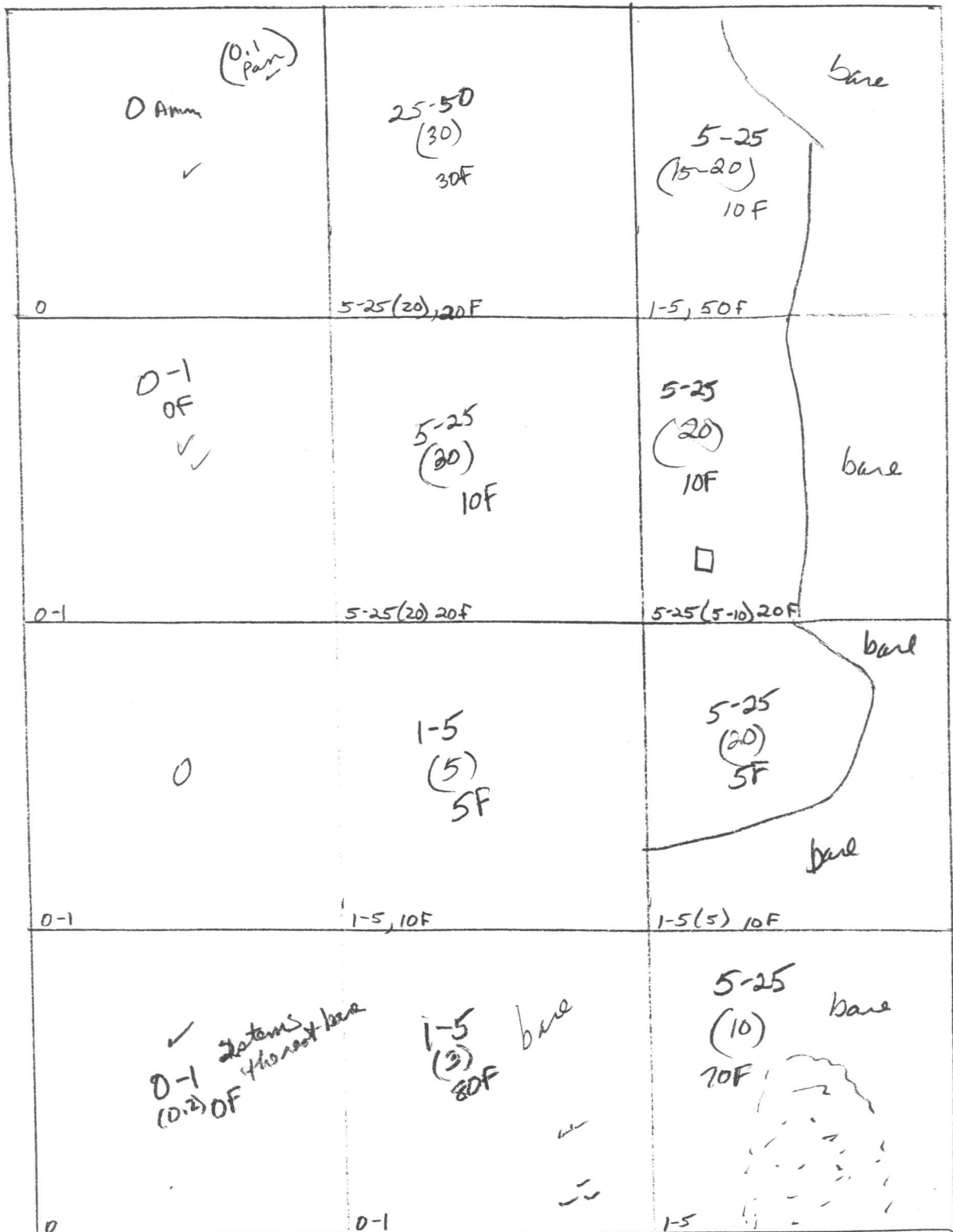
overwashed

5A

0	0-1 (1) 30F OG □ ✓✓ ✓✓	0	□=15%
0	1-5, 10F	0-1, 50F	
0	1-5 (2) OF OG	0	
0-1, 50F	5-25 (10) 2F, 10G	1-5, OF, 10G	
1-5 OF OG	0	0	
5-25 (10) OF, OG	0-1 (1)	1-5 (2)	
0-1 OF OG	0 ✓ dead stems	0-1 OF OG	
1-5 (5) 1F, 10G	1-5 (4)	1-5, OF, 30G	

15 x 20 m
fenced

5B



13 x 13

6A

fenced

P S 5-25 (10-20) 40F 10G 5-25(5-10) 40F, 30G	25%P 5-25 (10) 10F 20G 5-25(5-10) 30F, 20G	40%P even 5-25 (5-10) 20F 10G 1-5(5) 10F, 20G
base 20%P 5-25 (20) 10F 5G 5-25(10-20) 40F, 30G	even 25-50 (40-50) 10G 10F 25-50(30-40) 30F, 30G	even 25-50-75 (50) 5F 10G 25-50(30-40) 30F, 40G
P S P 5%P 25-50 (30) 20F 10G 25-50(30) 40F, 40G	even 25-50 50 20F 5G □ 25-50(30-40) 40F, 40G	even 50-75 (60) 10F 10G 25-50(40-50) 30F, 20G

Deer
Pellets

□ 50%
make it
60 in bag

13 x 13
unfenced

68

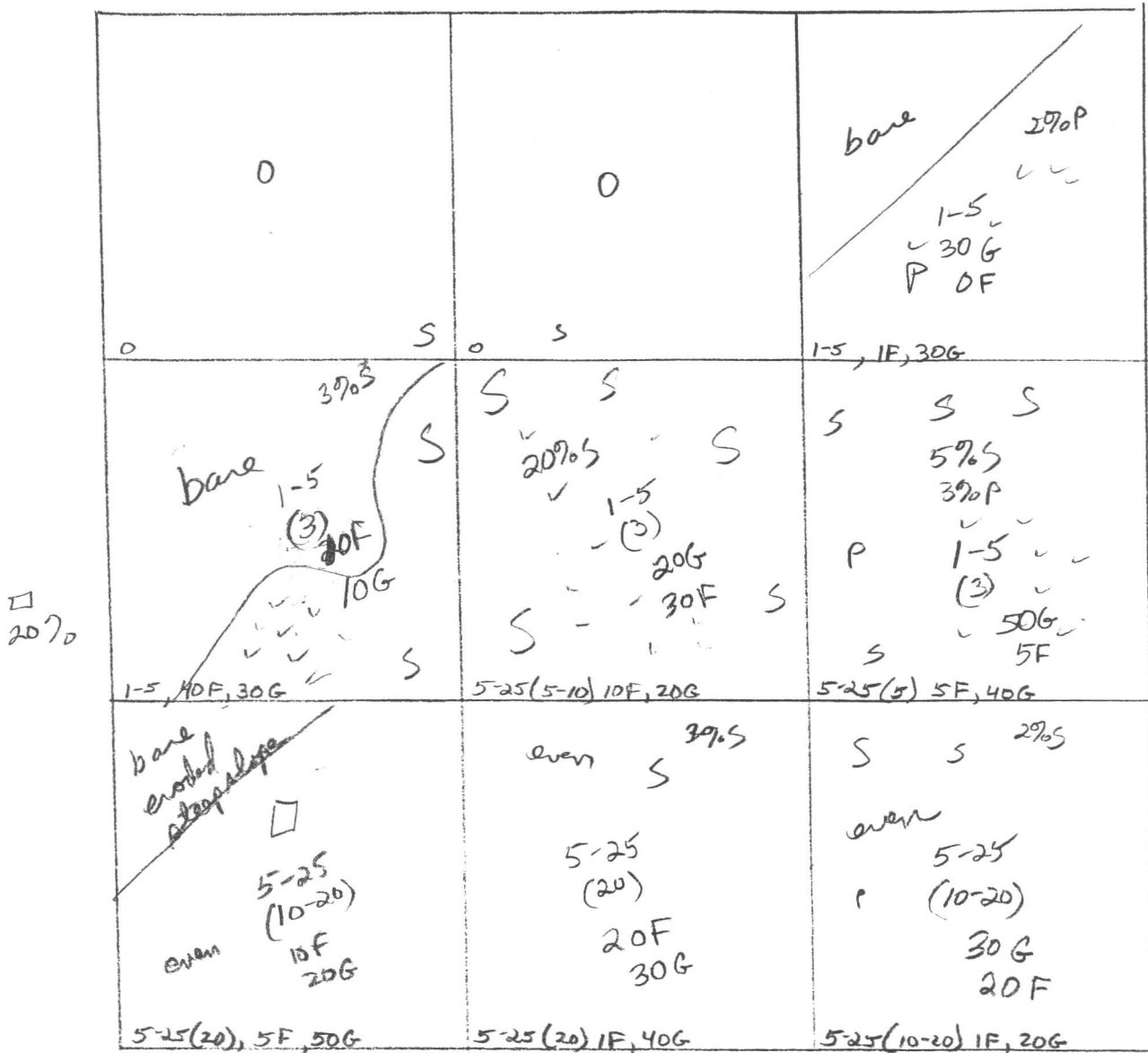
S S S 20% S S 5-25 (10) 40F 10G S P 5-25 (20) 30F, 20G	30% S S 1-5 (2) 10F 10G S 1-5 10F, 50G	S 10% S S S 5-25 5% P (10) 30G S P 1-5F 5-25 (10) 10F, 40G P
20% S S 1-5 (5) 30G 5F S 5-25 (20) 30F, 20G	20% S 5-25 even (15-20) 50G 0F S 5-25 (20-30) 20F, 40G	5% S P 5-25 (10) 5G 1%F S S 5-25 (10) 5F, 40G
10% S even 5-25 (10) S S 5F 20G 5-25 (20) 10F, 40G	5% S even S 5-25 2F (25) 20F S 25-50 (20-30) 20F, 40G	25% S S 5-25 even (10) S 10G 5F S 5-25 (20-30) 5F, 50G

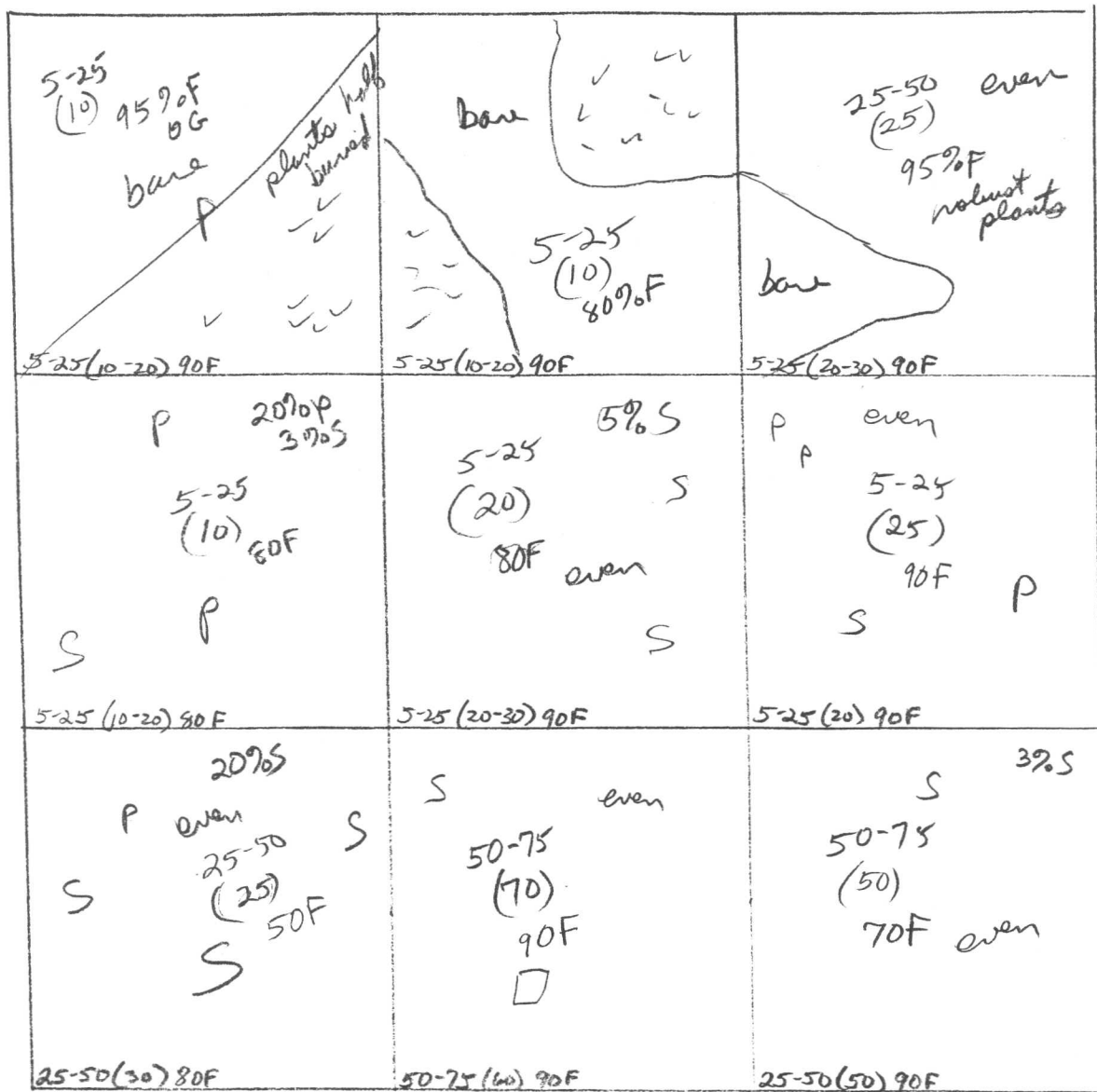
□ = 15%
20

13 x 13

unfenced

7A

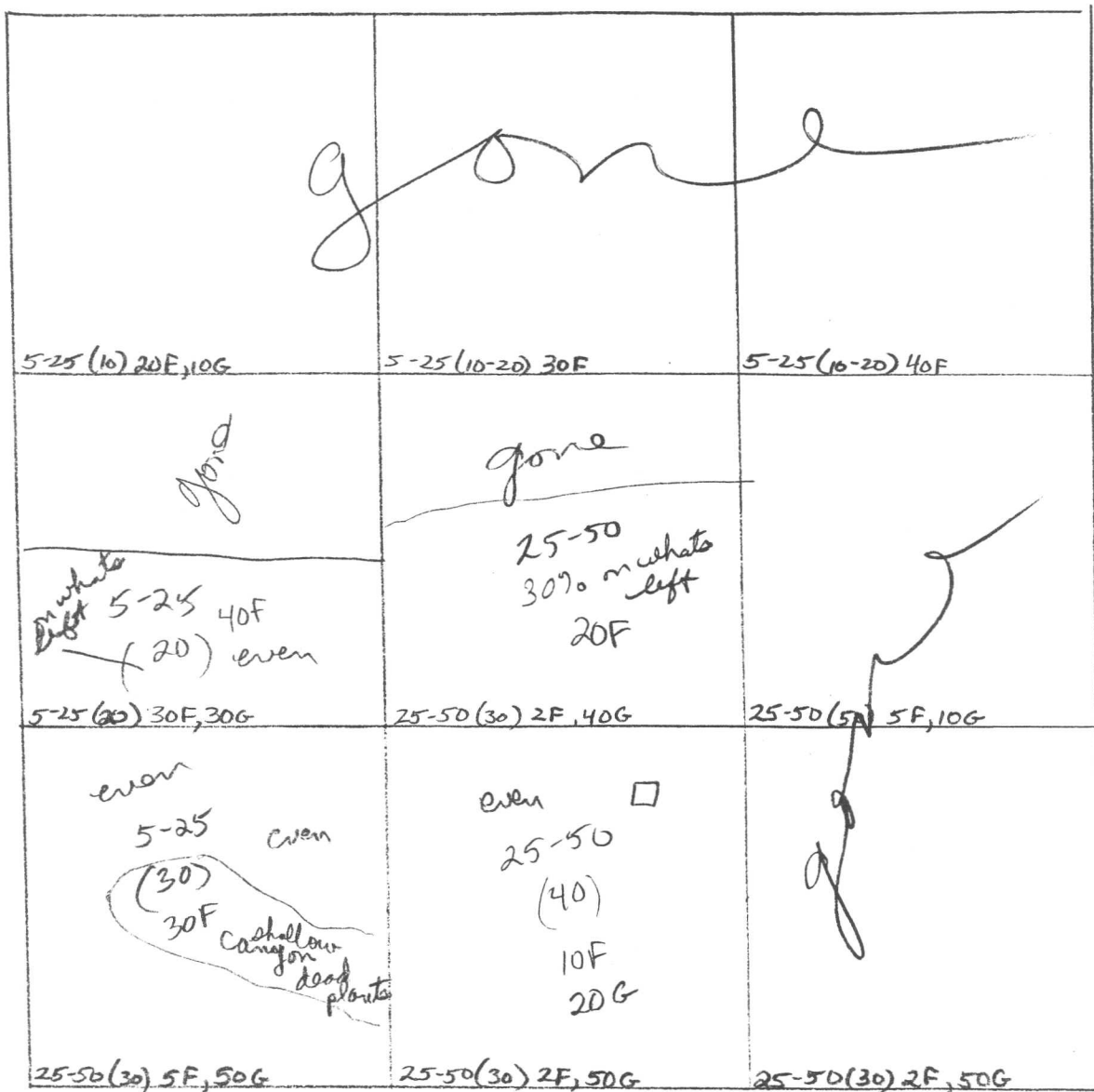




□ = 30%

13 x 13
unfenced

8A



13 x 13

fenced

8B

20% S bare 5-25 (10-20) 50F SS 5-25 (10-20) 50F	59.5% S ~~20% S~~ bare 1-5 90F (5) 1-5 (70F)	20% S 0 S 0-1 (0.2) S 3 small clumps 30F 0-1 (1) 5F
S 50-75 even (60) 90F 25-50 (30-40) 80F	25-50 even (50) 90F 25-50 (30-40) 80F	10% S 25-50 even (30) 90F 25-50 (20-30) 60F
59% S S 50-75 (55) 90F 25-50 (40-50) 80F	□ 50-75 (70) 90F even 50-75 (50-60) 90F	3% S 50-75 Even (50) 90F S 25-50 (50) 80F washed out

a fair amount of
cypress
throughout

□ = 50%

South ↑

9A - unfenced

dead (even) 5-25 dead 10% dead live 1-5 (3) 20F 20G 5-25 (10-20) 20F, 30G	10% S 1-5 S (4) 40F 10G S 5-25 (5-10) 30F, 20G
5-25 live (5 line) 10F (5-10) 30F even dead = 1-5% S 5-25 (20) 5F, 50G	S = 10% even 40F 5-25 (5-10) 10G 5-25 (10-20) 5F, 30G
even 5-25 (20) 10F 30G 5-25 (20) 5F, 40G	Sever S S 5-25 (20) S 60F 30G 10% S 5-25 (20) 10F, 20G
5-25 even 10G 10-20 50F bare 5-25 (10-20) 10F, 20G	5-25 (10) bare 40F 10G 5-25 (10) 10F, 20G
bare even 5-25 10-20 OG 50F 5-25 (10) 30F, 20G	bare 10G 5-25 (10) 30F even 5-25 (10-20) 30F, 20G
even OG 5-25 (5-10) S 50F 5-25 (20) 20F, 30G	S S 10% S even 5-25 20G (15) S 5-25 (10-20) 40F, 30G

□ = 5%

good bit of plant buried

9B - fenced

5-25 3% S (25) S S even 80F 5-25 (20) 90F	25% S S even S 5-25 40F (20) 10G 5-25 (20) 80F
even small canyon 5-25 (25) 80F 5-25 (20-30) 90F	5% S S S even 5-25 40F (25) 40F 5-25 (20) 80F
even slope 25-50 (35) 80F 25-50 (30) 90F	even S bare 5-25 (10) 20F 5-25 (10) 50F
even 5-25 (25) 60F 3% S 25-50 (20-30) 90F	even 3% S 5-25 S (20) 40F bare 5-25 (20) 50F
even 25-50 (35) 40F 5-25 (20-30) 80F	5-25 (20) even 20F bare 5-25 (10-20) 50F
even 5-25 (20) 50F bare 5-25 (10-20) 70F	1-5 (3) 10F bare 1-5

□ = 35%

13 x 13

unfenced

inland
↑

10A

□ 220%

Even 5-25 (15) S 30F dead stems on line bunches = 30G no live grass 5-25 (10-20) 20F, 20G	bare 1-5 50F OG 5-25 (10-20) 10F, 10G	S 15% S S bare 1-5 40%F (3) 30G S 5-25 (10-20) 10F, 40G
bare S 5% S 1-5 (5) 50F OG bare 5-25 (10-20) 20F, 20G	even 5-25 (10-20) 40F OG 5-25 (10-20) 10F, 10G	even 5-25 (5-10) 10G 30F bare 5-25 (10-20) 10F, 30G
5-25 even (5-10) 10F OG 5-25 (10-20) 20F, 30G	even 5-25 (5-10) OG 10F 5-25 (10-20) 30F, 20G	5-25 even (10) OG 5F dead plants straw fully 5-25 (10-20) 40F, 10G

poor grazing evidence
on dead leaves
around a line clamp

13 x 13
fenced

10B

even 100% S S 5-25 (25) 20F 15G S 5-25 (20-30) 70F, 20G	25-50 (30-40) even 40F 10G 25-50 (20-30) 60F, 30G	25-50 (40) even 40F 10G 25-50 (20-30) 50F, 30G
25-50 (30-40) even 50F 5G some flow buried 5-25 (20-30) 60F, 30G	25-50 (40) even 10G 50F 25-50 (30) 50F, 10G	25-50 (40) even 70F 0G 5-25 (20-30) 40F, 20G
even 25-50 (30) 70F 0G bare bird 5-25 (20) 60F, 10G	even 5-25 (25) 90F 0G 5-25 (20) 60F, 5G	5-25 even (20) 70F 0G big low 5-25 (10) 30F, 10G

□ = 25% 20-25%

13 x 13
unfenced

11A

1905 S 5-25 (10) 156 50F even 5-25 (5-10) 30F 10G 5-25(10-20) 30F	5-25 (10) 156 50F even 5-25 (5-10) 30F 10G 5-25(20) 40F, 20G	S 5-10 90S even 5-25 (20) 30F 156 5-25(20) 50F, 20G
5-25 (15) 156 70F 5-25(5) 40F, 30G	2090S (5-10) SS 5-25 90F only old leaves grazed (20%) 5-25(10) 30F, 20G	1500S 5-25 (10) 50F 10G 5-25(10-20) 40F, 30G
S 5-25 (5-10) 60F 0G 5-25(10-20) 30F, 40G	5-25 (10) 80F Base 5-25(10-20) 20F, 40G	S 5-10 90F (25) old grass only (30%) 5-25(5-10) 10F, 20G

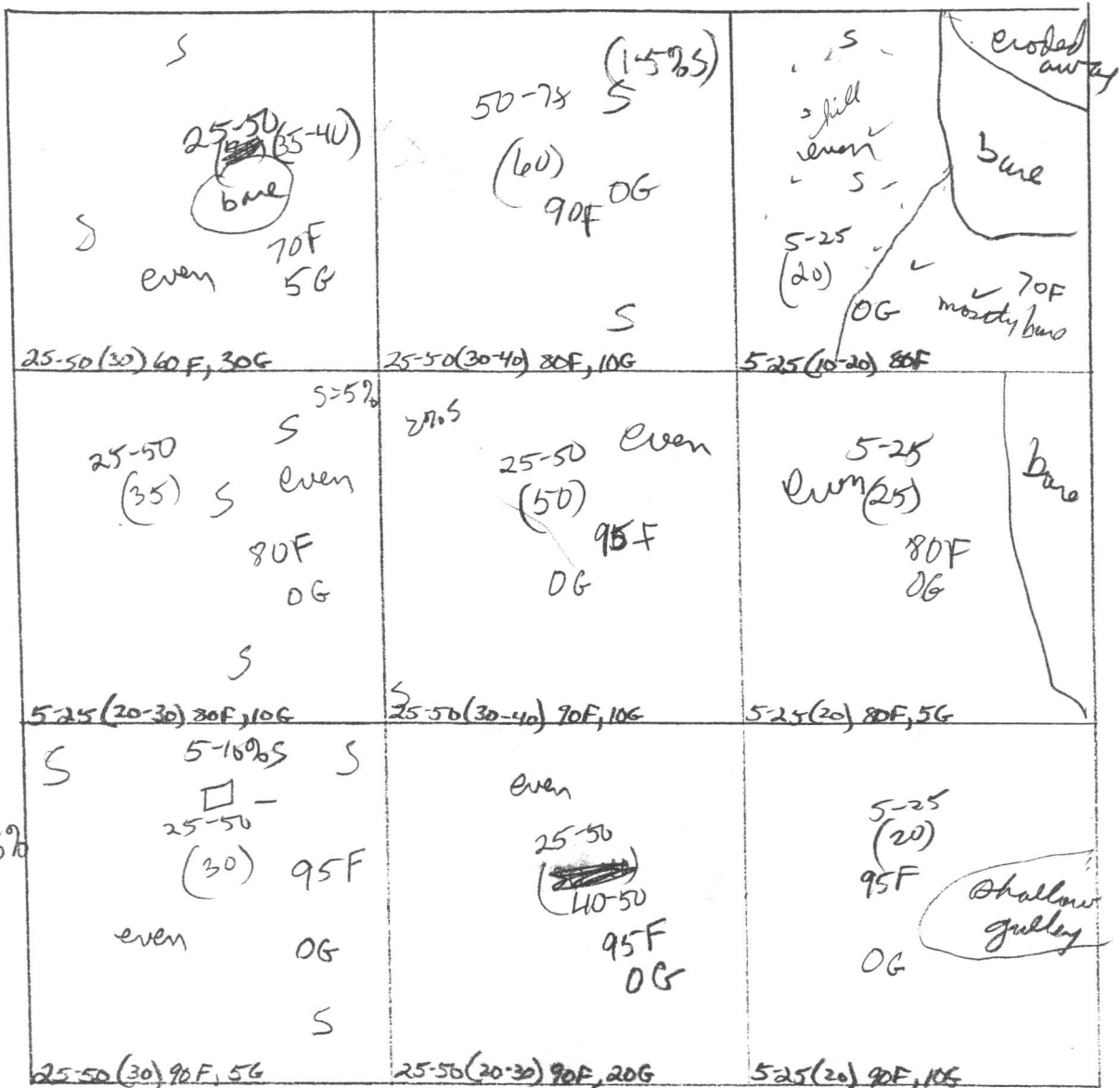
$$\square = 358$$

35

13 x 13

fenced

11B



□ = 45%

13 x 13

fenced

12A

lots of sand accum. over whole plot except NE corner - see photo #15

15+16
Roll 6

S 5-25 (5-10) 60F 0G 5-25 (5-10) 60F	S base approx 10% S 5-25 (10-20) 70F, 40G most flowers buried & think 30F 5-25 (5-10) 70F, 40G	15S even 5-25 (10-20) 70F, 40G most flowers buried & think 30F 5-25 (5-10) 70F, 40G	S (1-5) 25-50 (30-40) 90F 0G 5-25 (20) 80F, 10G
even 25-50 (25) 30F 0G flowers not fully emerged 25-50 (20-30) 80F, 20G	even 25-50 (40) 50F 25-50 (30-40) 90F, 20G	Even 25-50 (50) 80F 25-50 (30) 80F	
S 25-50 (30) 80F 0G 25-50 (3) 80F, 10G	even 25-50 (30) 60F 0G 25-50 (30-40) 80F, 20G	S 25-50 (40) 90F 25-50 (30) 80F, 10G Stop & Log	

see photo

marker to see
if sand
buried

occurs
in previous
plots

□ = 20%

flowers
much
longer
here (all
out of bar
where sand
has not
accum. &
not so
much of
plant bar
see photo

13 x 13
unfenced

12 B

mostly bare ✓ bare S 1-5 (3) 50F ✓ OG S ✓ ✓ ✓ 1-5 (5) 30F	even 5-25 (25) 50F	5-25 (20) gully 60F 5-25 (20-30) 40F
25-50 (30) even 70F 1G 25-50 (20-30) 20F	25-50 (35) even 80F OG 5-25 (20) 20F	25-50 (30-40) even 60F 25-50 (20-30) 30F
25-50 (40) even 80F 26 25-50 (30) 20F	even S 25-50 (40) 80F 26 5-25 (20-30) 20F	25-50 (40) even 90F OG 5-25 (20-30) 40F, 10G ended away

D = 25%

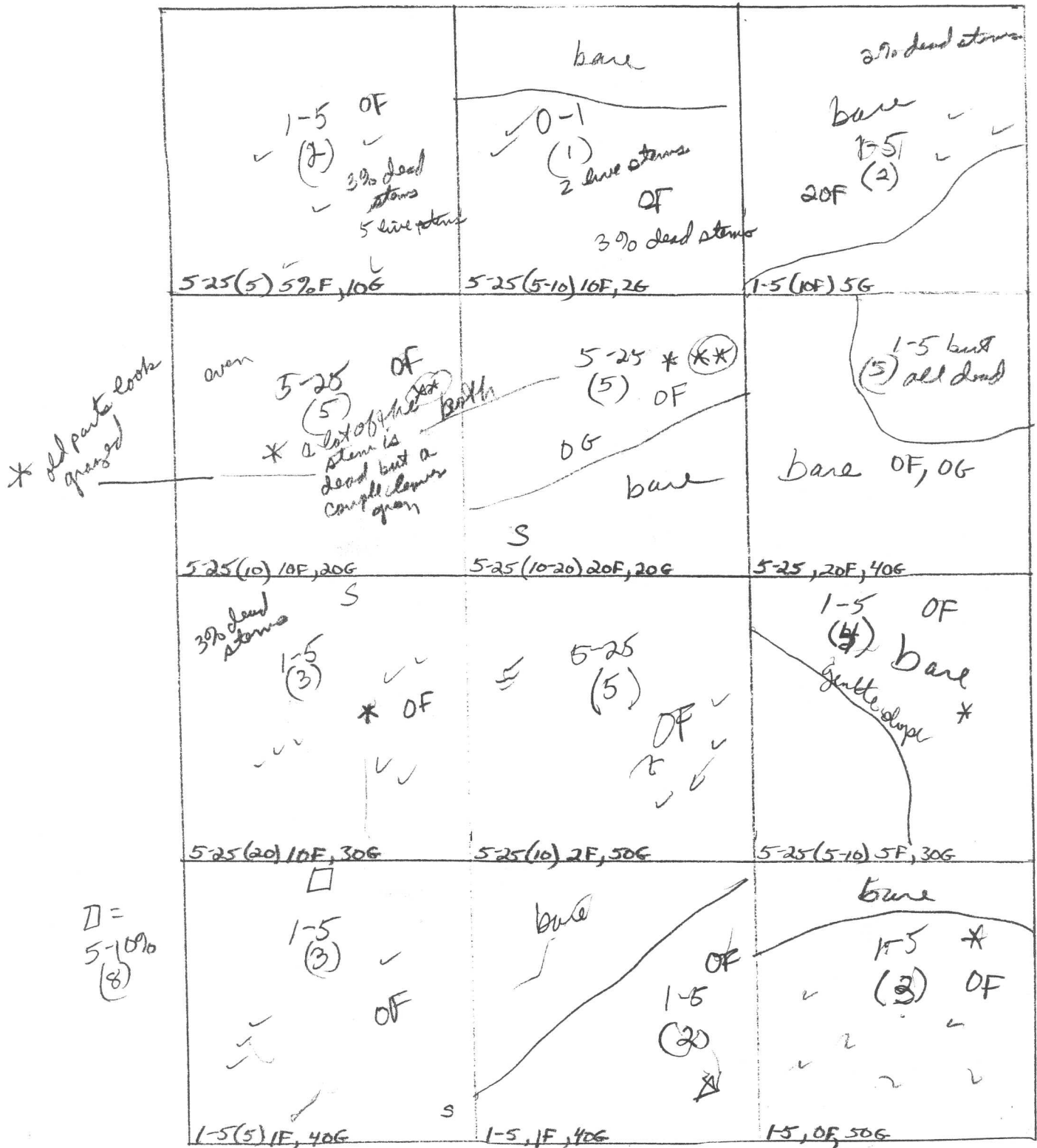
15 x 20 m
fenced

13A

0 0-1 (1)	5-25 (10-20) 40F bare 6G 5-25 (10-20) 30F bare	5-25 (5-10) 60F OG bare 5-25 (5) 60F
0 0	bare □ = 60% 6F even 5-25 (20) 5-25 (20) 30F	5-25 (20) even OG 10F □ = 10% 6 25-50 (20-30) 60F, 2G
bare 5-25 even 10-20 30F 5-25 (20) 40F, 5G	even 25-50 (25) 30F 25-50 (20-30) 40F, 2G	25-50 (30) even 40F OG 25-50 (30) 60F
25-50 (30-40) even 50F OG 25-50 (30) 40F, 1G	25-50 (30) even 50F 25-50 (20-30) 30F	25-50 (30) 25F even OG 25-50 (30) 40F, 5G

15 x 20 m
unfenced

138



15 x 20 m
unfenced

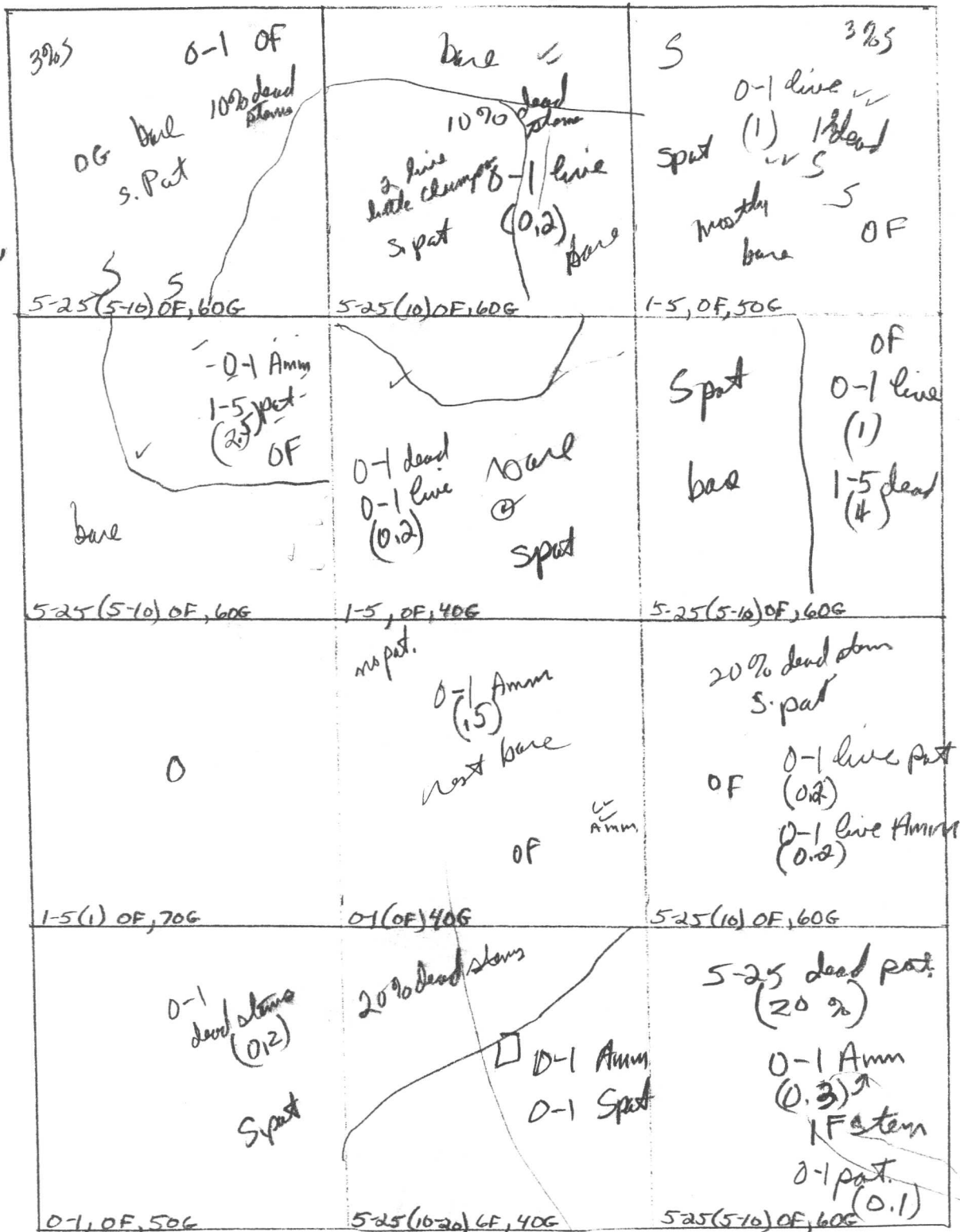
S.pat./Ammophila

14A

S. patens

DS = dead stems

all dead stems
broken off
a few in.
above
surface

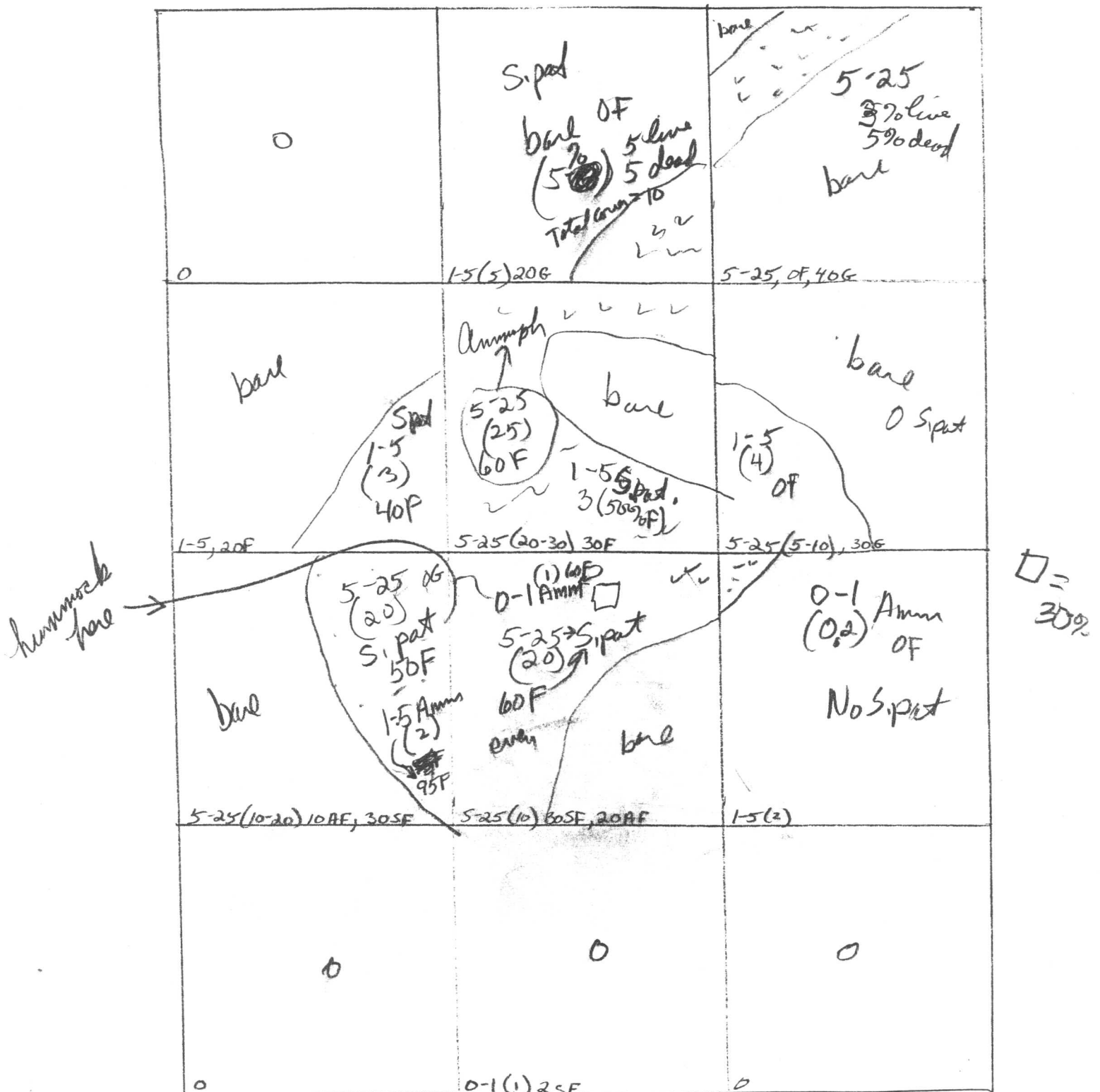


□ = 3%

15 x 20 m
fenced

S. patens

14B



SF = S. patens flowers
AF = Ammophila flowers

15A



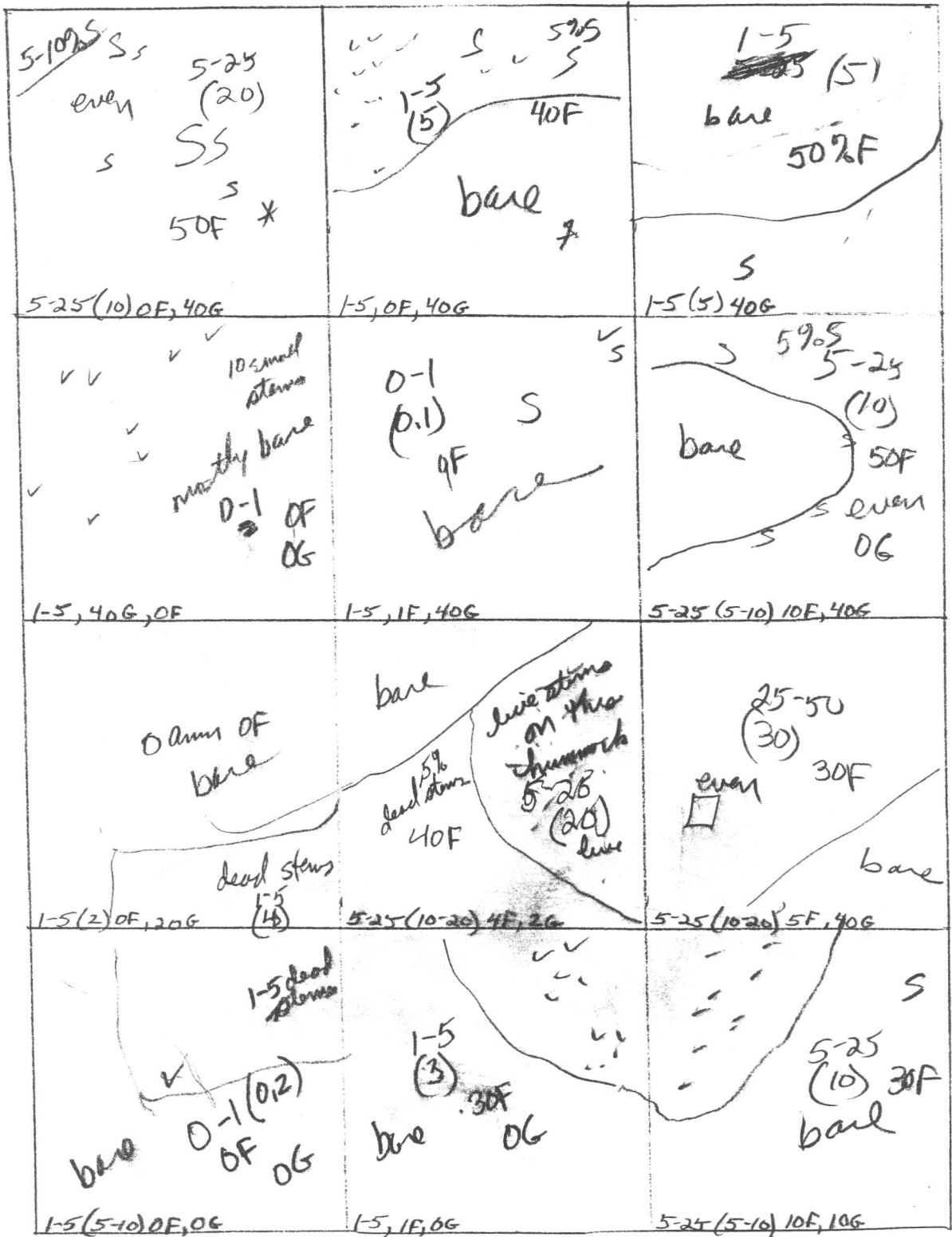
15 x 20 m

fenced

Ammophila
(w S. patens)

15B

* old stems
grazed

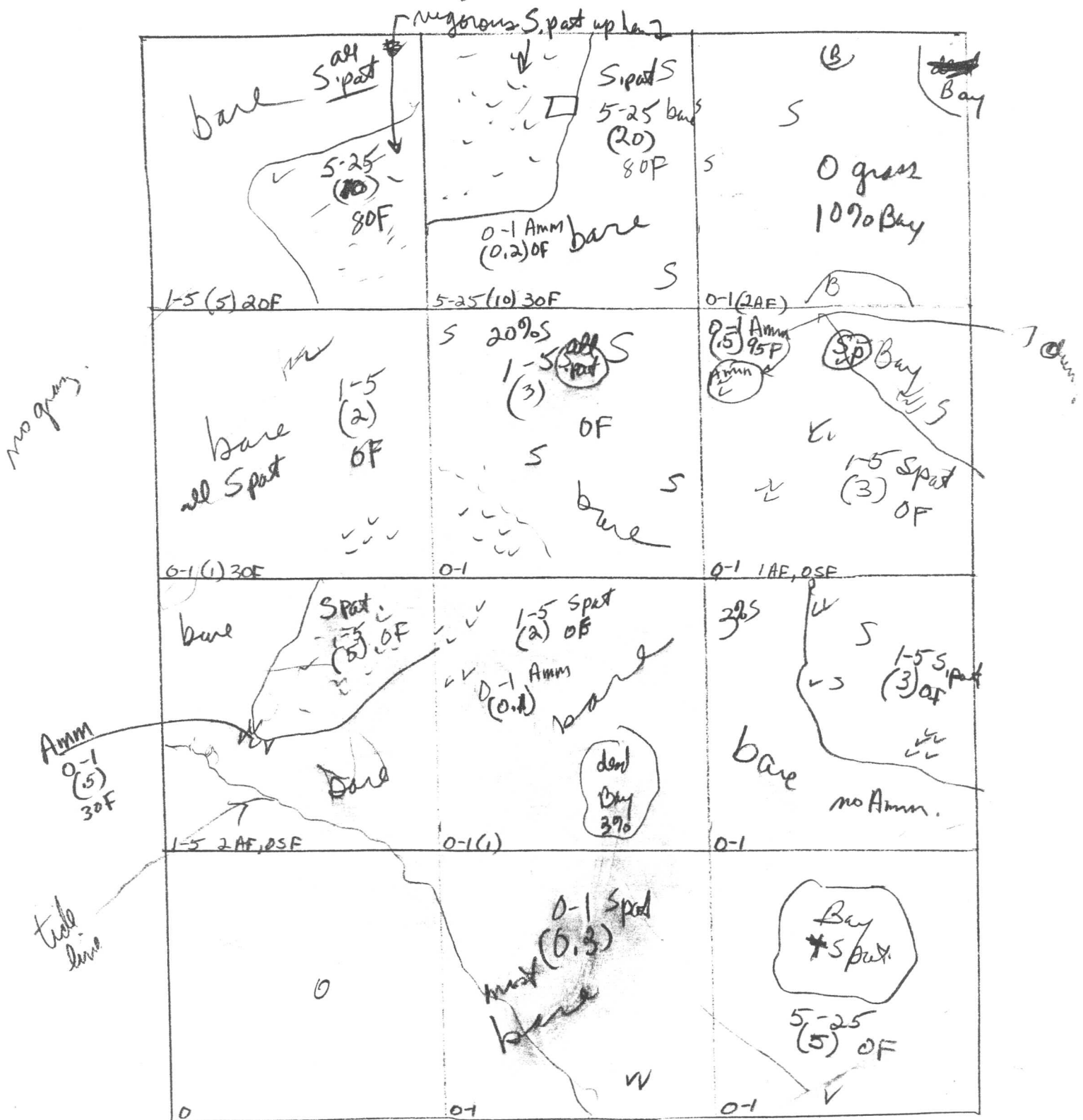


15 x 20 m

fenced

S. patens

16A

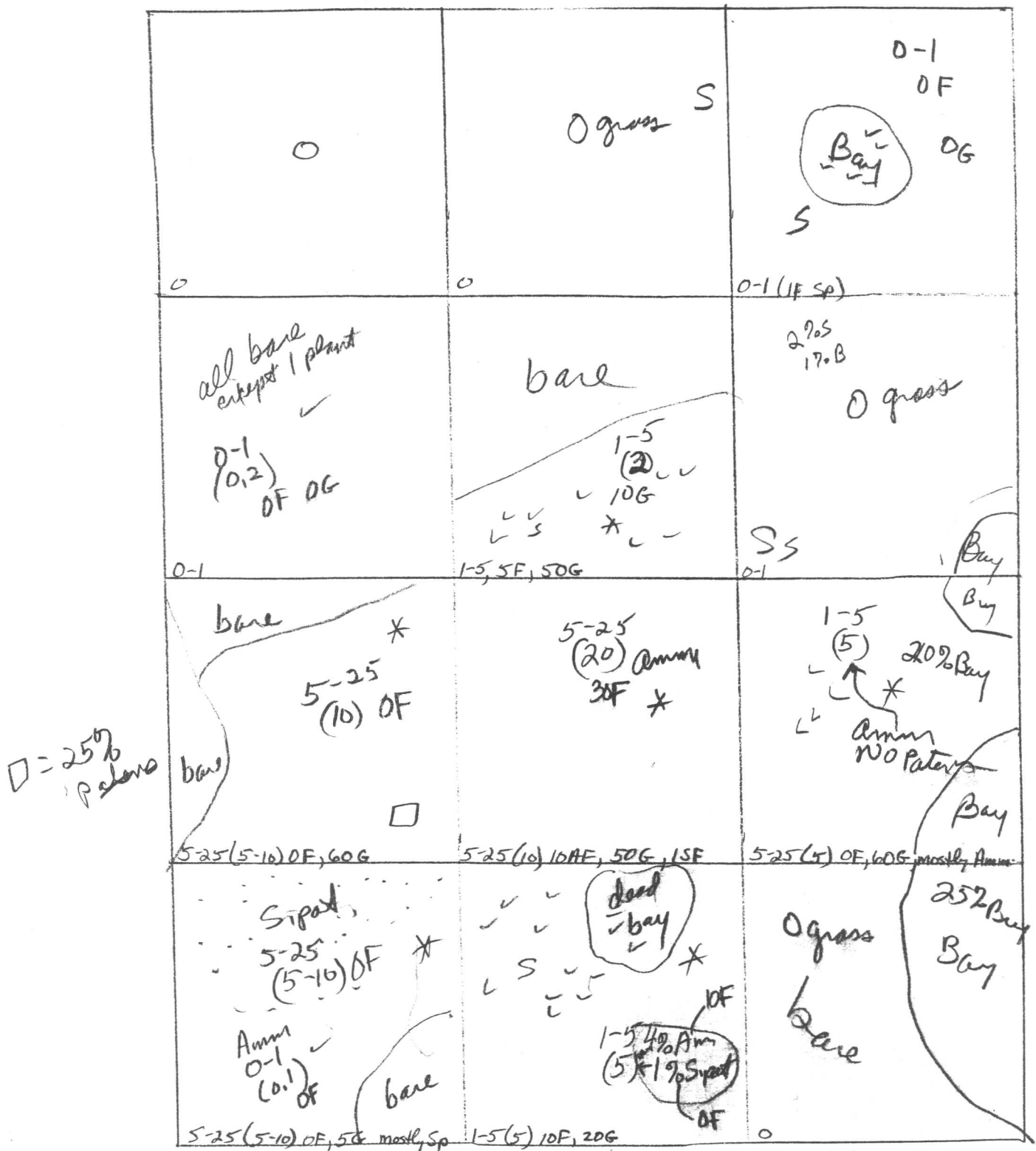


15 x 20 m

unfenced

A. patens

16B



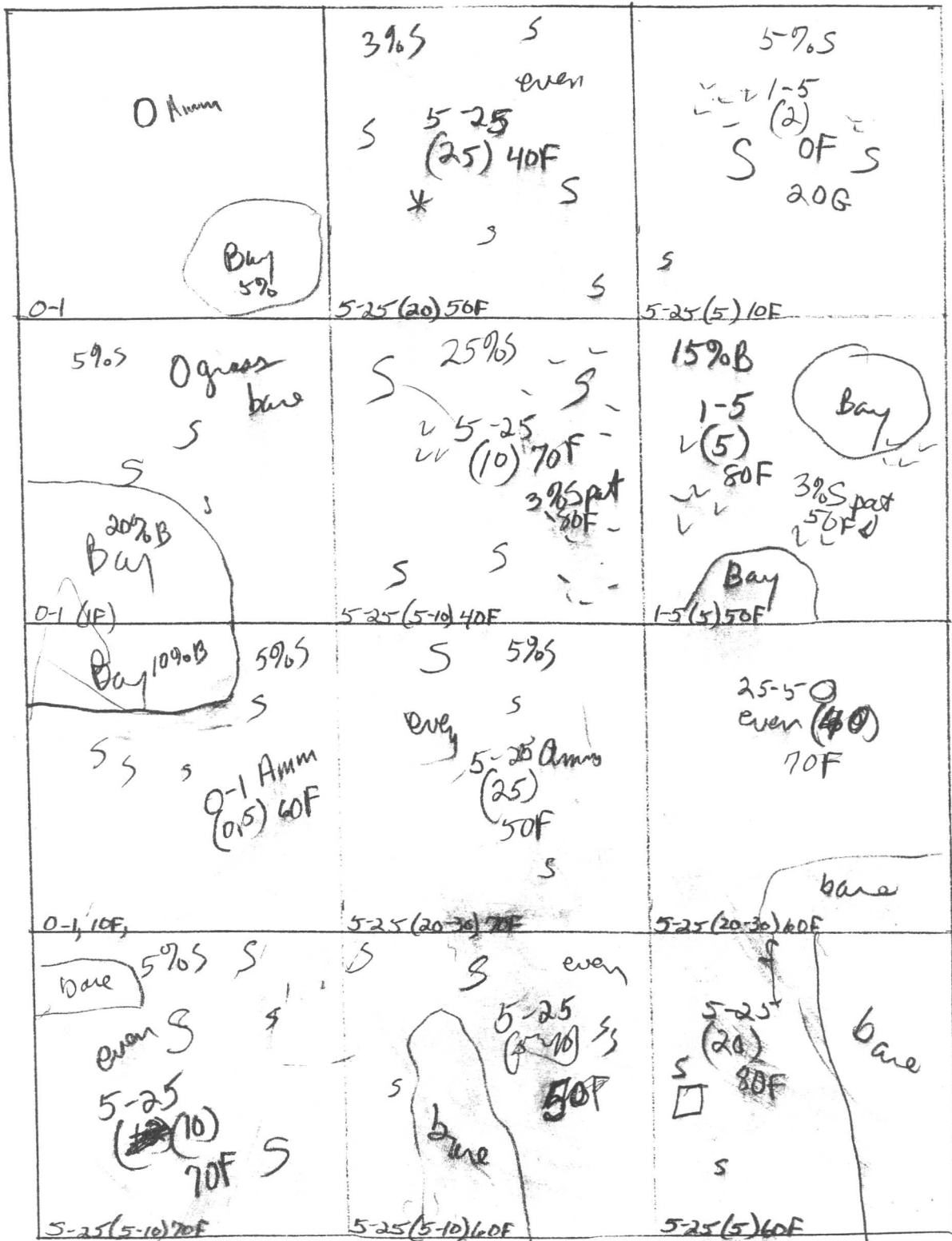
15 x 20 m

fenced

Ammophila

17 A

x dead leaves
grass only



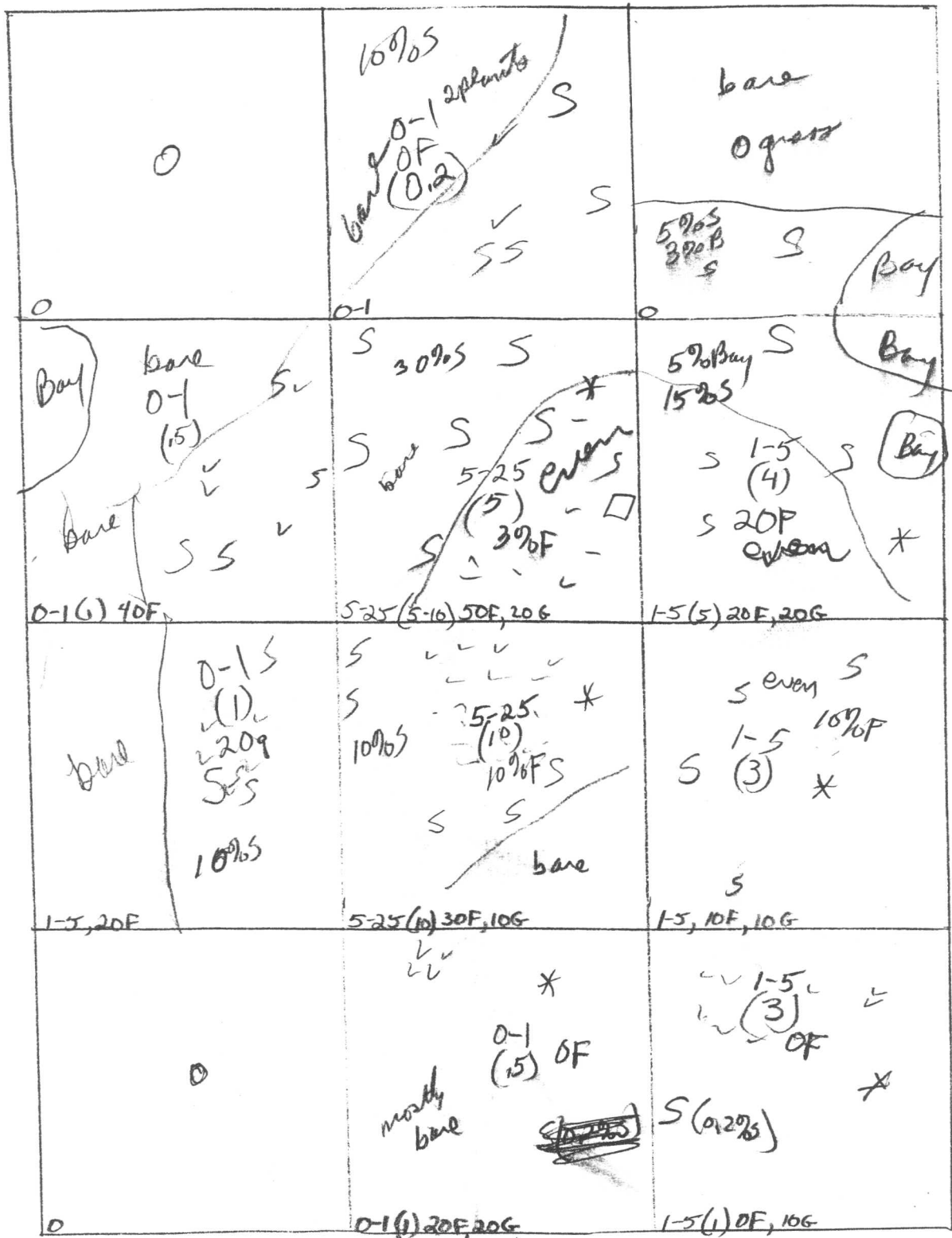
□ = 35

15 x 20 m

unfenced

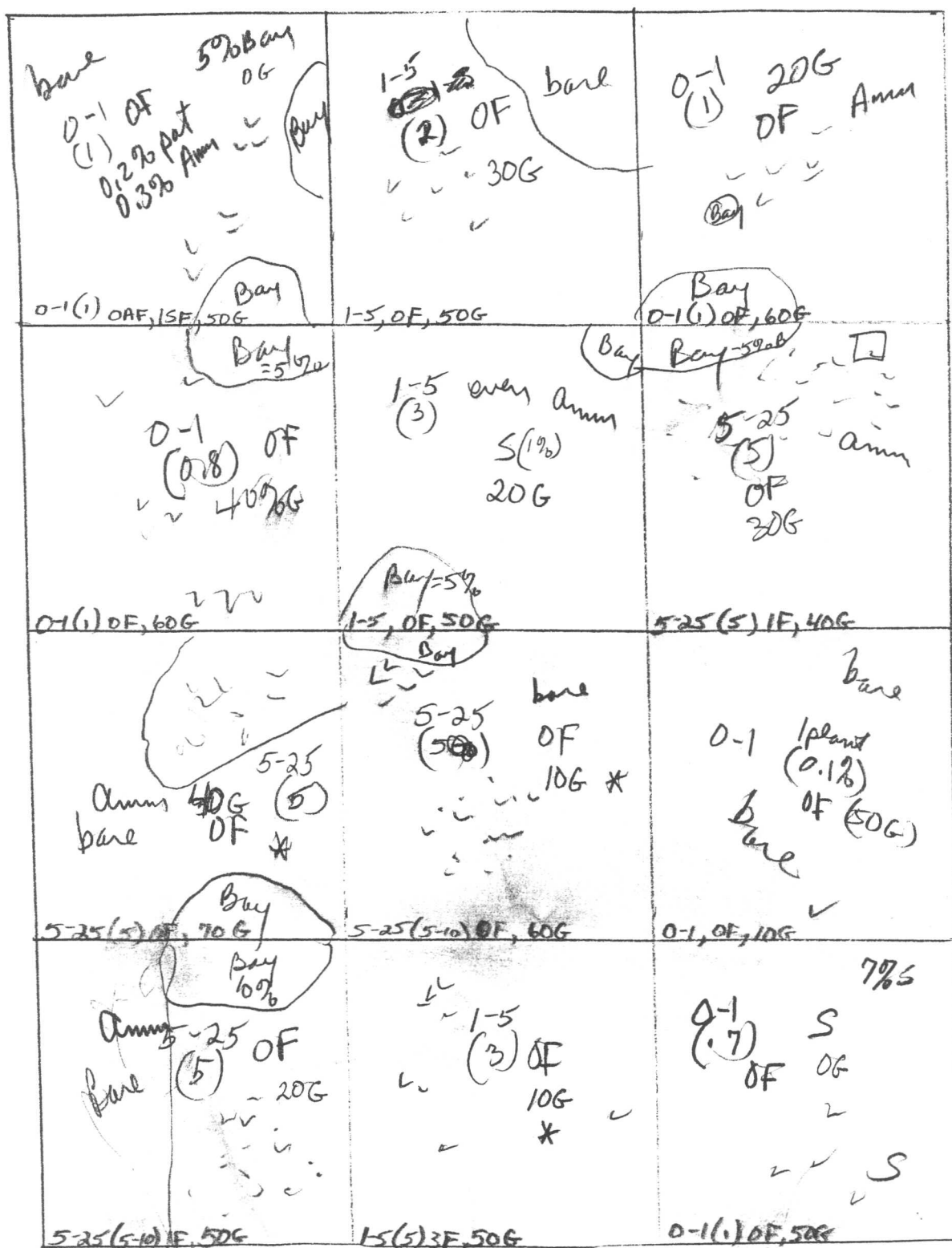
Ammophila

17B



15 x 20 m
unfenced

18A



Denise Seliskar's Data Sheets - September 1995

15 x 20 m
fenced

18B