Vegetation Survey of Herring Spawning Localities in Ganges Harbour, B.C.

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VEGETATION SURVEY OF HERRING SPAWNING LOCALITIES IN GANGES HARBOUR, B.C.

by

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ABSTRACT

Haegele, C. W. 1977. Vegetation survey of herring spawning localities in Ganges Harbour, B.C. Fish. Mar. Serv. MS Rep. 1433: 17 p.

The ability to accurately record and assess herring spawn depositions depends to a considerable degree on a knowledge of the vegetative substrate upon which the adhesive eggs are deposited. A map of the shoreline vegetation in Ganges Harbour and vicinity was prepared from aerial photographs of this region taken in July 1975. Just prior to the 1977 herring spawning season, an underwater survey of vegetation in Ganges Harbour was undertaken by divers to ground-check the map. The divers found a large amount of loose drifting vegetation in this area which would not have been distinguishable from rooted vegetation in aerial photographs. Also, in some locations the rooted vegetation was so sparse (as low as 1% cover) that it was either misidentified or missed altogether in interpreting the aerial photographs. In spite of these problems (which were probably unusually acute in this area) the vegetation map prepared from aerial photographs was generally accurate and provided a satisfactory basis for assessing the distribution and abundance of herring egg depositions.

Key words: Shoreline vegetation, Diving survey.

RÉSUMÉ

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Pour être en mesure de recenser avec exactitude les dépôts de ponte des harengs, il est nécessaire de bien connaître le genre de substrat végétal sur lequel viennent s'accrocher les oeufs. Une carte de la flore littorale du havre Ganges et des environs a été dressée d'après des photos aériennes prises en juillet 1975. En 1977, juste avant la saison du frai des harengs, une équipe de plongeurs a étudié la végétation marine du havre afin de vérifier les données de la carte. Ils y ont trouvé de grandes quantités de végétaux en suspension qui n'avaient pu être différenciés des plantes enracinées par la photographie aérienne. En outre, à certains endroits, les végétaux enracinés étaient si rares (ne couvrant que 1 % du fond marin) qu'ils avaient été mal identifiés ou n'avaient pas été recensés. En dépit de ces difficultés, sans doute plus sérieuses dans cette région qu'à l'ordinaire, la carte de la végétation dressée d'après les photos aériennes s'est révélée, en général, exacte et a servi de fondement fiable à l'évaluation de la distribution et de l'importance des dépôts d'oeufs de harengs.

Mots-clés: Flore littorale, étude en plongée.

INTRODUCTION

Pacific herring spawn predominantly on rooted vegetation in the littoral and upper sublittoral zone. To aid in locating, recording, and analyzing herring spawnings in British Columbia, shoreline vegetation maps of major spawning localities are being prepared at the Pacific Biological Station. These maps are prepared from aerial photographs and generally no ground-truth determination is carried out as part of the mapping. However, when opportunities present themselves, an attempt is made to evaluate the accuracy of these charts (Haegele 1975; Haegele and Humphreys 1976). The opportunity to ground-check a map in the Ganges Harbour set of vegetation charts (Haegele and Hamey 1976) arose in late February 1977 when a team of Pacific Biological Station herring investigators were sampling herring spawn in the area.

METHODS

AERIAL PHOTOGRAPHY AND MAPPING

Vertical aerial photographs of 24 × 24 cm format at a photo scale of 1:3600 were obtained for Ganges Harbour on July 9, 1975. Two types of film were used: Kodak Aerochrome Infrared No. 2443 with a medium yellow filter and Kodak Ektachrome MS Aerographic No. 2448. Standard photogrammetric procedures were used for preparing a map of the littoral and sublittoral vegetation in this area. Five major vegetation types (sea grasses, rockweed, red algae, brown algae, and green algae) were identified and mapped from a key based on colour which was developed for this purpose (Haegele 1975).

SURVEYING AND SAMPLING

Four transects roughly perpendicular to the shoreline were established, two each on the north and south shores of Ganges Harbour. A team of divers sampled along each transect, taking 1/4 m^2 or 1 m^2 samples. The position where each sample was taken was recorded by a shore crew using surveying techniques following procedures described by Humphreys and Haegele (1976). In addition to the sample and its location, the following information was obtained:

1. Bottom type -- one or more of the following:

Bottom types	Particle size	Code
Mud	< 0.02 cm	M
Sand	0.02 to 0.15 cm	S
Pebbles	0.15 to 6.0 cm	P
Cobbles	6.0 to 25 cm	C
Boulders	> 25 cm	B
Solid substrate	Rockshelf	R
Shells (usually bivalve)	Variable	s

2. Percent cover -- as percent of the total area within the sample quadrat covered by rooted vegetation.

3. Depth -- measured by tape from the surface and corrected to chart datum from Institute of Ocean Sciences tidal height printouts for Fulford Harbour.

SAMPLE PROCESSING

All samples of vegetation were sorted by species and weighed in the field laboratory. Species were identified using keys by Widdowson (1973; 1974) and Scagel (1967).

RESULTS

The location of sample transects are shown in Fig. 1, which is the vegetation map for the entrance to Ganges Harbour prepared from aerial photographs. The outlined sections around the transects were enlarged and the positions of sample stations identified (Fig. 2, 3, 4). The sample results for the four transects are shown in Tables 1-4 with the corresponding vegetation type identification from the aerial maps.

TRANSECT 1

At Transect 1, the width of the vegetated zone as determined from the aerial photographs (238 m) was confirmed by the diver survey. The outer 65 m of vegetation was typed from the photographs as red algae whereas the diving survey showed the red algae band to be somewhat wider (90 m). The dominant species of red algae were Gracilaria verrucosa and Neoagardhiella baileyi; percent cover 1% or less. Shoreward of the red algae, a band of Zostera marina was determined, from aerial photographs, to extend to within 30 m of the baseline, whereas the diving survey showed the inner edge to be 22 m from the baseline. However, from 38 m shoreward, the Zostera was found to be patchy with nearly half the bottom bare. Percent cover of the Zostera was in the range of 10-25% except in the inner patchy section where patches were at 50% and 70% cover. The Zostera was succeeded by a band of Fucus sp. with an average cover of 10%.

TRANSECT 2

Again, the determination of the width of the vegetated zone from the diver survey was identical to that from the aerial photographs (177 m). The map prepared from the photographs shows an outer zone of sea grasses from 177 to 100 m from baseline succeeded by red algae to 12 m with an inner band of green algae. The diving transect showed the rooted vegetation to be exclusively Zostera marina from the outer edge to 12 m from base, where it

was succeeded by Ulva sp. However, only the outer 50 m were of relatively uniform Zostera at percent cover from 20-40%. Beyond that, to the inner edge of the Zostera, percent covers of less than 1% (three stations) alternated with 20% and 25% cover. In addition, much loose material (detritus) consisting mostly of torn-up red algae was found intermixed with the Zostera. At the one station where the detritus was sampled, it had 27 times the biomass of the Zostera.

TRANSECT 3

The width of the vegetated zone at Transect 3 was 97 m by diving survey and 107 m from aerial photographs. The diving survey showed an outer zone of red algae surrounding a reef. This vegetation was typed as brown algae from photographs. An inner band of red algae succeeded by rockweed to 10 m from base was the same for the diving survey and for the photography. Between the two bands of algae, the photographs were interpreted as showing a bed of sea grasses, while the diving survey revealed bare bottom with the occasional patch of detritus, mostly red algae. The dominant red algae encountered in the transect samples were Constantinea subulifera and Prionitis lanceolata and cover was 25% for the outer band and 80% for the inner band.

TRANSECT 4

The width of the vegetated zone (47 m) at Transect 4 was again the same for the aerial photographs and for the diving survey. From the aerial photographs, three bands of vegetation were discerned -- an outer brown algae band succeeded by a red algae band, and an inner rockweed band. The three stations sampled by divers showed that the vegetation is very complex with red, brown, and green algae almost equally represented at all stations. Percent cover increased from the outer edge of vegetation inward from 25-80%.

Although there are some discrepancies between results from the aerial photographs and the diving survey, mapping from aerial photographs can be considered to be sufficiently accurate for herring spawn purposes.

On Transect 1, except for the slight vegetation boundary displacements, the vegetation typing from photographs was very good, especially considering the very low percent covers encountered. On Transect 2, the red algae band identified from aerial photographs was actually very sparse Zostera marina with an accumulation of detritus, mostly loose red algae. The problem here was that attached vegetation cannot be differentiated from vegetation drift on aerial photographs, especially when the rooted vegetation is at very low cover. On Transect 3, the outer algal zone was typed as brown algae while the diving survey showed it to be red algae. This is a recurrent problem and has two possible explanations. Firstly, it is difficult to distinguish brown algae from foliose red algae on film when they are under water since only texture can be used for typing. The colour typing from infrared photographs cannot be applied because of the rapid light attenuation of red wavelengths in water. Secondly, it is possible

that brown algae were present and dominant at the time of photography. The sea grass bed identified from the photographs on Transect 3 was probably an accumulation of detritus wrongly interpreted. The three distinct bands of vegetation identified from aerial photographs on Transect 4 probably accurately represent the dominant vegetation at the time of photography. The diving survey showed that the vegetation here was a thorough mixture of all types of algae.

DISCUSSION

Because of the amount of effort required, it is impractical to ground-check all of our vegetation mapping from aerial photographs by diving surveys. Spot checks such as the one carried out at Ganges Harbour are valuable in several ways. Besides establishing whether the aerial maps are sufficiently accurate, an increased awareness of potentials for error makes future mapping more accurate. Also, some ground-truth work in an area mapped gives an indication of the species composition of the vegetation types and information on percent cover.

Errors in mapping vegetation from aerial photographs appear to be on a sufficiently small scale that the assessment of the distribution and abundance of herring egg depositions is not affected. Information on percent cover of the vegetation will have to be obtained in the field during the annual herring spawn surveys by Fisheries and Marine Service personnel as this information cannot be extracted from aerial photographs.

ACKNOWLEDGEMENTS

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1974. The marine algae of British Columbia and northern Washington: revised list and keys. Part II. Rhodophyceae (red algae). Syesis 7: 143-186, Fig. 1-8.

Table 1. Sample data for Transect 1. Distance is from base of transect, depth is corrected to chart datum, and bottom type is according to code in text table.

Station	Dist. (m)	Depth (m)	Bottom type	% Cover	Vegetation species	Biomass (g/m^2)	Vegetation type: Diving	Vegetation type: Aerial mapping
1	238	-4.0	MSPC	< 1	Gracilaria verrucosa Neoagardhiella baileyi Pikea californica	4 2 1	Red algae	Red algae
2	212	-3.5	MSPs	1	Neoagardhiella baileyi Gracilaria verrucosa	118 35	Red algae	Red algae
3	174	-2.4	SPCs	< 1	Gracilaria verrucosa Neoagardhiella baileyi Ulva sp.	50 24 91	Red algae	Red algae - Sea grasses Interface
4	145	-1.4	MSPCs	5	Zostera marina Neoagardhiella baileyi Gracilaria verrucosa	100 82 6	Red algae - Sea grasses Interface	Sea grasses
5	126	-1.2	MSPC	10	Zostera marina	235	Sea grasses	Sea grasses
6	108	-0.7	SPCs	10	Zostera marina	114	Sea grasses	Sea grasses
7	90	-0.4	SPs	20	Zostera marina	327	Sea grasses	Sea grasses
8	72	-0.1	SPs	25	Zostera marina	288	Sea grasses	Sea grasses
9	54	+0.4	SPs	20	Zostera marina	300	Sea grasses	Sea grasses
10	38	+0.8	Ss	50	Zostera marina	203	Sea grasses (patchy)	Sea grasses
11	22	+1.1	Ss	70	Zostera marina	314	Sea grasses (Inner edge)	Bare

Table 1 (cont'd)

Station	Dist. (m)	Depth (m)	Bottom type	% Cover	Vegetation species	Biomass (g/m^2)	Vegetation type	
							Diving	Aerial mapping
12	8	+1.7	BR	10	Fucus distichus	1428	Rockweed	Rockweed
Baseline	0	-	BR	-	Fucus distichus	-	Rockweed (Inner edge)	Rockweed (Inner edge)

Table 2. Sample data for Transect 2. Distance is from base of transect, depth is corrected to chart datum, and bottom type is according to code in text table.

Station	Dist. (m)	Depth (m)	Bottom type	% Cover	Vegetation species	Biomass (g/m^2)	Vegetation type	
							Diving	Aerial mapping
1	177	-1.8	Ss	25	Zostera marina	188	Sea grasses	Sea grasses
2	152	+0.4	Ss	40	Zostera marina	786	Sea grasses	Sea grasses
3	132	+0.8	Ss	20	Zostera marina	416	Sea grasses	Sea grasses
4	108	+1.0	Ss	< 1	Zostera marina	23	Sea grasses	Sea grasses
5	86	+1.1	Ss	20	Zostera marina	150	Sea grasses	Red algae
6	66	+1.2	Ss	< 1	Zostera marina Detritus (Red algae)	36 984	Sea grasses	Red algae
7	45	+1.3	Ss	25	Zostera marina	322	Sea grasses	Red algae
8	21	+1.6	Ss	< 1	Zostera marina	128	Sea grasses	Red algae
Baseline	0	-	SP	-	Ulva sp.	-	Green algae (Inner edge)	Green algae (Inner edge)

Table 3. Sample data for Transect 3. Distance is from base of transect, depth is corrected to chart datum, and bottom type is according to code in text table.

Station	Dist. (m)	Depth (m)	Bottom type	% Cover	Vegetation species	Biomass (g/m^2)	Vegetation type	
							Diving	Aerial mapping
1	107	-3.8	R	25	Prionitis lanceolata	28	Red algae	Brown algae
					Constantinea subulifera	21		
					Gigartina sp. (juv.)	5		
					Gigartina papillata	2		
					Ceramium rubrum	1		
					Rhodymenia sp. (juv.)	1		
					Ulva sp.	1		
2	93	-0.6	R	25	Prionitis lanceolata	73	Red algae	Brown algae
					Rhodymenia pertusa	2		
3	22	-0.9	R	80	Constantinea subulifera	186	Red algae	Red algae
					Prionitis lanceolata	170		
					Laminaria sp. (frag.)	130		
					Ulva sp. (frag.)	1		
-	10	-	R	-	Fucus sp.	-	Rockweed (Inner edge)	Rockweed (Inner edge)

Table 4. Sample data for Transect 4. Distance is from base of transect, depth is corrected to chart datum, and bottom type is according to code in text table.

Station	Dist. (m)	Depth (m)	Bottom type	% Cover	Vegetation species	Biomass (g/m^2)	Vegetation type	
							Diving	Aerial mapping
1	47	-2.3	R	25	Laminaria sp. (holdfast)	34	Mixed algae	Brown algae
					Laminaria sp. (juv.)	2		
					Costaria costata	1		
					Constantinea subulifera	8		
					Sarcodiotheca furcata	8		
					Gigartina sp. (juv.)	3		
					Rhodymenia sp. (frag.)	1		
					Cladophora sp.	14		
					Ulva sp. (frag.)	4		
2	32	+0.2	R	50	Ulva sp.	103	Mixed algae	Red algae
					Cladophora sp.	43		
					Derbesia marina	29		
					Gigartina exasperata	78		
					Rhodymenia pertusa	14		
					Prionitis lanceolata	8		
					Sargassum muticum	49		
3	22	+0.7	CBR	80	Derbesia marina	448	Mixed algae	Red algae - Rockweed Interface
					Ulva sp.	18		
					Fucus distichus	133		
					Gigartina papillata	70		
-	0	-	R	-	Fucus sp.	-	Rockweed (Inner edge)	Rockweed (Inner edge)

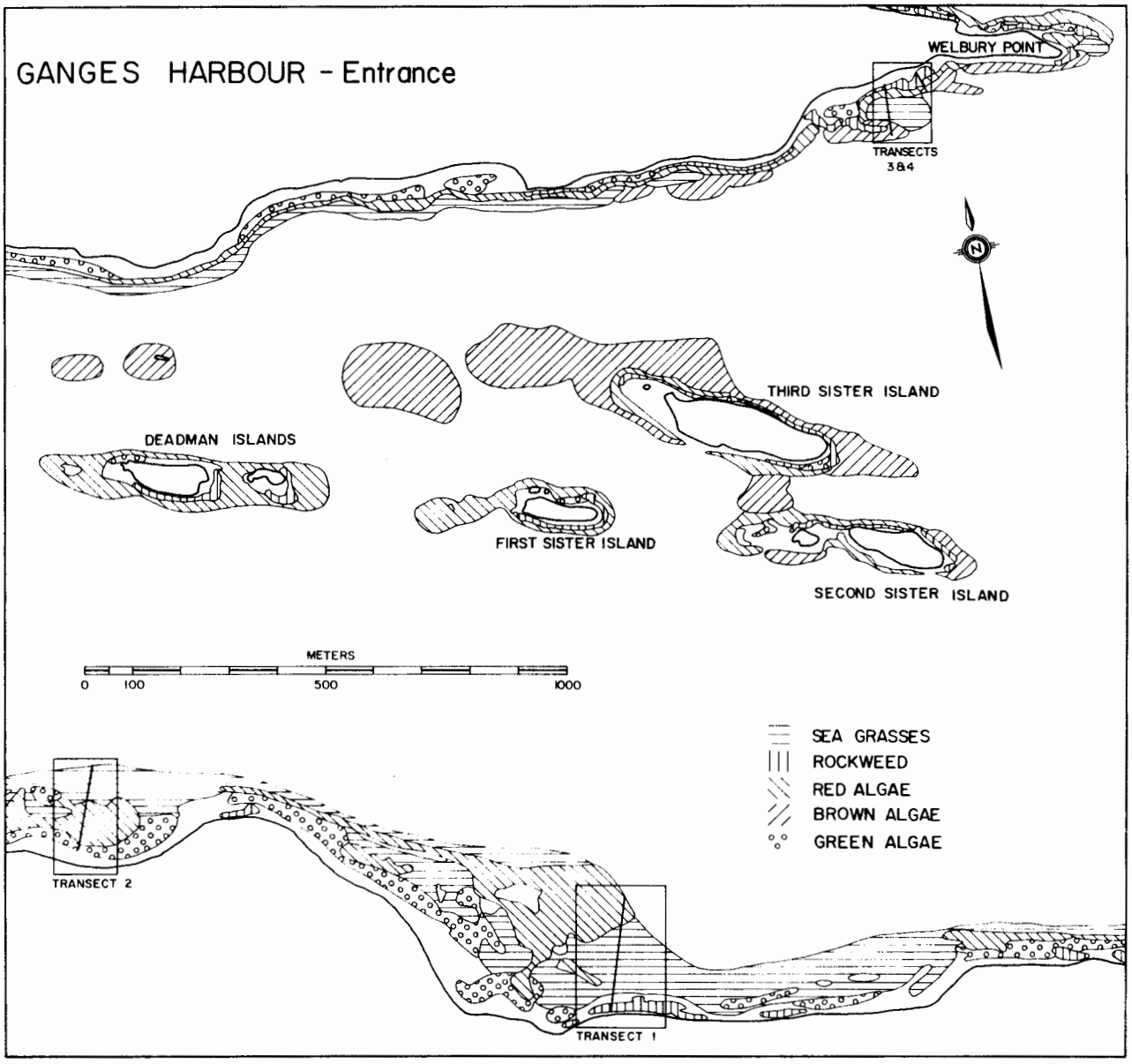

Fig. 1. Vegetation map prepared from aerial photographs of the entrance to Ganges Harbour, showing diving transects. Outlined rectangular areas show boundaries of Fig. 2, 3, 4.

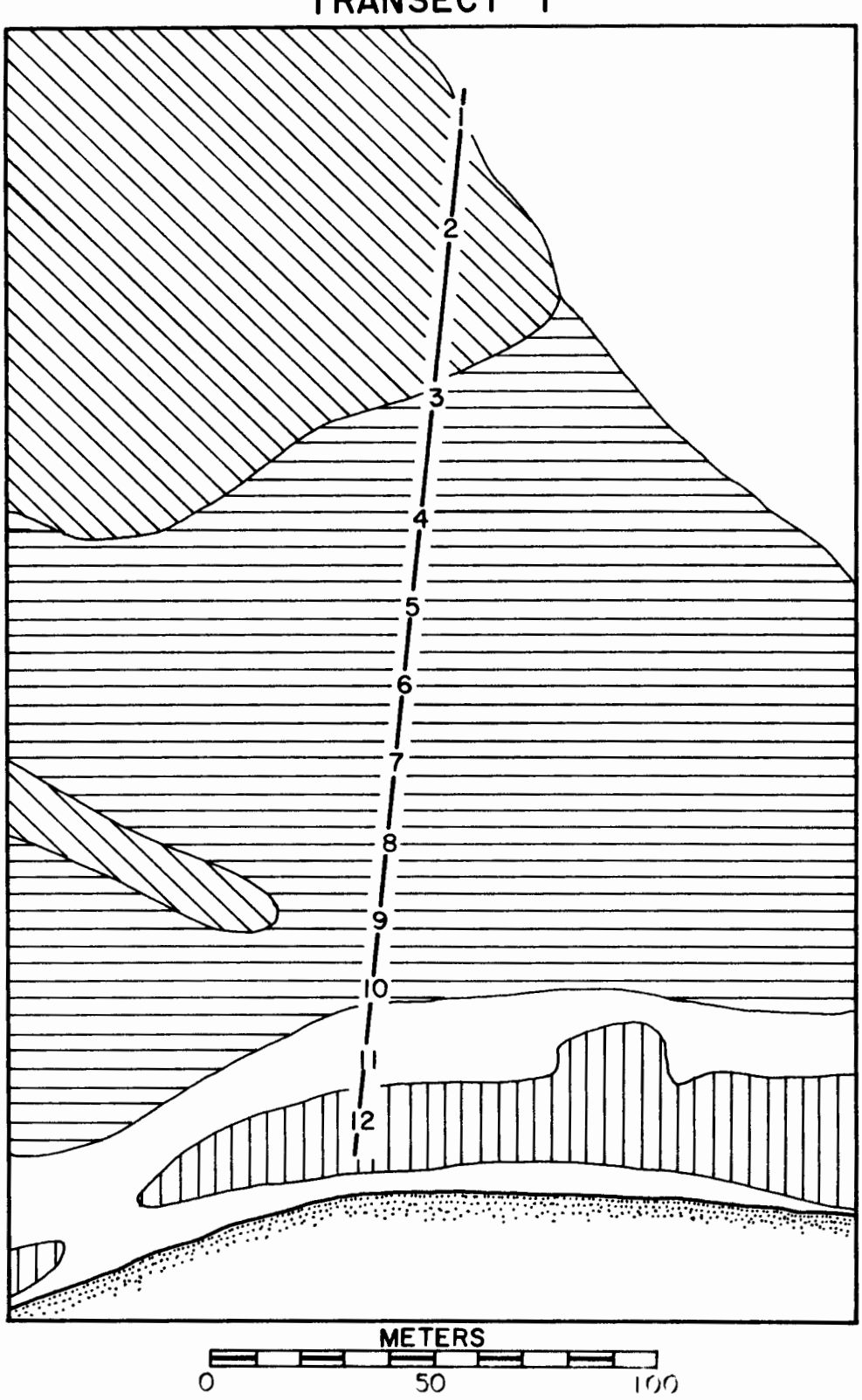

Fig. 2. Vegetation zones as identified from aerial photographs at Transect 1. Numbers indicate sample station locations. For key to hatching see Fig. 1.

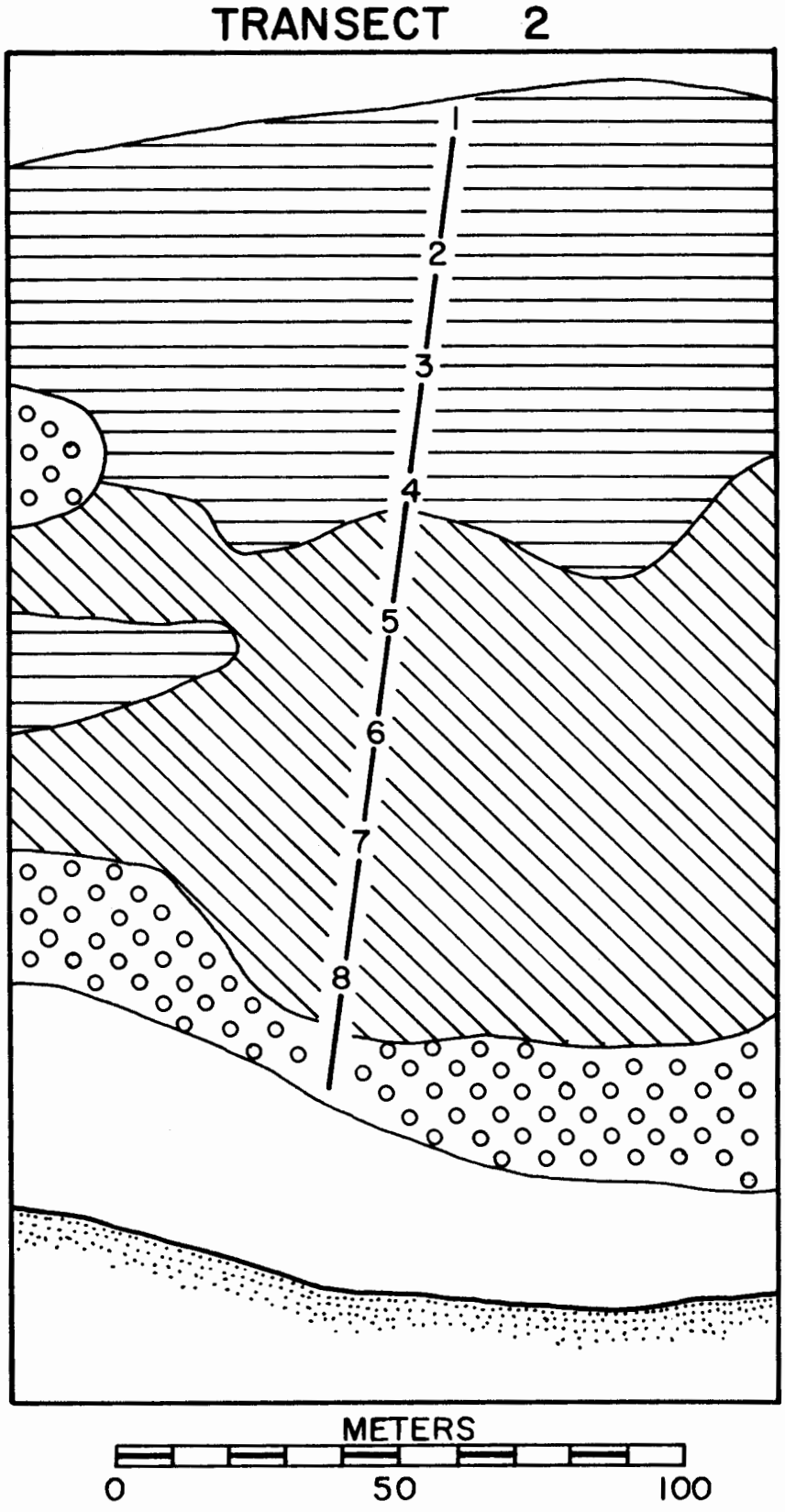

Fig. 3. Vegetation zones as identified from aerial photographs at Transect 2. Numbers indicate sample station locations. For key to hatching see Fig. 1.

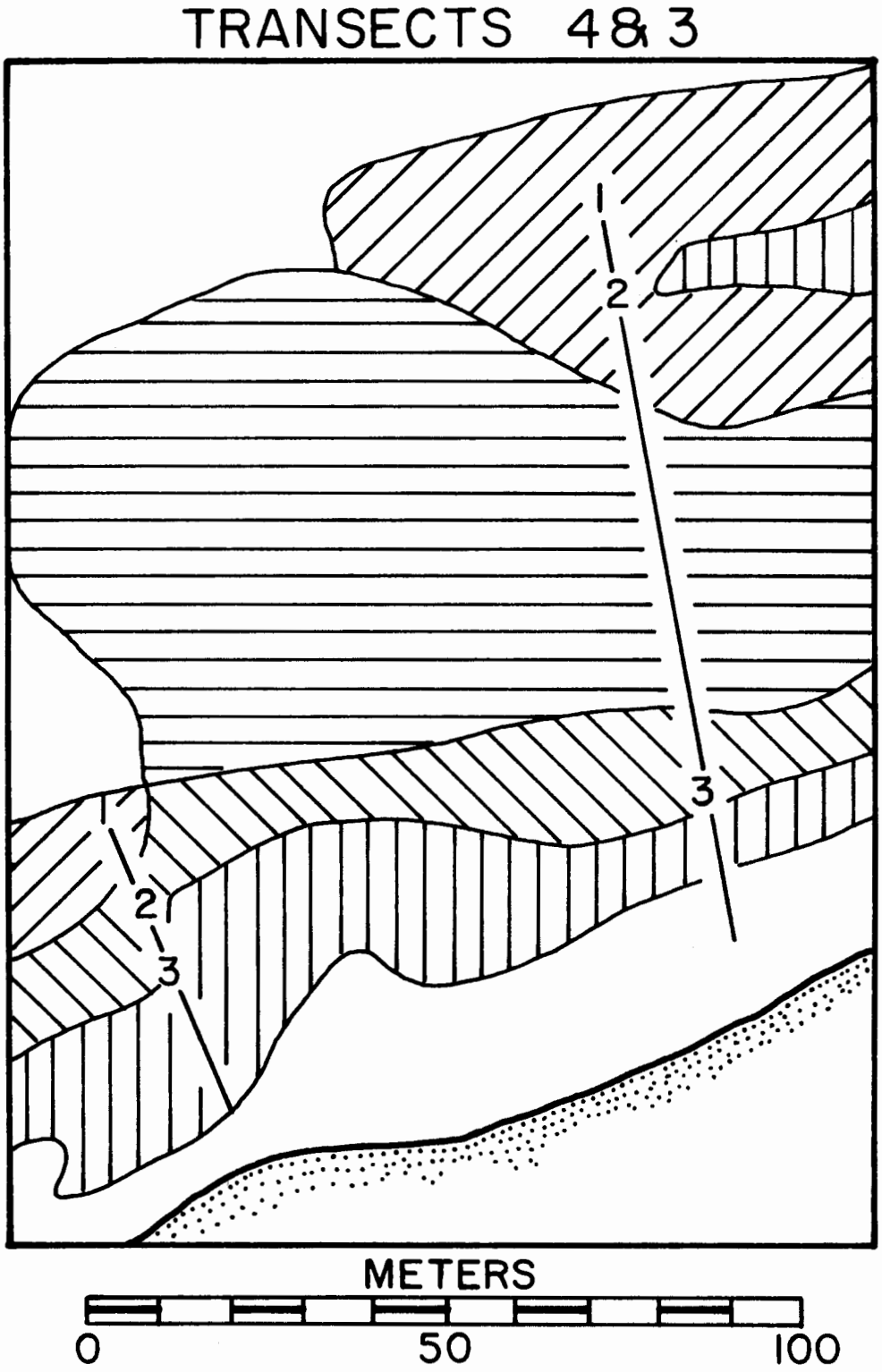

Fig. 4. Vegetation zones as identified from aerial photographs at Transect 3 (right) and Transect 4 (left). Numbers indicate sample station locations. For key to hatching see Fig. 1.