

WORKSHEET 2 : SITE JUDGEMENT.

Following the initial identification of a wetland area using the methods outlined in Worksheet 1 ie) using maps, aerial surveys and aerial photographic interpretation and previous literature, the next stage is to visit the area in order to continue a detailed evaluation.

The first stage of an on-site visit is to identify the structure of the area with regard to the evaluation of the area for waterbirds, vegetation and zoo-benthic biomass (see worksheets 6,8,9 and 12).

This process involves initially identifying the following features:-

1. If the area is tidal how will the state of the tide effect the field evaluation of the site ie) ease of access - by boat, by foot etc. How will the tidal regime effect the distribution of the waterbirds at the site ?
 - study the tide tables prior to an on-site visit.
2. Is the area used by waterbirds ? If yes :-
 - as a roost site during high tides ?
 - as a foraging area during low tide ?
 - both ?
3. How does the structure of the wetland affect the ease with which it can be evaluated ?
 - a. the effect of the tidal regime with regard to site access (see part 1.)
 - b. the effect of the tidal regime to methods of evaluation (see Worksheet 3)
 - c. the effect of the tidal regime to times at which evaluation is possible ie) daylight hours - dawn, dusk or midday.
 - d. the presence of physical topographical features within the wetland which may affect the ease of evaluation :-
 - restricted view over the wetland due to bunds, hillocks, trees etc.
 - deep channels to cross in order to cover the whole area.
 - deep soft mud.

- a large area to cover.
- restricted access ie. military zone, airport, private land.

The wetland may be viewed from a static vantage point such as a nearby hillock, sand-dune, tree hide, tower etc. to avoid disturbance to waterbirds and other wildlife on-site. If the survey area is large or cannot be easily and effectively viewed from one or two vantage points it is necessary to walk through the area in order to assess waterbird numbers. In situations where the birds are very often obscured from the observer an effective method of assessing the numbers present is to walk through an area and disturb the waterbirds so they can be counted in flight as they fly to another area in the wetland. This method is particularly effective in situations such as saltpans where birds are hidden by small bunds between the pans.

NOTES:

WORKSHEET 3 : USE OF TIDE TABLES

It is very important to study tide tables prior to or site evaluation.

- to determine the most productive time during one day at which to evaluate a site.

Which tide is ⁿ necessary ^a for which assessment technique?

High Tide

- to count Roosting shorebirds
- to enable access by boat to areas unapproachable on foot ie) nesting colonies on mangrove islands, shallow mangrove creeks.

Low Tide

- to count foraging shorebirds
- to evaluate mangrove vegetation
- to conduct zoobenthic bioman^{SS} sampling
- for general wetland assessment

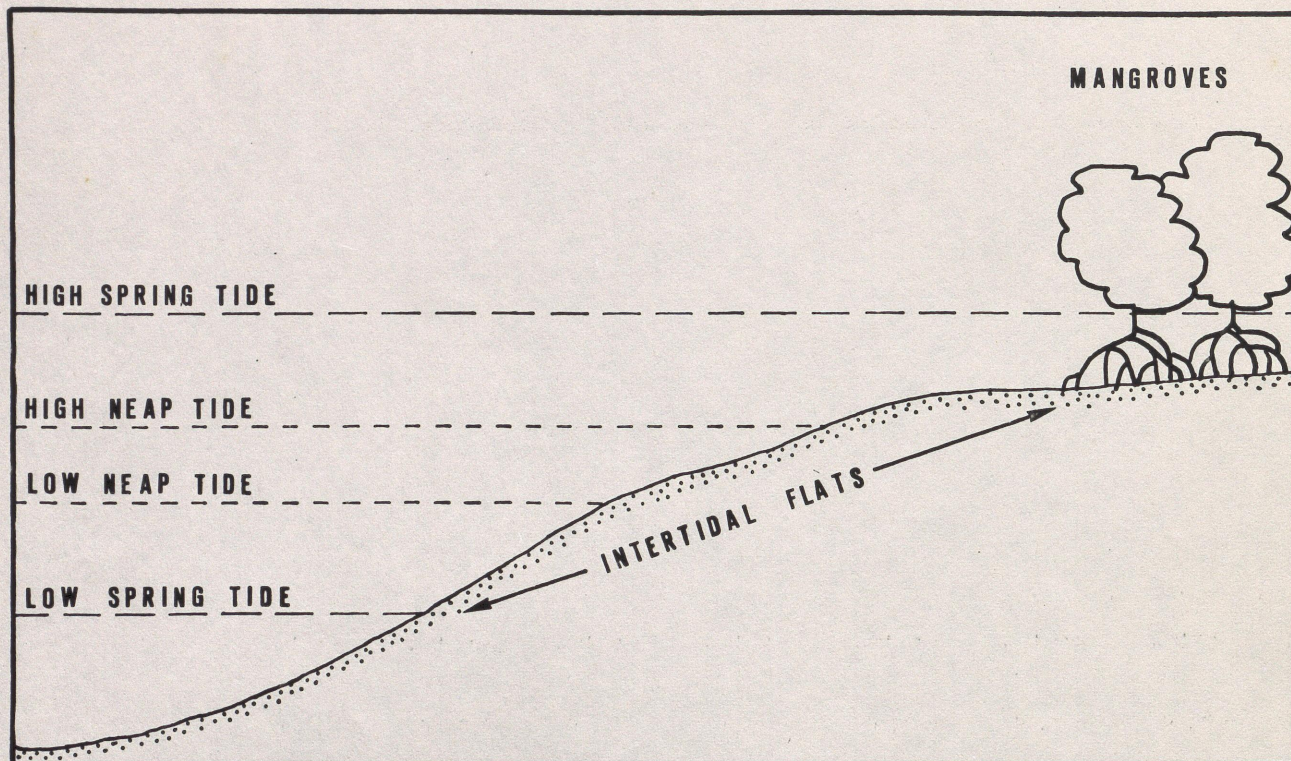
It can be seen that Low Tide is generally more useful when evaluating a tidally influenced wetland than high tide. Access to an area on foot allows a lot more mobility than moving by boat. Foot surveys are ⁿ necessary ^{ss} when conducting mangrove plots, counts of waterbirds over large intertidal flats or through areas where birds may be hidden ie) behind bunds etc.

- To determine the most productive period during the month in which to evaluate a site. This is always dependant on the cycle of 'Spring and Neap' tides.

'Spring' tides occur shortly after the new and full moons. During 'Spring' tides the rise and fall of the water is at its greatest. This means that at low Spring tide there will be more intertidal flat exposed ^d tide the water will reach its highest limit up the intertidal flats. *highest in the high*

Neap tides occur during the period half way ^y between the 'Spring' tides. During a Neap tide there is the minimum rise and fall of water, this means that at low Neap tide there is little intertidal flat exposed and during high Neap tide the water will rise only a short way - ^{us} ~~there~~ some foraging substrate may be continually exposed.

(See Diagram 1).



What are the advantages and disadvantages of Spring and Neap tide.

a) Spring Tides

- At Low Tide provide the largest area of foraging substrate for waterbirds .
- Enables longer periods of evaluation time to be spent studying the intertidal areas at the wetland.
- At high tide the inundation of water forces birds to fly to high tide roost sites.
- At high tide allows close approach to the seaward mangrove fringe in a boat.

b) Neap Tides.

- At low tide provide little foraging area for waterbirds.
- At high tide enable birds to feed in small areas of exposed intertidal flats.
- At high tide birds are not forced to fly to high tide roost sites.
- During both high and low tide ^{it} prevents close approach to mangroves by boat.

~~During the~~

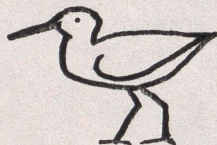
- During the complete tidal cycle allows longer periods of time to be spent evaluating the vegetation ie) conducting Mangrove vegetation plots.

To determine the state of the tide on any particular day see information sheet 4 - How to use Tide Tables.

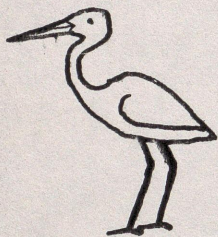
NOTES:

WORKSHEET 4 : IDENTIFICATION OF WATERBIRD SPECIES.

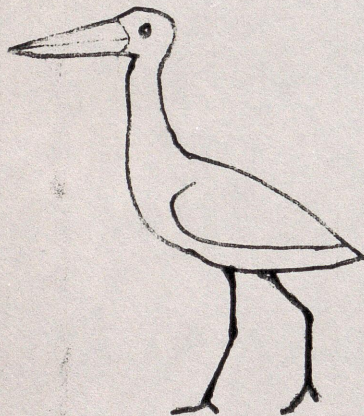
Generally waterbirds can be divided into 4 groups :-



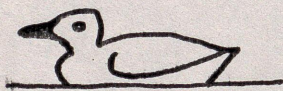
SHOREBIRDS - small, short legged with either a long bill or a short bill.



^EHERONS and EGRETS - large, white or grey with large sharp bill and long legs.



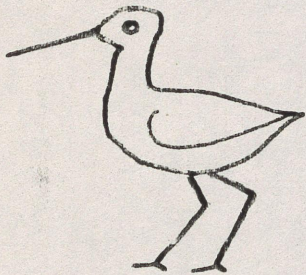
STORKS - very large with a massive bill and very long legs.



DUCKS - swimming on water, medium sized
GEESE - larger.

Shorebirds can be divided further into 5 groups :-

Large Sandpipers / Godwits / Shanks / Snipe / Dowitcher

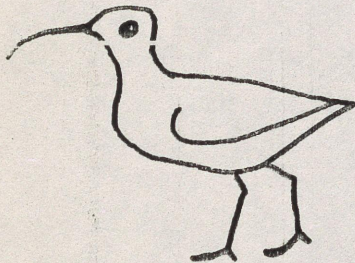


Medium - Large sized

Long bill, long legs, small eye.

EXAMPLES :

Curlews / Whimbrels



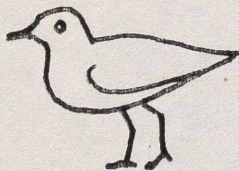
Medium - Large sized

Brown colour, long decurved bill, small eye.

EXAMPLES :

Plovers.

Small - medium sized

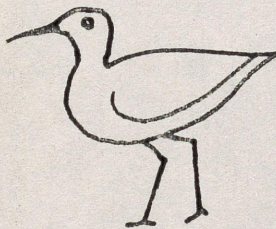


Short, thick bill, large eye.

EXAMPLES :

Small Sandpipers.

Small sized



Medium length bill which can be slightly downcurved, upcurved or straight. Small eye.

EXAMPLES :

Stints.

Very small sized



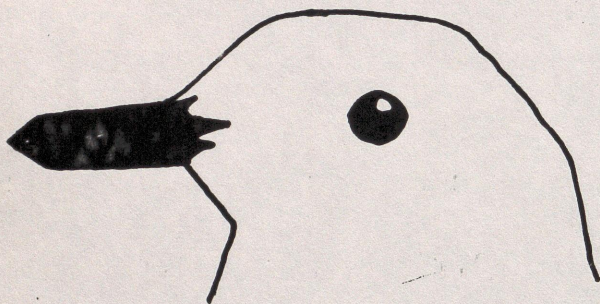
Short legs, thin, short bill.

EXAMPLES :

Foraging strategies in relation to the general characteristics of the bird can also be used to identify them into general groups:-

Birds with LARGE EYES and SHORT BILLS hunt their prey visually ie) on the surface, which they then peck with fast movements.

Those with SMALL EYES and LONG BILLS hunt prey by touch below the surface ie) using sensors at the bill tip which feel prey during probing rather than seeing it with the eyes.

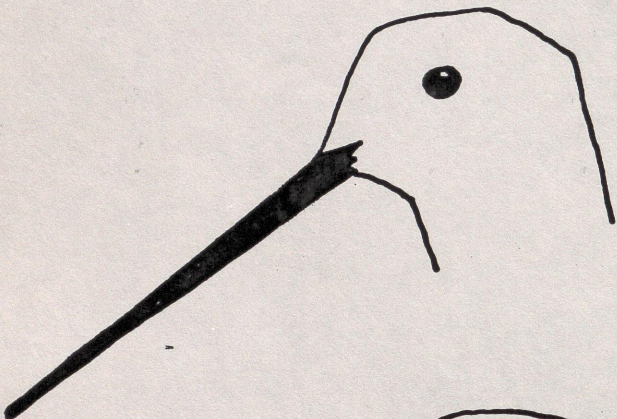


LARGE EYE / SMALL BILL

Stop - Look - Run - Peck feeding action.

Prey pecked from surface.

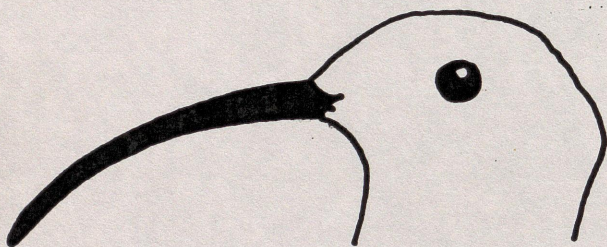
- PLOVERS. Examples :



LONG BILL / SMALL EYE

Deep bill probing for burrowing invertebrates.

- GODWITS / DOWITCHERS / SNIPE.
Examples :



MEDIUM BILL / STRAIGHT, DECURVED,
OR UPCURVED BILL / MEDIUM EYE

Multiple and single pecking (surface and sub-surface). Shallow probing.

- SANDPIPERS / SHANKS. Examples :



SMALL, STRAIGHT BILL / TINY SIZE

Continous and rapid surface pecking.

- STINTS. Examples :

For a general habitat breakdown per species see Appendix 1.

With the use of field guides waterbirds can be identified to the species.

Field guides for use in the S.E.Asia/Pacific region include:-

WBSJ : A Field Guide to the Birds of Japan (pp108 - 168)

King, B, Woodcock, M and Dickinson, E.C. : A Field Guide to The Birds of S.E. Asia (plates 1,2,7,11,13,18).

NOTES :

Table : Percentage of waders observed foraging in eight wetland habitats in the Malay Peninsula in September to November 1984.

Wader Species	% of Birds Foraging in Habitats									Number of Birds*
	Intertidal						Non-Tidal			
	A	B	C	D	E	F	G	H	I	
Black-winged Stilt									100	70
Crab Plover				100						1
Oriental Pratincole								96	4	1314
Little Ringed Plover			44				16	40		64
Kentish/Malaysian Pl.			5	95						21
Mongolian Plover	85			15			+			1367
Large Sandplover		42		58						257
Lesser Golden Plover	69						2	27	2	964
Grey Plover	9			91						44
Great Knot	15			85						352
Red-necked Stint	76	20		4						269
Temminck's Stint		100								3
Long-toed Stint			5					89	6	267
Curlew Sandpiper	89	11								1067
Spoon-billed Sandpiper		100								13
Broad-billed Sandpiper	100									230
Asiatic Dowitcher	1			99						76
Black-tailed Godwit	94								6	138
Bar-tailed Godwit				100						406
Whimbrel		25		75						400
Curlew	12	6		82						229
Redshank	79			19	2					790
Marsh Sandpiper	63				37					798
Greenshank	60			19	17			2	2	176
Wood Sandpiper							+	95	5	1996
Terek Sandpiper	91			9						222
Common Sandpiper			58	15		11	1		15	133
Turnstone		73		27						91
T O T A L										11758

* Number of birds counted on roosts are not included

Key to Habitats:

- | | |
|---|---------------------------------------|
| A = soft mud | E = brackish pools within mangal zone |
| B = consolidated mud | F = mangrove vegetation on mud |
| C = dry and cracked mud | G = salt pans |
| D = muddy sand | H = paddy fields |
| I = Fresh-water lake bordered by wet meadows. | |

Sandpiper: D

WORKSHEET 5 : USE OF BINOCULARS AND TELESCOPES

Generally optical equipment such as binoculars and telescopes are necessary in order to conduct observations on waterbirds. Wetland areas are often large and usually very flat, making close approach to wildlife difficult. Therefore binoculars and telescopes are needed to count and identify bird species.

Binoculars

- binoculars should be fairly light and small (to prevent vibration and the burden of a heavy weight around the neck etc).
- ideal binocular specifications for observing waterbirds are 10 X 50 and 8 X 30. This means the actual magnification is the first figure i.e.) 10X and 8X respectively. The second figure tells you the diameter in mm's of the exit lens i.e) the lens away from your eyes when looking through the binoculars. The diameter of the exit lens is important because generally the smaller its diameter the less light and smaller field of view the binoculars will have. (Figure 1) It is important to have good light to perceive colours on birds and a large field of view is desirable when counting large bird flocks at a great distances.
- binoculars which have magnifications larger than 10X or a zoom capability i.e) 10-20X are generally not suitable for observing birds. These binoculars are difficult to hold steadily during observation and produce a vibrating image, thus making identification difficult.

Telescopes

- ideally telescopes should be used to assess species and numbers of waterbirds at a distance. Telescopes provide the facility to be able to identify birds at a far greater distance than binoculars, this is often particularly appropriate when surveying shorebirds in vast intertidal areas.
- telescopes have greater magnifications than binoculars, the ideal is 30X, other telescopes have zoom capabilities which enable magnification to be increased from 20X to 60X - these can be very useful also.

Light gathering Power

Colour - Shifting¹

- telescopes are always mounted on a tripod to prevent vibration of the instrument.
- telescopes and binoculars can be used in conjunction with one another during evaluation i.e) initially use the binoculars to locate (and count) bird flocks, roosts, feeding individuals and then indentify the species using the telescope on the tripod.

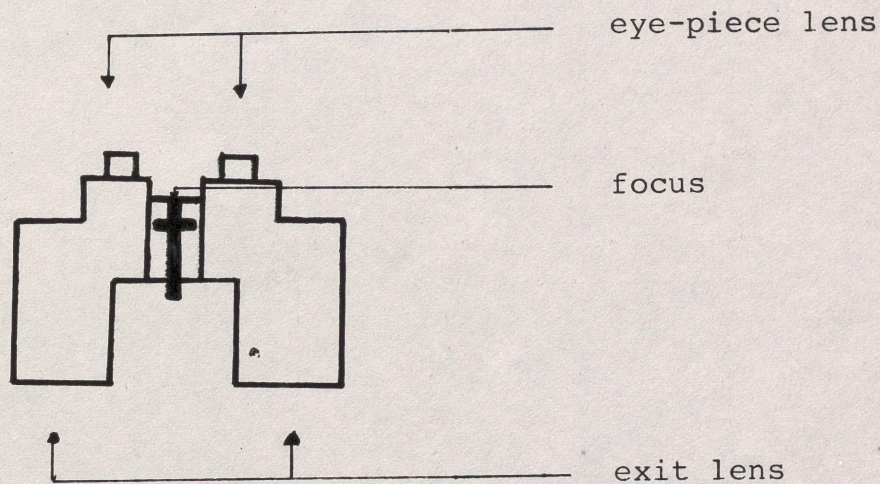


Figure 1: Generalized binoculars.

NOTES :

WORKSHEET 6: EVALUATION OF WATERBIRD NUMBERS

Evaluation of waterbird numbers concerns the techniques by which the numbers of waterbirds utilizing a site can be either counted or estimated accurately.

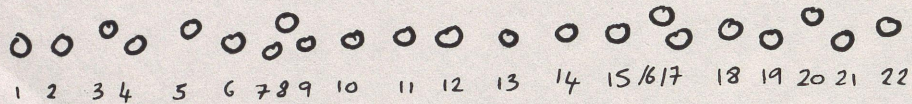
The decision as to whether an accurate individual count or an estimate will be the most effective method will depend on factors given in Worksheet Nos. 2,3 ie) size and physical features of the area, tidal regime and number and distribution of shorebirds present. Also dependant upon these factors will be the method used to evaluate the shorebird numbers ie) viewing the wetland from a stationary point or walking through the site.

To evaluate the numbers of waterbirds utilizing a site, whether from a stationary point or by moving through the area, we use binoculars or telescopes (see Worksheet 5). Below is a summary of when to count accurately or estimate the number of waterbirds present:

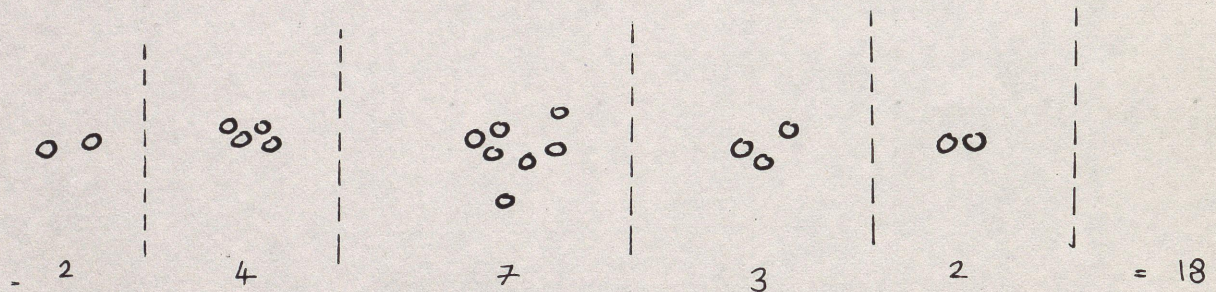
- a) counting individual birds within an area.
 - small numbers of birds present ie) <1,000.
 - limited inter- or intra- site movement by waterbirds ie) the birds are stationary at a roost site.
 - no on-site disturbance ie) people, birds of prey, which may force birds to fly frequently within the site.
 - the birds are well spaced out ie) foraging in an open area.
- b) estimating the numbers of birds within an area.
 - large numbers of birds present ie) >2,000
 - birds continually in flight ie) moving along the coast to a roost site in large flocks.
 - ^Alot of disturbance forcing birds to be unsettled and continually take flight, making prolonged observation on the ground difficult.
 - a closely-packed flock of birds, where due to the "tightness" of the flock counting individual birds is difficult ie) at a large roost.
 - due to poor light conditions ie) viewing into the sun or over a great distance, identification of particular species is not possible.

Methods of Accurate Counts :

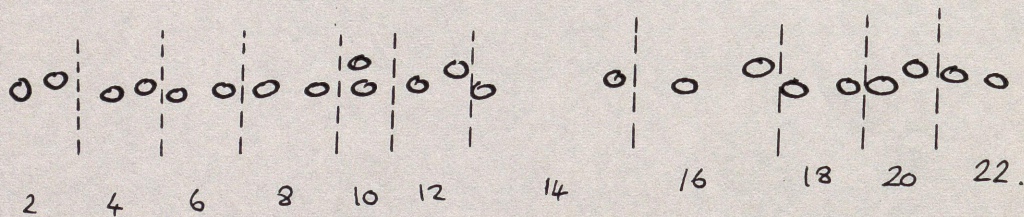
- close viewing of individuals with binoculars or a telescope. Counting 1,2,3,4,5,6,7 etc
- distant viewing of an evenly distributed flock. Counting 1,2,3,4,5,6,7etc. Example:



- visually divide birds into small groups and count each group individually, ie) when there is an uneven distribution of numbers. Totals for each group are then added to form the final total. Example:



- counting flocks in multiples ie) 3,6,9,12,15.....etc or 2,4,6,8,10.....etc. This method can be used for either evenly or unevenly distribution of waterbirds.

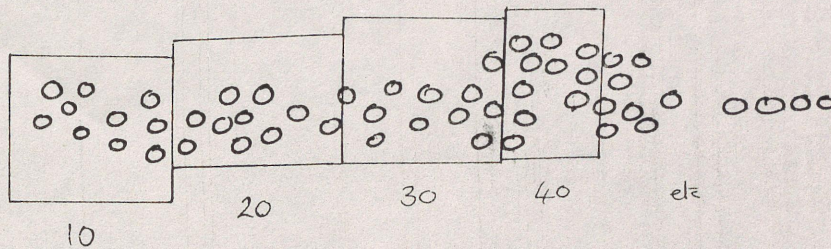


Methods of Estimating Numbers.

- Block Method.

Used for a distant flock in flight or for a densely packed flock at a roost. Used for aerial evaluation of large flocks.

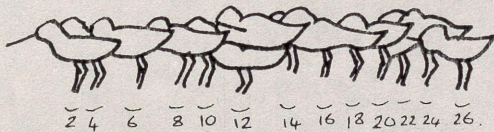
Count or estimate a block of 10, 100 or 1,000 birds (depending on overall flock size). Example:



- Leg Method.

Used at ^a close distance for a densely packed flock ie) a roost, when a large number of birds are hidden by others in front.

Count numbers of birds legs in multiples of 2 and divide by 2. Example:



NOTES:

WORKSHEET 7 : COMPLETION OF WADER COUNT FORMS

See attached INSTRUCTION form.

Important points :

- Sketch map of site
- Continuation of regular counts

INTERWADER - EAST ASIA/PACIFIC WADER STUDY PROGRAMME

COUNT FORM INSTRUCTIONS.

NAME AND ADDRESSES. Please write that of the leader of the group on the front with helpers and their addresses on the back.

SITE NAME. Give name of site (preferably one which can be located on a map), nearest town or district and country.

DATE.START,FINISH. Please use numerals for the date e.g.84 05 29 for 29 May 1984, use standard International Calender. Use the 24 hour clock for the start and finish of the count.

TIDE. Indicate the state of the tide with the following codes :

- 1 - High tide (including 1.5 hours before or after).
- 2 - Going out.
- 3 - Low tide (including 1.5 hours before or after).
- 4 - Coming in.

LATITUDE AND LONGITUDE Give the LATitude and LONGitude, in degrees and minutes, of the centre point of the site.

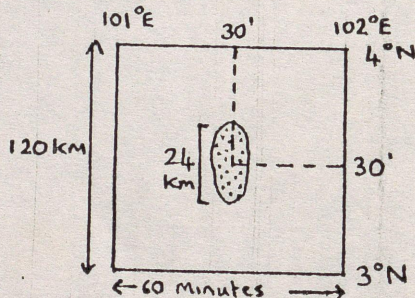
ACCURACY This is the size of the site measured in degrees and minutes. To measure ACCuracy of a site :

1. Measure maximum length or width of a site in Km.
2. Convert this distance into minutes and degrees of latitude. In S.E. Asia 2Km = 1 minute (1') of latitude. In Australia or China 1.6Km = 1 minute of latitude. Minimum Accuracy is 1 minute.

Example:

Country in S.E. Asia
 Max size = 24Km = 12'
 Accuracy = 12'

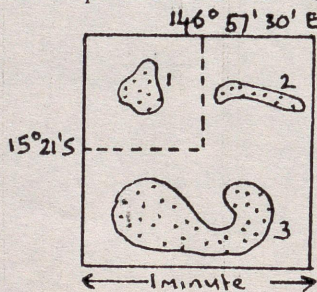
Lat.	Long.	Acc.	Site.
03 30N	101 30	12	



SITE NUMBER This is only necessary if adjacent sites have the same latitude and longitude e.g. two nearby lakes or the shoreline and nearby rice padi areas. Number the sites 1, 2, 3 etc and supply a map showing relative positions of the three sites.

Example:

Lat.	Long.	Acc.	Site.
15 21S	146 57	1	1
15 21S	146 57	1	2
15 21S	146 57	1	3



HABITAT. Use a combination up to six of the following habitat codes to describe the site. Using at least one from each section :

SECTION 1 - LOCATION.

Coastal - Tidal	T
Coastal - Non tidal	N
Inland - More than 10Km from coast	I

SECTION 2 - SITE TYPE.

Ocean	O	Reclamation/Industrial site	H
Bay, Inlet, Estuary	E	Agricultural area	Z
Lake, Swamp, Lagoon	L	Sewage Treatment Works	W
Shrimp/Fish Ponds	Y		

SECTION 3 - WATER

Sea	C	Saline(Saltworks)	A
Fresh	F	Dry	D
Brackish	B		

SECTION 4 - SUBSTRATE

Sand	S	Rice Field	P
Mud	M	Grassland	G
Rock	R	Mangroves associated	K
Marsh	V	Other (specify)	X

Examples.

Muddy Beach - T E C M N , Coastal Shrimp Ponds - N Y B M , Rice padi less than 10Km from coast - N L F P , Tin mining pool - I H L F S V , Estuary no mangrove - T E B M.

WIND DIRECTION AND STRENGTH (Wn Dir & Wn Str): Indicate using these codes:

Direction: N NE E SE S SW W NW No Wind
 1 2 3 4 5 6 7 8 0

Strength: Calm Gentle Moderate Strong Gale
 0 1 2 3 4

MAP Draw a sketch map on the back of the sheet. The map should show site boundaries, habitats, access, route taken on survey, direction of North and a scale.

NEW SITE If site to your knowledge has not been surveyed before put Y, if it has been surveyed put N. If unknown leave blank.

COUNT DISRUPTED? If some event led to birds leaving the site without being counted put a '1' here and write details on the back. Otherwise leave blank.

TOTAL SPECIES AND BIRDS Write in the total numbers of species and waders recorded. Then record the total for each of the species you observed. The notes column can be used for subtotals, breeding records, sub-species etc.

SUB-SPECIES OR RACE If it is possible to distinguish between separate races or subspecies in the field then record separate counts for each, or note which race is present if there is only one. This is only possible in species such as Bar-tailed Godwit, Lesser Golden Plover, Mongolian Plover, Little Ringed Plover and Black-winged Stilt. Note characters used to distinguish races on the rear of the form.

OTHER WADERS Can be used for rarer waders as well as unidentified waders (specify small, medium & large, if possible, otherwise just write U/I).

Please check your sheets for errors - especially that your counts correspond to the correct species.

Remember to fill in LAT, LONG and ACC and DRAW A MAP.

Keep a copy of the data yourself and then send your sheet to your Regional or National Co-ordinator. If you have no co-ordinator send direct to :

INTERWADER DATA CENTRE,
c/o RAOU
21 GLADSTONE ST.
MOONEE PONDS 3039
VICTORIA
AUSTRALIA.

THANK YOU AND HAPPY COUNTING.

COMPUTER CODE NUMBERS OF WADER SPECIES FOR INTERWADER DATA SHEET

Rostratulidae		
<u>Rostratula benghalensis</u>	170	Painted Snipe
Haematopodidae		
<u>Haematopus ostralegus</u>	130	Oystercatcher
<u>Haematopus fuliginosus</u>	131	Sooty Oystercatcher
Recurvirostridae		
<u>Himantopus himantopus</u>	146	Black-winged Stilt
<u>Cladorhynchus leucocephalus</u>	147	Banded Stilt
<u>Recurvirostra avosetta</u>	988	Avocet
<u>Recurvirostra novaehollandiae</u>	148	Red-necked Avocet
Dromadidae		
<u>Dromas ardoela</u>	977	Crab Plover
Burhinidae		
<u>Burhinus oedicnemus</u>	976	Stone Curlew
<u>Burhinus magirostris</u>	174	Bush Thick-knee
<u>Esacus magirostris</u>	175	Beach Thick-knee
Glareolidae		
<u>Glareola maldivarum</u>	172	Oriental Pratincole
<u>Glareola lactea</u>	986	Small Pratincole
<u>Stiltia isabella</u>	173	Australian Pratincole
Charadriidae		
<u>Charadrius dubius</u>	851	Little Ringed Plover
<u>Charadrius hiaticula</u>	895	Ringed Plover
<u>Charadrius placidus</u>	989	Long-billed Plover
<u>Charadrius alexandrinus</u>	990	Kentish Plover
<u>Charadrius ruficapillus</u>	143	Red-capped Plover
<u>Charadrius peronii</u>	991	Malaysian Plover
<u>Charadrius mongolus</u>	139	Mongolian Plover
<u>Charadrius leschenaultii</u>	141	Large Sandplover
<u>Charadrius asiaticus</u>	985	Caspian Plover
<u>Charadrius veredus</u>	142	Oriental Plover
<u>Charadrius bicinctus</u>	140	Double-banded Plover
<u>Charadrius melanops</u>	144	Black-fronted Plover
<u>Charadrius rubricollis</u>	138	Hooded Plover
<u>Erythrogonys cinctus</u>	132	Red-kneed Dotterel
<u>Peltohyas australis</u>	145	Inland Dotterel
<u>Pluvialis dominica</u>	137	Lesser Golden Plover
<u>Pluvialis squatarola</u>	136	Grey Plover
<u>Vanellus cinereus</u>	994	Grey-headed Lapwing
<u>Vanellus indicus</u>	993	Red-wattled Lapwing
<u>Vanellus duvaucelii</u>	984	River Lapwing
<u>Vanellus miles</u>	133	Masked Lapwing
<u>Vanellus tricolor</u>	135	Banded Lapwing
<u>vanellus vanellus</u>	992	Northern Lapwing

Scolopacidae

<u>Calidris tenuirostris</u>	165	Great Knot
<u>Calidris canutus</u>	164	Red Knot
<u>Calidris alba</u>	166	Sanderling
<u>Calidris ruficolis</u>	162	Red-necked Stint
<u>Calidris minuta</u>	857	Little Stint
<u>Calidris temminckii</u>	987	Temminck's Stint
<u>Calidris subminuta</u>	965	Long-toed Stint
<u>Calidris melanotos</u>	978	Pectoral Sandpiper
<u>Calidris acuminata</u>	163	Sharp-tailed Sandpiper
<u>Calidris ferruginea</u>	161	Curlew Sandpiper
<u>Calidris alpina</u>	888	Dunlin
<u>Euryornorhynchus pygmaeus</u>	983	Spoon-billed Sandpiper
<u>Limicola falcinellus</u>	167	Broad-billed Sandpiper
<u>Tryngites subruficollis</u>	887	Buff-breasted Sandpiper
<u>Philomachus pugnax</u>	934	Ruff
<u>Lymnocyptes minimus</u>	982	Jack Snipe
<u>Gallinago gallinago</u>	981	Common Snipe
<u>Gallinago stenura</u>	852	Pintail Snipe
<u>Gallinago megala</u>	169	Swinhoe's Snipe
<u>Gallinago hardwickii</u>	168	Japanese Snipe
<u>Limnodromus semipalmatus</u>	939	Asiatic Dowitcher
<u>Scolopax rusticola</u>	980	Eurasian Woodcock
<u>Scolopax mira</u>	979	Amami Woodcock
<u>Limosa limosa</u>	152	Black-tailed Godwit
<u>Limosa lapponica</u>	153	Bar-tailed Godwit
<u>Numenius minutus</u>	151	Little Curlew
<u>Numenius phaeopus</u>	150	Whimbrel
<u>Numenius arquata</u>	893	Curlew
<u>Numenius madagascarensis</u>	149	Eastern Curlew
<u>Tringa erythropus</u>	995	Spotted Redshank
<u>Tringa totanus</u>	891	Redshank
<u>Tringa stagnatilis</u>	159	Marsh Sandpiper
<u>Tringa nebularia</u>	158	Greenshank
<u>Tringa guttifer</u>	850	Spotted Greenshank
<u>Tringa flavipes</u>	978	Lesser Yellowlegs
<u>Tringa ochropus</u>	832	Green Sandpiper
<u>Tringa glareola</u>	154	Wood Sandpiper
<u>Xenus cinereus</u>	160	Terek Sandpiper
<u>Actitis hypoleucos</u>	157	Common Sandpiper
<u>Heteroscelus brevipes</u>	155	Grey-tailed Tattler
<u>Heteroscelus incanus</u>	156	Wandering Tattler
<u>Arenaria interpres</u>	129	Ruddy Turnstone
<u>Phalaropus lobatus</u>	932	Red-necked Phalarope
Unidentified wader	996	
Unidentified small wader	997	
Unidentified Medium wader	998	
Unidentified large wader	999	

NB. CODE FOR BAR-TAILED GODWIT (153) HAS BEEN MIS-PRINTED ON THE SURVEY FORMS AS 143. PLEASE ALTER THIS ON YOUR FORMS.

INTERWADER — COUNT DATA FORM 1

K1 K2 Country Obs. No. Site Code Record No.

Name:

Address:

Site Name:

Year Month Day Start Finish Tide Habitat
 Lat N/S Long Acc Site No Wn Dir Wn Str

SKETCH MAP
ON THE
BACK?

Count disrupted? Total coverage? Total species Total birds New site?

Species	Total	Notes
Painted Snipe	170	
Oystercatcher	130	
Black-winged Stilt	146	
Avocet	988	
✕ Oriental Pratincole	172	
Little Ringed Plover	851	
✕ Long-billed Plover	989	
Kentish Plover	990	
✕ Malaysian Plover	991	
Mongolian Plover	139	
Large Sandplover	141	
✕ Oriental Plover	142	
Lesser Golden Plover	137	
Grey Plover	136	
✕ Northern Lapwing	992	
Red-wattled Lapwing	993	
Grey headed Lapwing	994	
✕ Great Knot	165	
✕ Red Knot	164	
Sanderling	166	
✕ Red-necked Stint	162	
Temminck's Stint	987	
✕ Long-toed Stint	965	
✕ Sharp-tailed Sandpiper	163	
Curlew Sandpiper	161	
Dunlin	888	
Broad-billed Sandpiper	167	
Ruff or Reeve	934	
Snipe sp.	846	
Asiatic Dowitcher	939	
Black-tailed Godwit	152	
Bar-tailed Godwit	143	
✕ Little Curlew	151	
Whimbrel	150	
Curlew	893	
Eastern Curlew	149	
Spotted Redshank	995	
Redshank	891	
Marsh Sandpiper	159	
Greenshank	158	
Green sandpiper	832	
Wood Sandpiper	154	
Terek sandpiper	160	
Common Sandpiper	157	
✕ Grey-tailed Tattler	155	
✕ Ruddy Turnstone	129	
Red-necked Phalarope	932	
Other waders		

INTERWADER — COUNT DATA FORM 1

K1 K2 Country Obs. No. Site Code Record No.

Name:

Address:

Site Name:

Year Month Day Start Finish Tide Habitat

 Lat N/S Long Acc Site No Wn Dir Wn Str

SKETCH MAP
ON THE
BACK?

Count disrupted? Total coverage? Total species Total birds New site?

Species	Total	Notes
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Oystercatcher	130	
Black-winged Stilt	146	
Avocet	988	
Oriental Pratincole	172	
Little Ringed Plover	851	
Long-billed Plover	989	
Kentish Plover	990	
Malaysian Plover	991	
Mongolian Plover	139	
Large Sandplover	141	
Oriental Plover	142	
Lesser Golden Plover	137	
Grey Plover	136	
Northern Lapwing	992	
Red-wattled Lapwing	993	
Grey headed Lapwing	994	
Great Knot	165	
Red Knot	164	
Sanderling	166	
Red-necked Stint	162	
Temminck's Stint	987	
Long-toed Stint	965	
Sharp-tailed Sandpiper	163	
Curlew Sandpiper	161	
Dunlin	888	
Broad-billed Sandpiper	167	
Ruff or Reeve	934	
Snipe sp.	846	
Asiatic Dowitcher	939	
Black-tailed Godwit	152	
Bar-tailed Godwit	143	
Little Curlew	151	
Whimbrel	150	
Curlew	893	
Eastern Curlew	149	
Spotted Redshank	995	
Redshank	891	
Marsh Sandpiper	159	
Greenshank	158	
Green sandpiper	832	
Wood Sandpiper	154	
Terek sandpiper	160	
Common Sandpiper	157	
Grey-tailed Tattler	155	
Ruddy Turnstone	129	
Red-necked Phalarope	932	
Other waders		

INTERWADER — COUNT DATA FORM 1

K1 K2 Country Obs. No. Site Code Record No.

Name:

Address:

Site Name:

Year Month Day Start Finish Tide Habitat

 Lat N/S Long Acc Site No Wn Dir Wn Str

SKETCH MAP
ON THE
BACK?

Count disrupted? Total coverage? Total species Total birds New site?

Species	Total	Notes
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Avocet	988	
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Long-billed Plover	989	
Kentish Plover	990	
Malaysian Plover	991	
Mongolian Plover	139	
Large Sandplover	141	
Oriental Plover	142	
Lesser Golden Plover	137	
Grey Plover	136	
Northern Lapwing	992	
Red-wattled Lapwing	993	
Grey-headed Lapwing	994	
Great Knot	165	
Red Knot	164	
Sanderling	166	
Red-necked Stint	162	
Temminck's Stint	987	
Long-toed Stint	965	
Sharp-tailed Sandpiper	163	
Curlew Sandpiper	161	
Dunlin	888	
Broad-billed Sandpiper	167	
Ruff or Reeve	934	
Snipe sp.	846	
Asiatic Dowitcher	939	
Black-tailed Godwit	152	
Bar-tailed Godwit	143	
Little Curlew	151	
Whimbrel	150	
Curlew	893	
Eastern Curlew	149	
Spotted Redshank	995	
Redshank	891	
Marsh Sandpiper	159	
Greenshank	158	
Green sandpiper	832	
Wood Sandpiper	154	
Terek sandpiper	160	
Common Sandpiper	157	
Grey-tailed Tattler	155	
Ruddy Turnstone	129	
Red-necked Phalarope	932	
Other waders		

NOTES:

WORKSHEET 8 : IDENTIFICATION OF MANGROVE SPECIES

1. Distinguishing Characteristics of GENUS : Fruit -
Flower -
Roots -
Leaves -
Bark -

2. Distinguishing Characteristics of SPECIES : Fruit -
Flower -
Roots -
Leaves -
Bark -

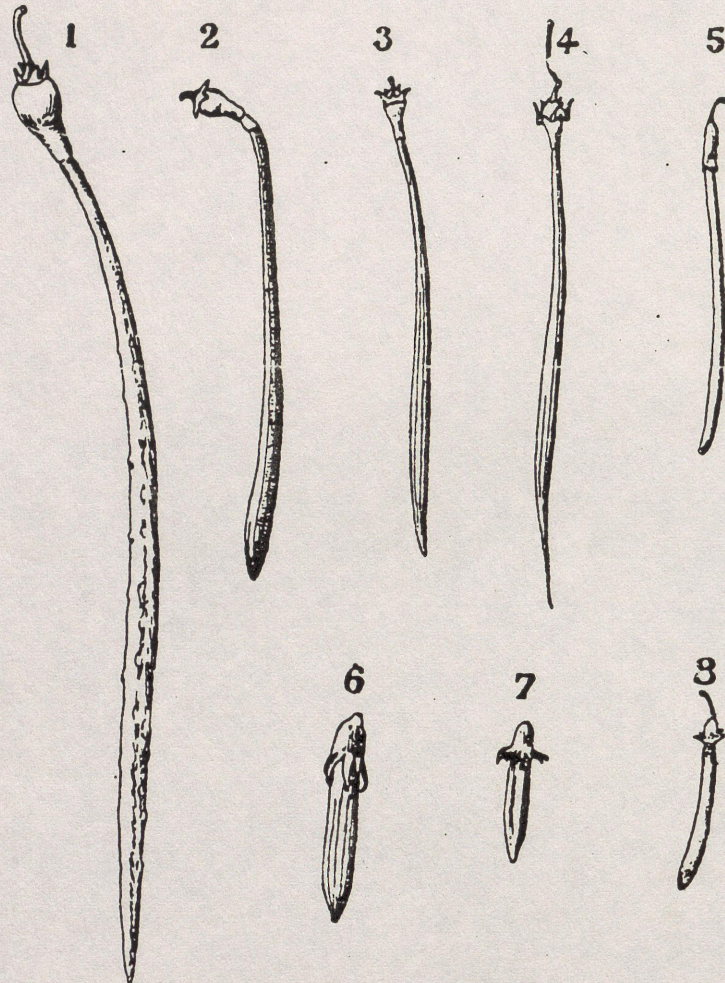
3. Species Name : _____

4. Identification Diagrams (Fill in the following boxes with diagrams).

Fruit :	Flower :
Roots :	Leaves :
Bark :	Other :

RHIZOPHORACEAE.

VIVIPAROUS FRUITS.



Scale approximately 1/5.

- | | |
|----------------------------------|----------------------------------|
| 1. <i>Rhizophora mucronata</i> . | 5. <i>Bruguiera parviflora</i> . |
| 2. " <i>conjugata</i> . | 6. " <i>gymnorhiza</i> . |
| 3. <i>Ceriops Candolleana</i> . | 7. " <i>eripetala</i> . |
| 4. <i>Kandelia Rheedii</i> . | 8. " <i>caryophylloides</i> . |

not a *rotan*, but suggestive of one, with its leaves produced into tendrils with which it climbs. *Crinum asiaticum* (*tembaga suasa*); a well-known liliaceous plant with white flowers and red stamens. *Paramignya longispina* (*limau lélang*); a shrub or small tree with long spines that make themselves unpleasantly felt in dry mangrove. *Sesuvium portulacastrum* (*gélang*); a creeping succulent herb suggestive of the Mesembryanthemums that are common in seaside places in the warmer parts of England, and that has given its name—mutilated into “Geylang”—to a road in Singapore. *Pandanus* spp. (*pandan* or *mengkuang*); armed or unarmed screw-pines, some of which have fruits suggestive of a pineapple.

(e) KEY TO IDENTIFICATION.

The following key, combined with the illustrations, leaf diagrams, and descriptions that follow, should enable anyone to identify the principal species without trouble.

I. TREES.

A. WITH STILT-ROOTS.

- | | |
|--|---|
| (i). Bark horizontally fissured, almost black. | BAKAU KURAP.
<i>Rhizophora mucronata</i> 4* |
| (ii). Bark greyish, smooth or furrowed. | BAKAU MINYAK.
<i>Rhizophora conjugata</i> 2.a. |
| (iii). Bark lenticellate; stilt roots generally absent or inconspicuous. | MATA BUAYA.
<i>Bruguiera eriopetala</i> 3.b. |

B. WITH ORDINARY BUTTRESSES.

- | | |
|---|---|
| (i). Bark not furrowed. | |
| (a). Light brown, lenticellate, buttresses fluted. | TENGAR.
<i>Ceriops Candolleana</i> 8.a. |
| (b). Grey, lenticellate, buttresses abrupt. | BERUS.
<i>Bruguiera caryophylloides</i> 3.c. |
| (c). Grey, smooth, normally buttressed. | LENGGADAI.
<i>Bruguiera parviflora</i> 3.d. |
| (d). Grey or reddish, smooth, pitted. | IPIL.
<i>Intsia retusa</i> 16.b. |
| (e). Reddish with papery flakes; roots serpentine. | NYIREH BUNGA.
<i>Carapa obovata</i> 6.c. |
| (ii). Bark furrowed: | |
| (a). Brown or black, not flaking off. | TUMU.
<i>Bruguiera gymnorhiza</i> 3.a. |
| (b). Brown or black, with conspicuous lenticels. | MATA BUAYA.
<i>Bruguiera eriopetala</i> 3.b. |
| (c). Dark chocolate brown, with large imbricate flakes. | NYIREH BATU.
<i>Carapa moluccensis</i> 9.c. |
| (d). Light grey with reddish lenticels. | DUNGUN.
<i>Heritiera littoralis</i> 9.a. |

* The numbers refer to the corresponding leaf diagrams, on pp. 98—103.

I. Trees.—(Contd).

C. BUTTRESSES INCONSPICUOUS OR ABSENT.

(i). Bark not furrowed:

- | | | |
|------|--|---|
| (a). | Red-brown with papery flakes. | API-API PUTEH.
<i>Avicennia intermedia</i> 9.b.* |
| | | API-API HITAM.
<i>Avicennia alba</i> 10.a. |
| (b.) | } Grey, smooth, minutely
(c.) } lenticellate.
(d.) } | API-API LUDAT.
<i>Avicennia officinalis</i> 6.a. |
| | | API-API BERBULU.
<i>Avicennia lanata</i> 8.c. 6.b. |
| (e). | | Grey with red-brown lenticels forming diagonal stripes, and copious white sap.
BUTA-BUTA.
<i>Excoecaria Agallocha</i> 10.c. |

(ii). Bark furrowed:

- | | | |
|------|--|---|
| (a). | Brown or reddish, twigs pendulous. | BEREMBANG.
<i>Sonneratia acida</i> 2.c. |
| (b). | Brown or reddish, twigs stiff. | PEREPAT.
<i>Sonneratia Griffithii</i> 8.b. |
| (c). | Brown or reddish, twigs stiff. | GEDABU.
<i>Sonneratia alba</i> 16.a. |
| (d). | Soft with large pale pinkish lenticels; flowers red. | TERUNTUM.
<i>Lumnitzera coccinea</i> 12.a. |
| (e). | Soft with large pale pinkish lenticels; flowers white. | TERUNTUM.
<i>Lumnitzera racemosa</i> 12.b. |

D. STEMS CONICALLY THICKENED AT BASE.

- | | | |
|-------|-------------------------------------|---|
| (i). | Bark smooth, reddish, lenticellate. | BERUS-BERUS.
<i>Kandelia Rheedii</i> 5 |
| (ii). | Bark pustular with milky sap. | PONGPONG.
<i>Cerbera spp.</i> 11 |

* The numbers refer to the corresponding leaf diagrams, on pp. 98—103.

II. SHRUBS.

A. WOODY.

- (i). Leaves opposite; simple.
Young leaves gummy, twigs pink. CHINGAM.
Scyphiphora hydrophyllacea 7.*
- (ii). Leaves alternate; simple.
- (a). Leaves green above and below. KACHANG-KACHANG.
Aegiceras majus. 13
- (b). Shrubby trees with conspicuous yellow flowers. BARU.
Hibiscus tiliaceus 15
- BARU.
Thespesia populnea 14.a.
- WALAN (?)
Brownlowia Riedelii 14.b.
- (c). Leaves with scaly brown undersides. DURIAN LAUT.
B. lanceolata 2.b.10b.
- (iii). Leaves alternate; compound.
Semi-climbers with flat green pods. SETUI, SALANG.
Derris uliginosa 10.d.

B. HERBACEOUS.

- (i). Leaves prickly.
- (a). Flowers white, fruit less than 1". JERUJU HITAM.
Acanthus ebracteatus 18.b.
- (b). Flowers blue, fruit more than 1". JERUJU PUTEH.
Acanthus ilicifolius 18.a.
- (ii). Leaves flaccid:
Flower heads pink. BELUNTAS.
Pluchea indica. 17

III. PALMS.

- (i). Erect, with armed stems. NIBONG.
Oncosperma filamentosa
- (ii). Erect, stemless, unarmed. NIPAH.
Nipa fruticans
- (iii). Climbing, with hooked flagella. ROTAN BAKAU.
Daemonorops leptopus

IV. CONIFERS.

- Small trees with alternate dark green leathery leaves. JATI LAUT.
Podocarpus polystachyus 1

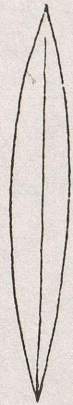
V. CYCADS.

- Plants with radiating fronds and leathery dark green leaflets. PAKU LAUT.
Cycas Rumphii. 1

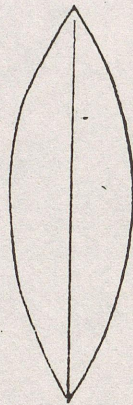
VI. FERNS.

- Coarse leaved ferns forming dense masses. PIAI.
Acrostichum aureum.

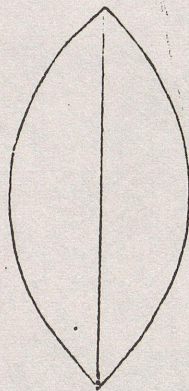
* The numbers refer to the corresponding leaf diagrams, on pp. 98-103.



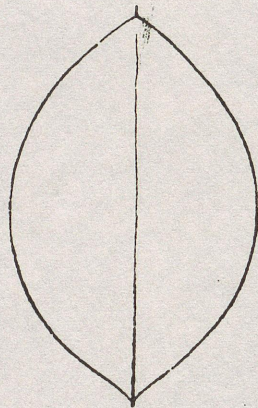
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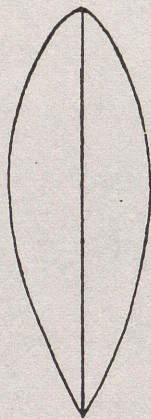
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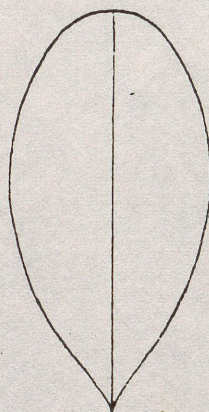
3



4



5



6

LEAF DESCRIPTIONS.

Note. Leaves are simple and opposite unless otherwise stated. The numbers refer to the diagrams opposite.

- 1.a. 3", alternate. Small coniferous trees with brown fissured bark.
- b. Compound; leaflets up to a foot or more. Palm-like shrubs with short stems and radiating fronds.
- 2.a. 6", midrib red, black dots on underside, mucronate. Trees with stilt-roots and grey bark.
- b. 5", midrib green, whole leaf usually yellowish. Normally buttressed trees with smooth grey bark. (See also 3.d.)
- c. 4", sessile, base of leaf and midrib crimson. Trees with brown fissured bark, pendulous twigs, and edible fruits.
- d. 4", alternate, under surface with brownish scales like *durian* leaf. Low shrubs on river banks. (See also 10.b.)
- 3.a. 6", midrib red, no black dots beneath; flowers over 1" long, scarlet. Trees with rough fissured brown bark.
- b. 5", midrib pink or green; flowers under 1" long, yellowish, green, or pinkish. Trees with lenticellate fissured bark.
- c. 4", midrib green; young shoots with salty leguminous taste. Trees with grey smooth lenticellate bark and abrupt buttresses. Compare 3.d.
- d. 5", whole leaf usually yellowish; young shoots with astringent taste. Trees with smooth bark and normal buttresses. Compare (c) above and 2.b.
4. 7", tip mucronate, under surface with black dots. Trees with stilt-roots and dark rough bark.
5. 4", margins reflexed; leaf buds twisted like an auger point. Small trees with conically thickened stems.
- 6.a. 4", margins reflexed, under surface patchily or completely grey but not woolly. Bushy trees with grey bark.
- b. 3½", under surface densely woolly; shape more usually as in 8 (c). Tall trees with grey bark.
- c. Compound; leaflets 4", under surface green with net-like venation. Trees with reddish papery-flaked bark.

JATI LAUT.

Podocarpus polystachyus.

PAKU LAUT.

Cycas Rumphii.

BAKAU MINYAK.

Rhizophora conjugata.

LENGGADAI.

Bruguiera parviflora.

BEREMBANG.

Sonneratia acida.

DURIAN LAUT.

Brownlowia lanceolata.

TUMU.

Bruguiera gymnorrhiza. ✓

MATA BUAYA.

Bruguiera eriopetala. ✓

BERUS.

Bruguiera caryophylloides. ✓

LENGGADAI.

Bruguiera parviflora. ✓

BAKAU KURAP.

Rhizophora mucronata. ✓

BERUS-BERUS.

Kandelia Rheedii.

LUDAT.

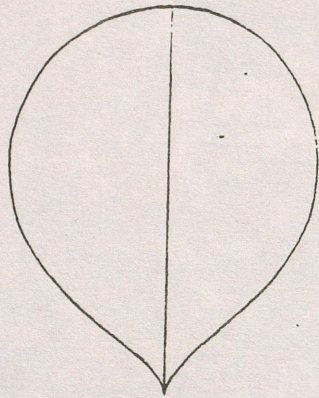
Avicennia officinalis. ✓

API-API BERBULU.

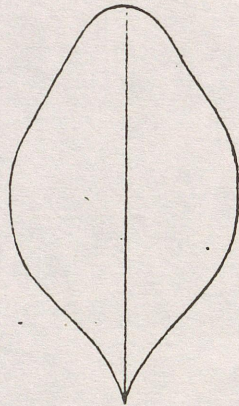
Avicennia lanata.

NYIREH BUNGA.

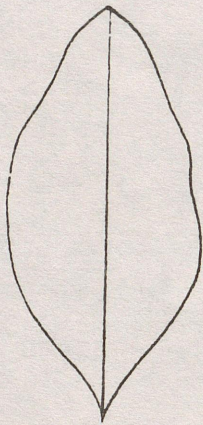
Carapa obovata.



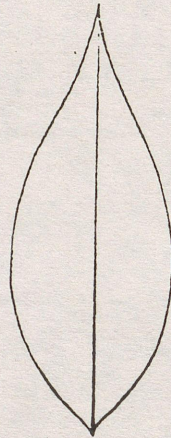
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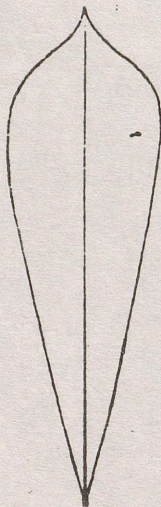
8



9



10



11



12

7. 2", petioles and young shoots gummy; terminal leaves with faces closely adpressed. Bushy shrubs.
- 8.a. 4", paler below, petioles 1½". Trees with fawn coloured bark with dark lenticels. Pneumatophores kneed.
- b. 4", same colour both sides, petioles ½" Trees with rough brown fissured bark. Pneumatophores pointed.
- c. 3½", under surface densely woolly. Often shaped as in 6 (b). Trees with grey smooth bark.
- 9.a. 6", alternate, under surface silvery scaly. Small trees without pneumatophores in dry mangrove.
- b. 3½" or less, opposite, under surface grey or glaucous. Trees with reddish bark peeling off in papery flakes.
- c. Compound; leaflets 4", usually 2 pairs, under surface with netted venation; leaves alternate. Trees with dark chocolate-brown very rough bark.
- 10.a. 6", dark green above, white or glaucous beneath, petioles stout. Trees with pendulous branches and grey bark.
- b. 4", alternate, with brownish scaly undersides suggestive of *durian*. Low shrubs on river banks. Usually as in 2.d.
- c. 4", alternate, green both sides, petiole slender. Trees with copious milky sap and grey bark with diagonal markings.
- d. Compound; leaflets 3", odd paired in 5s or 3s; leaves alternate. Shrubs or climbers with flat single-seeded pods.
11. 8" or more, alternate. Bushy trees with milky sap and conspicuous white flowers.
- 12.a. Alternate; flowers scarlet in umbellate clusters. Large trees.
- b. Alternate; flowers white in lax racemes. Shrubs or small trees.

CHINGAM.

Scyphiphora hydrophyllacea.

TENGAR.

Cerriops Candolleana.

PEREPAT.

Sonneratia Griffithii.

API-API BERBULU.

Avicennia lanata.

DUNGUN.

Heritiera littoralis.

API-API MERAH.

Avicennia intermedia.

NYIREH BATU.

Carapa moluccensis.

API-API HITAM.

Avicennia alba.

DURIAN LAUT.

Brownlowia lanceolata.

BUTA-BUTA.

Excoecaria Agallocha.

SALANG, SETUI.

Derris uliginosa.

PONG-PONG.

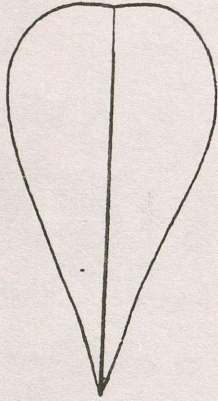
Cerbera spp.

TERUNTUM.

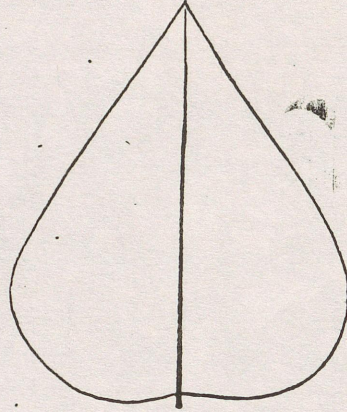
Lumnitzera coccinea.

TERUNTUM, SESUP.

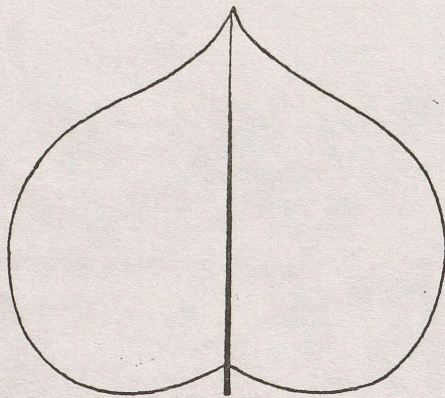
Lumnitzera racemosa.



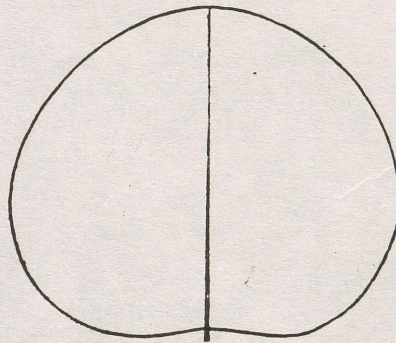
13



14



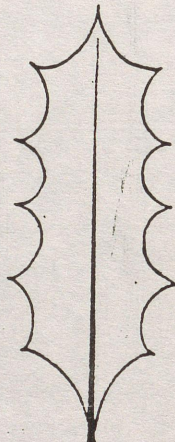
15



16



17



18

13. 3", alternate. Erect shrubs with white flowers and crescent-shaped fruits.
KACHANG-KACHANG.
Aegiceras majus.
- 14.a. 5", alternate, both sides green; petiole as least as long as leaf. Shrubs or small trees with large yellow flowers.
BARU, WARU.
Thespesia populnea.
- b. 5", alternate, lower surface scaly brown, petiole shorter than leaf. Small trees with inconspicuous flowers.
WALAN (?).
Brownlowia Riedelii.
15. 4", alternate, lower surface grey, margin slightly toothed. Shrubs or small trees with large yellow flowers.
BARU, WARU.
Hibiscus tiliaceus.
- 16.a. 3", surface corrugated, same colour above and below. Trees with brown fissured bark and pointed pneumatophores.
GEDABU.
Sonneratia alba.
- b. Compound; leaflets 2½", generally two pairs; leaves alternate. Trees with pitted bark and large buttresses.
IPIL.
Intsia retusa.
17. 2½", alternate, flaccid. Erect herbaceous shrubs with pink flower heads.
BELUNTAS.
Pluchea indica.
- 18.a. 5", prickly, light green; flowers blue, fruits over 1". Shrubby herbs with aerial roots. Leaves very variable.
JERUJU PUTEH.
Acanthus ilicifolius.
- b. As above, darker green; flowers white, fruits under 1" long.
JERUJU HITAM.
Acanthus ebracteatus.

The following do not fit the key but are easily identifiable without:—

- Fern* with large leaves forming dense clumps as illustrated on page 153.
PIAI, LARAT.
Acrostichum aureum.
- Palms* (a) Stemless, entirely unarmed, leaves erect.
NIPAH.
Nipa fruticans.
- (b) With tall stems armed with sharp spines. Leaves drooping.
NIBONG.
Oncosperma filamentosa.
- (c) Climbing by means of thorny flagella formed by prolongation of the rachis.
ROTAN BAKAU.
Daemonorops leptopus.

WORKSHEET 9 : VEGETATION DATA COLLECTION

We need to be able to assess the species diversity of the vegetation within a wetland (see Worksheet 8 : Identification of Mangrove species) and collect quantitative data on the "condition" of the vegetation (in this case - mangroves). In order to collect this data we set up vegetation plots or conduct vegetation transects.

Initially vegetation maps and aerial photographs can be studied of an area. This will provide the information necessary to determine the range of vegetation types within that wetland. Based on this the position of the vegetation plots or transect line can be determined before visiting the site in order to attain the most comprehensive coverage of vegetation types within that wetland.

Vegetation plots

Each plot is measured at 15m X 15m and marked by placing 1.5-2m long bright coloured PVC stakes into the soil. This is then bounded by nylon string to form the 15 X 15m square. The tree trunks enroute to the plot are also marked with a bright colour e.g) yellow paint in order to facilitate relocation of the plot. Short term plots i.e) one visit only, are assessed for the above points (i.e)1-7). Vegetation assessment over a long-term period i.e) to assess relative growth of the trees, regeneration rates, death rates etc is one of the advantages of setting up a series of vegetation plots within a wetland. If long-term plots are to be set up a number of points must be completed during the initial visit.

- 1) All trees >4cm in girth are labelled.
- 2) The exact position of all these trees should be mapped on a scale of 1:50 using 1mm graph paper.
- plots can be further divided into 9 equal squares of 5m X 5m to make mapping easier.

The "Condition" of the vegetation is defined as follows :-

1. Situation and physical make-up of the vegetation plot i.e) situated on an offshore island, in a mangrove fringe with landward bunds, in delic mangrove, estuarine mangrove or riverine mangrove.
2. Floristic composition - species present within the plot.
3. Height of the vegetation - estimated height of all trees within the plot.

4. Basal area of trees - circumference of all tree trunks at breast height within the plot.

5. General condition of the trees - this can be estimated in terms of :-

i) Amount of dead/defoliated branches.

ii) Leaf density and dis-colouration.

Trees can be divided into 4 main classes to differentiate their general condition :-

0 - healthy trees i.e) no i) or ii)

1/4) these units are developed from the first plot studied

3/4) with regard to i) and ii), they then remain fixed for all proceeding plots.

+ - dead trees.

6. Crown diameters - estimated diameter of tree crowns within the plot.

7. Density of saplings - number of regenerating trees in the ground layer/study plots.

Vegetation Transects

Simple vegetation transects consist of straight line transects through an area with representative details of the flora noted at 10m intervals. Floristic details noted within a 2m radius include :-

1. Species composition of vegetation.

2. Height of the vegetation.

3. Crown diameter of trees.

4. Composition and density of ground layer i.e) density of regenerating trees or coverage of grasses etc.

5. Condition of the trees i.e) dead, alive or with many dead branches (see point 5 above).

Interpretation of vegetation data

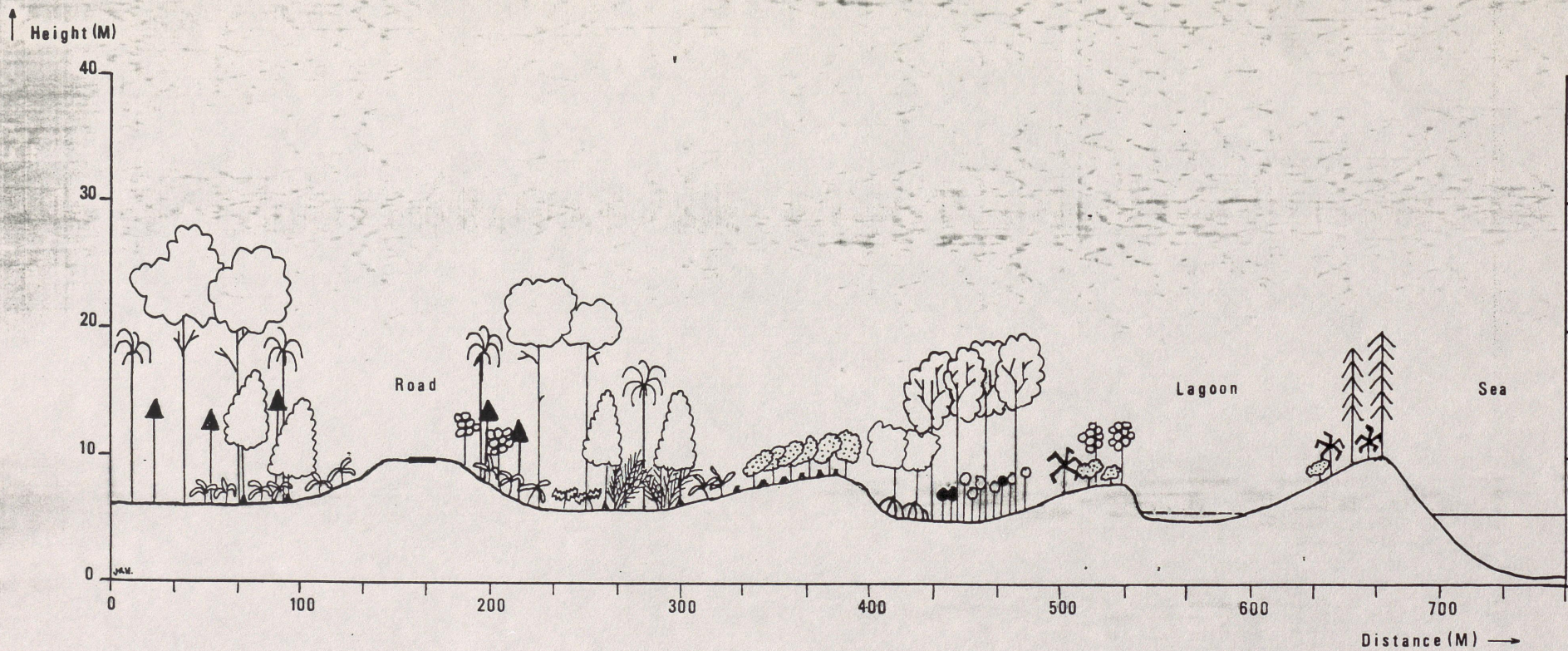
For a general report on the vegetation type found within a wetland community, an inventory of vegetation types with notes on species, general zonation, maximum height of trees and threats accompanied by a vegetation maps and a transect diagram (for example of simple vegetation transects See Appendix I) is sufficient.

For long term studies the results obtained from vegetation plots can be mapped and graphed to show changes in :-

1. Total number of trees and saplings/ha.
2. Total number of trees/ha with a girth of >4cm.
3. Height of the vegetation.
4. Total basal area of trees in m/ha.
5. Average height of trees/ha with a girth of >4cm.
6. Numbers/ha of dead trees with a girth of >4cm.
7. Estimated total leaf cover (%)/ha.

Long term studies will enable the researcher to gauge the changes and conclude as to their causes or initial further studies i.e) why are large numbers of Avicennia marina trees dying at one particular site. These conclusions can then be used to assess management plans for an area and aid the identification of possible problems for other areas.

NOTES :



KEY



Casuarina equestifolia



Pandanus sp



Hibiscus tiliaceus



Avicennia alba



Ceriops tagal



Rhizophora mucronata



Cocos nucifera (dead)



Unidentified sp



Nipa fruticans



Acrostichum speciosum



Acanthus ebracteatus



Bruguiera cylindrica



Excoecaria agallocha



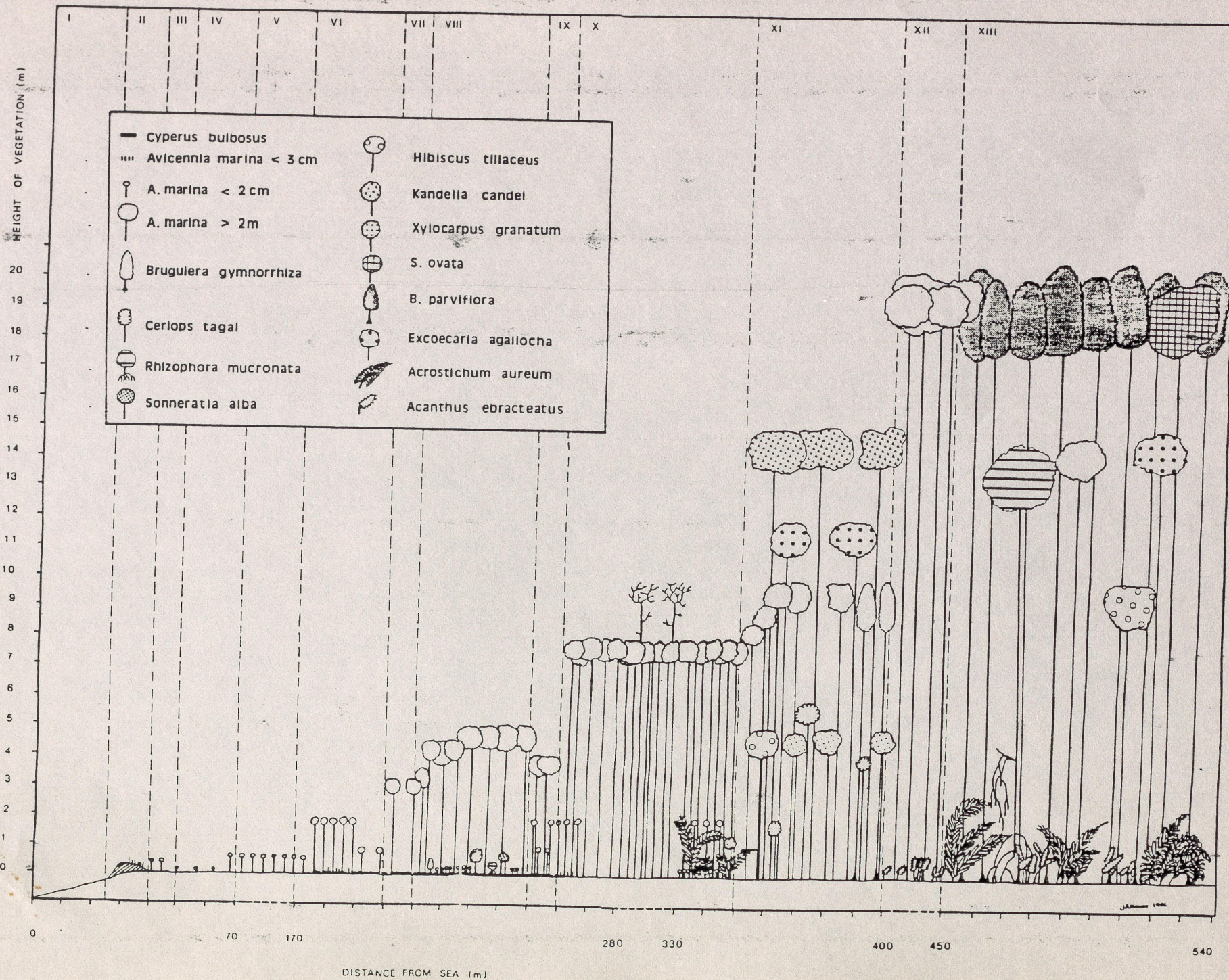
Scyphiphora hydrophyllacea



Oncosperma tigilaria



Unidentified sp



WORKSHEET 10 : GENERAL ASSESSMENT OF A WETLAND

Using the Wetland Data Sheets (INTERWADER form 3H) Six general heading for data collection have been developed.

1. Site Data (points 6-14)

This provides general information on the wetland area, important points are site name, geographical co-ordinates, area, and water regimes.

2. Habitat Data (points 15-21)

This provides more specific information of the wetland type, particularly with regard to status, ownership and disturbance.

3. Land use and Management Data (points 22-29)

This provides information on the general land-use of an area with specific regard to its management for these needs e.g. the degree to which the timber resource is utilized or the number of local people who hunt waterbirds and how many they kill/year. Such information should also be represented on a map. Many of these questions can be answered by interviewing local people.

4. Ornithological Importance of the Site Data (points 30-33)

This provides base line data for future studies and immediately points to the ornithological importance of an area with regard to other wetland sites in S.E Asia (as documented by INTERWADER during the 1983-1987 period). Base line data such as these immediately indicate the productivity of an area and provide a framework for conservation proposals and management plans with respect to rare and endangered waterbirds species.

5. Threats to the site data (points 34-35)

Documents threats to the productivity, land-use and wildlife populations within an area. This information can also be illustrated on a map.

6. Evaluation and Potential Management Data (points 36-43)

This provides a general base-line for proposing management plans and future research as well as detailing successful survey techniques and problems encountered at the wetland.

The completion of Data Sheet 3H can be carried out using methods specified in Worksheet 11.

NOTES :

1. Country	2. Date	3. Date/s of site visit
4. Report compiler Name: Address: Tel:		5. Sheet No/Office use

SITE DATA

6. Site name	7. District/Province/Nearest town	8. Geographical coordinates of site centre Latitude: Longitude:
9. Site area (ha or sq km)	11. Average water depth (m) Max: Min:	13. Fluctuations/permanence Is water permanent YES/NO Describe fluctuations
10. Altitude of site (m)	12. Salinity (by taste) Fresh Brackish Saline Salinity measurements Max: Min:	14. Tidal patterns/exposure Area at Low Tide Area at High Tide (h Mud Sand Rock

HABITAT DATA

15. Wetland Type

16. Habitat Types <u>Coastal Wetlands</u> % 01: inshore waters/open sea (<6m) 02: sea bays, straits (<6m) 03: estuaries, mudflats, 04: rocky sea coasts, sea cliffs 05: sea beaches (sand pebbels) 06: coastal sand dunes 07: small island, islet 08: coastal salt-w. lk, lagoon, marsh 09: coastal fresh-w. lk, lagoon, marsh 10: mangrove swamps, mangrove forest 11: man-made prawn/fish ponds/ saltworks <u>Inland Wetlands</u> 13: rivers, streams (fast flowing) 14: rivers, streams (slow flowing) 15: riverine "oxbow" lakes and marshes 16: fresh-water lakes, marshes (natural) 17: man-made reservoirs, lakes, marshes 18: temporarily flooded wet grasslands 19: temporarily flooded arable 20: rice paddies 21: swamp forest, temp. flooded forest 22: salt lake, salt basin, marshes 23: canals	17. Disturbance Grazed Harvested scrub mangroves lowld. forest plantation grassland marsh Disturbance High <input type="checkbox"/> Med <input type="checkbox"/> Low <input type="checkbox"/>	18. Ownership of site Private Local authority State Others (specify) Comments and %
	19. Protection Status % National Park Nature Reserve Hunting Reserve Unprotected Other (specify)	20. Position in Country (mark with arrow)

21. MAP I. Please provide a detailed map of the site showing site boundaries, direction north, scale and habitat areas.

LAND USE AND MANAGEMENT DATA

22. Population Data

Estimate the numbers of people living within the site boundary (Tick boxes):

None 1-20 21-100 101-1000 1001-10000 10000+

Approximate the numbers of people living in the immediate surroundings (5km of the site boundary):

None 1-20 21-100 101-1000 1001-10000 10000+

Source of information:

Official census Local information Estimate

Comments:

23. Agricultural Activities

a. Summarize the main agricultural land uses in the area

b. Domestic Animals (Estimate number present)

Numbers present	within site	within 1km
-----------------	-------------	------------

Water Buffalo

Cattle

Goats

Other (specify)

Comments: How is the site being affected by the animals?
Are the affects beneficial, neutral or harmful?

c. Rice cultivation

% of site under rice

Are all the areas at the same state of growth?...

.....

Are herbicides /pesticides used? Which ones?...

.....

.....

Are some rice areas left fallow or grazed?

.....

.....

.....

Are any rice areas used by waterbirds?

Which species and which type of rice areas?

.....

.....

.....

.....

.....

24. Industrial Activities. Give details of the developments, resource exploitations, pollutions etc.in the area
(If complex please use extra sheets and provide a sketch map)

ORNITHOLOGICAL IMPORTANCE OF THE SITE DATA

30. Two separate species lists are provided.

LIST 1 InterWader Data Form I (please give 5 copies covering 5 separate counts).

LIST 2 consists of waterbird all species.

Please complete these as accurately as possible.

Total number of species of waders and waterbirds recorded on the site

List any non-wetland bird species which are of interest and which also occur on the site

31. Ornithological summary of the Importance of the site to resident and migratory species, especially waders.

Please provide details of the reasons why it is important and list the species of interest, large nos. and concentrations.

32. MAP III. Please provide a detailed sketch map of the site showing site boundary, scale, direction north and indicate the positions of breeding colonies, wader concentrations, feeding and roosting areas, etc.

33. Importance Categories

Does the site support for: (give details, species, numbers)

a. 1% of the population of a wader or waterbird of a biogeographic region?

b. 1% of the national population of a wader or waterbird?

c. 10,000 ducks, geese, swan or 20,000 waders?

d. Endangered species?

THREATS TO THE SITE DATA

34. Threats to the area. Give details and % of site affected

Existing

Potential

1. Bunds or dyke building

2. Drainage

3. Agricultural changes

4. Industrial development

5. Pollution, herbicides, insecticides

6. Recreational pressures

7. Hunting pressures

8. Other (specify)

Comments:

35. MAP. Please indicate on the LAND-USE(29)MAP II the position of threats and their extent using the number code from 34.

SITE EVALUATION AND POTENTIAL MANAGEMENT DATA

36. Name and position of the nearest similar habitats supporting waterbirds and waders

37. If the site is not a reserve already could it be made into one? Give details of the procedures required to achieve this aim. Could the site be improved by the creation of areas of restricted access, creation of water bodies, islands etc. Please give details.

38. Has the site got educational potential? How could this be organised? Which government bodies need to be involved? Please give details.

39. Has the site got tourism and recreation potential? Has it got adequate access points, infrastructure; which bird attractions could be highlighted safely; what management is required and which government department needs involvement? Please give details.

40. General Management suggestions. What actions need to be taken as soon as possible? Is a survey required; wader counts; added protection local education? Please give details.

41. Other Wildlife of Interest on the Site. Mammals, insects, marine interest etc. Please give details.

42. Survey techniques used in this work.

Use of which method. Boat/foot/plane/vehicle/questionnaire/reports/others

Survey period

Number of survey personnel involved(Names and addresses if possible)

Any problems encountered during the survey

43. Important names and addresses for contacts/government officials/locals etc
References and research.

Research Priorities:

WETLAND BIRD LIST

Abundance codes

- A - 1-10
- B - 11-100
- C - 101-500
- D - 501-1000
- E - 1001-10,000
- F - 10,000+

Resident (If known to breed give number of pairs)

Migration (Give peak seasons I-XII)

May-July

Aug-Oct

Nov-Jan

Feb-April

Average numbers seen during survey period

Maximum count and date

- 1 Little Grebe Podiceps ruficollis
- 2 Great Crested Grebe P. cristatus
- 3 Red-necked Grebe P. grisegena
- 4 Black-necked Grebe P. nigricollis
- 5 White Pelican Pelecanus onocrotalus
- 6 Spot-billed Pelican P. philippensis
- 7 Cormorant Phalacrocorax carbo
- 8 Indian Shag P. fuscicollis
- 9 Little Cormorant P. niger
- 10 Oriental Darter Anhinga melanogaster
- 11 White-bellied Heron Ardea insignis
- 12 Great-billed Heron A. sumatrana
- 13 Grey Heron A. cinerea
- 14 Purple Heron A. purpurea
- 15 Little Heron Butorides striatus
- 16 Indian Pond Heron Ardeola greyii
- 17 Chinese Pond Heron A. bacchus
- 18 Java Pond Heron A. speciosa
- 19 Cattle Egret Bubulcus ibis
- 20 Pacific Reef Egret Egretta sacra
- 21 Chinese Egret E. eulophotes
- 22 Great Egret E. alba
- 23 Plumed Egret E. intermedia
- 24 Little Egret E. garzetta
- 25 Black-crowned Night Heron Nycticorax nycticorax
- 26 Rufous Night Heron N. caledonicus
- 27 Malayan Night Heron Gorsachius melanolophus
- 28 Japanese Night Heron G. goisagi
- 29 Yellow Bittern Ixobrychus sinensis
- 30 Schrenck's Bittern I. eurhythmus
- 31 Cinnamon Bittern I. cinnamomeus
- 32 Black Bittern I. flavicollis
- 33 Eurasian Bittern Botaurus stellaris
- 34 Milky Stork Mycteria cinerea
- 35 Painted Stork M. leucocephala
- 36 Asian Openbill Anastomus oscitans
- 37 Black Stork Ciconia nigra
- 38 Storm's Petrel C. stormi
- 39 Black-necked Stork Ephippiorhynchus asiaticus
- 40 Greater Adjutant Leptoptilos dubius
- 41 Lesser Adjutant L. javanicus
- 42 Black-headed Ibis Threskiornis melanocephalus
- 43 Glossy Ibis Plegadis falcinellus
- 44 Eurasian Spoonbill Platalea leucorodia
- 45 Black-faced Spoonbill P. minor
- 46 Common Crane Grus grus
- 47 Hooded Crane G. monacha
- 48 Demoiselle Crane Anthropoides virgo
- 49 Japanese Crane Grus japonensis

WETLAND BIRD LIST

		Resident (If known to breed give number of pairs)	Migration (Give peak seasons I-XII)	Abundance codes				Average numbers seen during surv. period	Maximum count and date
				May-July	Aug-Oct	Nov-Jan	Feb-April		
100	Purple Swamphen <u>Porphyrio porphyrio</u>								
101	Coot <u>Fulica atra</u>								
102	Masked Finfoot <u>Heliopais personata</u>								
103	Pheasant-tailed Jacana <u>Hydrophasionus chirurgus</u>								
104	Bronze-winged Jacana <u>Metopidius indicus</u>								
105	Painted Snipe <u>Rostratula benghalensis</u>								
106	Oystercatcher <u>Haematopus ostralegus</u>								
107	Black-winged Stilt <u>Himantopus himantopus</u>								
108	Avocet <u>Recurvirostris avocetta</u>								
109	Stone Curlew <u>Burhinus oedicephalus</u>								
110	Oriental Pratincole <u>Glareola maldivarum</u>								
111	Small Pratincole <u>G. lactea</u>								
112	Australian Pratincole <u>Stiltia isabella</u>								
113	Little Ringed Plover <u>Charadrius dubius</u>								
114	Ringed Plover <u>C. hiaticula</u>								
115	Long-billed Plover <u>C. placidus</u>								
116	Kentish Plover <u>C. alexandrinus</u>								
117	Malaysian Plover <u>C. peronii</u>								
118	Mongolian Plover <u>C. mongolus</u>								
119	Greater Sandplover <u>C. leschenaultii</u>								
120	Oriental Plover <u>C. veredus</u>								
121	Lesser Golden Plover <u>Pluvialis dominica</u>								
122	Grey Plover <u>P. squatarola</u>								
123	Grey-headed Lapwing <u>Vanellus cinereus</u>								
124	Red-wattled Lapwing <u>V. indicus</u>								
125	River Lapwing <u>V. duvaucelii</u>								
126	Great Knot <u>Calidris tenuirostris</u>								
127	Knot <u>C. canutus</u>								
128	Sanderling <u>C. alba</u>								
129	Red-necked Stint <u>C. ruficollis</u>								
130	Little Stint <u>C. minuta</u>								
131	Temminck's Stint <u>C. temminckii</u>								
132	Long-toed Stint <u>C. subminuta</u>								
133	Sharp-tailed Sandpiper <u>C. acuminata</u>								
134	Curlew Sandpiper <u>C. ferruginea</u>								
135	Durlin <u>C. alpina</u>								
136	Broad-billed Sandpiper <u>Limicola falcinellus</u>								
137	Ruff <u>Philomachus pugnax</u>								
138	Jack Snipe <u>Lymnocyptes minimus</u>								
139	Snipe <u>Gallinago gallinago</u>								
140	Pintail Snipe <u>G. stenura</u>								
141	Swinhoe's Snipe <u>G. megala</u>								
142	Japanese Snipe <u>G. hardwickii</u>								
143	Asiatic Dowitcher <u>Limnodromus semipalmatus</u>								
144	Woodcock <u>Scolopax rusticola</u>								
145	Black-tailed Godwit <u>Limosa limosa</u>								
146	Bar-tailed Godwit <u>L. lapponica</u>								
147	Little Whimbrel <u>Numenius minutus</u>								
148	Whimbrel <u>N. phaeopus</u>								

WETLAND BIRD LIST

		Resident (If known to breed give number of pairs)	Migration (Give peak seasons I-XII)	Abundance codes				Average numbers seen during survey period	Maximum count and date
				May-July	Aug-Oct	Nov-Jan	Feb-April		
149	Curlew <u>N. arquata</u>								
150	Eastern Curlew <u>N. madagascarensis</u>								
151	Spotted Redshank <u>Tringa erythropus</u>								
152	Spotted Redshank <u>T. totanus</u>								
153	Marsh Sandpiper <u>T. stagnatilis</u>								
154	Greenshank <u>T. nebularia</u>								
155	Green Sandpiper <u>T. ochropus</u>								
156	Wood Sandpiper <u>T. glareola</u>								
157	Terek Sandpiper <u>Xenus cinereus</u>								
158	Common Sandpiper <u>Actitis hypoleucos</u>								
159	Grey-tailed Tattler <u>Heteroscelus brevipes</u>								
160	Wandering Tattler <u>H. incanus</u>								
161	Turnstone <u>Arenaria interpres</u>								
162	Red-necked Phalarope <u>Phalaropus lobatus</u>								
163	Great Black-headed Gull <u>Larus ichthyaetus</u>								
164	Black-headed Gull <u>L. ridibundus</u>								
165	Brown-headed Gull <u>L. brunnicephalus</u>								
166	Herring Gull <u>L. argentatus</u>								
167	Slaty-backed Gull <u>L. schistisagus</u>								
168	Black-tailed Gull <u>L. crassirostris</u>								
169	Common Gull <u>L. canus</u>								
170	White-winged Black Tern <u>Chlidonias leucopterus</u>								
171	Whiskered Tern <u>C. hybrida</u>								
172	River Tern <u>Sterna aurantia</u>								
173	Common Tern <u>S. hirundo</u>								
174	Roseate Tern <u>S. dougallii</u>								
175	Little Tern <u>S. albifrons</u>								
176	Gull-billed Tern <u>Gelochelidon nilotica</u>								
177	Caspian Tern <u>Hydroprogne caspia</u>								
178	Osprey <u>Pandion haliaetus</u>								
179	White-bellied Sea Eagle <u>Haliaeetus leucogaster</u>								
180	Grey-headed Fish Eagle <u>Ichthyophaga ichthyaetus</u>								
181	Lesser Fish Eagle <u>I. nana</u>								
182	Marsh Harrier <u>Circus aeruginosus</u>								
183	Northern Harrier <u>C. cyaneus</u>								
184	Pied Harrier <u>C. melanoleucos</u>								
185	Crested Kingfisher <u>Ceryle lugubris</u>								
186	Pied Kingfisher <u>Ceryle rudis</u>								
187	Kingfisher <u>Alcedo atthis</u>								
188	Brown-winged Kingfisher <u>Pelargopsis amauroptera</u>								
189	Stork-billed Kingfisher <u>P. capensis</u>								
190	Ruddy Kingfisher <u>Halycon coromanda</u>								
191	White-breasted Kingfisher <u>H. smyrnensis</u>								
192	Black-capped Kingfisher <u>H. pileata</u>								
193	Collared Kingfisher <u>H. chloris</u>								

WORKSHEET 11 : COMPLETION OF WETLAND DATA SHEETS
(INTERWADER FORM 3H)

As shown in Worksheet 10 (General Assessment of a Wetland) there are six points to be considered when evaluating a wetland. Using a data sheet such as that developed by INTERWADER is an excellent method by which to record the relevant data.

- the important point to remember is to try to fill in as many points as possible. This can be done either :-

- i) By direct personal observation
- ii) By obtaining information from local people
- iii) By a literature search in a library.

i) By direct personal observation

This is the most important method by which to evaluate a wetland. The information provided is always new, up-to-date and reliable. Information can be provided for almost all the sections in the Data Sheet in this way.

ii) By obtaining information from local sources

Important features and activities relating to a wetland can be gathered in this manner, information which is often not available to an observer can be collected. Most wetland areas have socio-economic importance to a local population and thus most wetlands have a peripheral community. If these areas are remote, the local community is often very inquisitive as to why visitors have come. This situation can be fully utilized by both parties i.e) the visitor (surveyor) to explain the reasons for the visit, to ask questions relating to the area and to promote the ideals of nature conservation and management with regard to the local economy. The local people will gain knowledge as to the importance of "their area" for migratory birds or wildlife etc on a regional or world scale as well as learning from additional questions relating to other areas. This technique of wetland evaluation can be called the "coffee shop technique" and is very important both from the point of view of gathering information as well as public relations with the local people. All conservation and management proposals for a wetlands area should always consider the local socio-economic effects of such legislation. Gauging the "local feeling" can be an extremely important part of assessing those effects.

iii) By a literature search in a library

Information can be gathered regarding historic data on the site. For example, changes in land ownership, size of the wetland and land-users. Also data on species found there and their relative abundance. Data collected during literature searches is always extremely useful before report preparation is undertaken.

N.B The compilation of a simple map of the wetland showing site boundaries, direction north, distances scale, habitat types, land-users, access points and position with extent of threats is always an important part of wetland evaluation.

WORKSHEET 12 : COLLECTION OF ZOO-BENTHIC BIOMASS

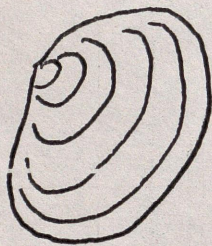
The zoo-benthic biomass of an area provides an indicator as to the density and identification of potential waterbird prey species present within an area. Waterbirds are highly sensitive to disturbance, such as pollution in an area, this is mainly due to a decrease in their food supply. So if we can assess the productivity of an area with regard to the abundance of known prey species for waterbirds we can indirectly assess its potential importance as a feeding area for these birds.

In the intertidal flats the invertebrate fauna found on the surface and burrowing below it are known as the zoo-benthic biomass. This can itself be divided into the macro-fauna - animals which will not pass through a 1mm sieve and meio-fauna - animals which will not pass through a 50um sieve. It is a selection of these animals which provide the basic food source for many species of migratory shorebirds and resident waterbirds. Animals which pass through the 50um sieve are known as the microfauna and are not important as prey species for shorebirds.

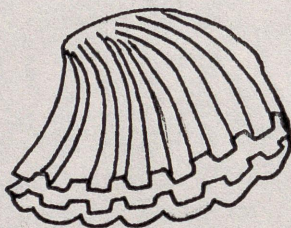
Quantative collection of zoo-benthic biomass data

In order to compare the productivity of one wetland with another (using available shorebird prey species as indicators) all data must be collected in a standard manner and produce a quantative result. The zoo-benthic biomass of an area is calculated as an Ash Free Dry Weight per square metre of intertidal flat (more about that later Worksheet 13)

Important prey type for shorebirds :-



Thin shell



Thick shell

Bivalve Molluscs
Examples :

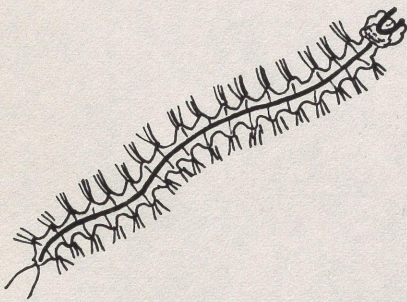
Crustaceans
Examples :



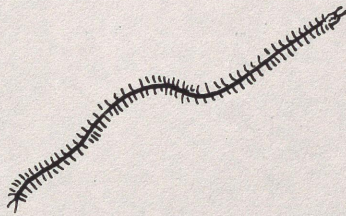
Crabs



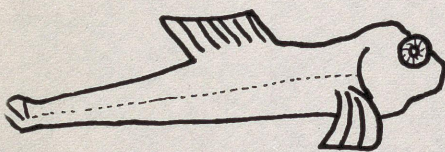
Shrimps



Polychaetae worms



Worms



Gobiid fish

Fish

During studies conducted by INTERWADER throughout S.E. Asia, techniques of benthic biomass determination have followed those developed by the Netherlands Institute for Sea Research (NIOZ). The standard technique can be summarized as follows :-

1. A series of cores are taken from the low tide limit to the high tide limit at 10m intervals (see diagram 1) i.e) if the area of exposed flats is 200m wide, a total of 20 cores will be taken.
2. For each core the macro-fauna is separated from the inorganic matter by sieving through a 1mm mesh.
3. The macro-fauna obtained from each core is stored in 5% Formalin in a plastic bag.
4. The contents of 10 cores are placed in one bag and constitute 1 sample.
5. Every subsequent 10 cores constitute 1 sample. So a 200m wide intertidal zone will be sampled by taking 20 cores which constitute 2 samples.

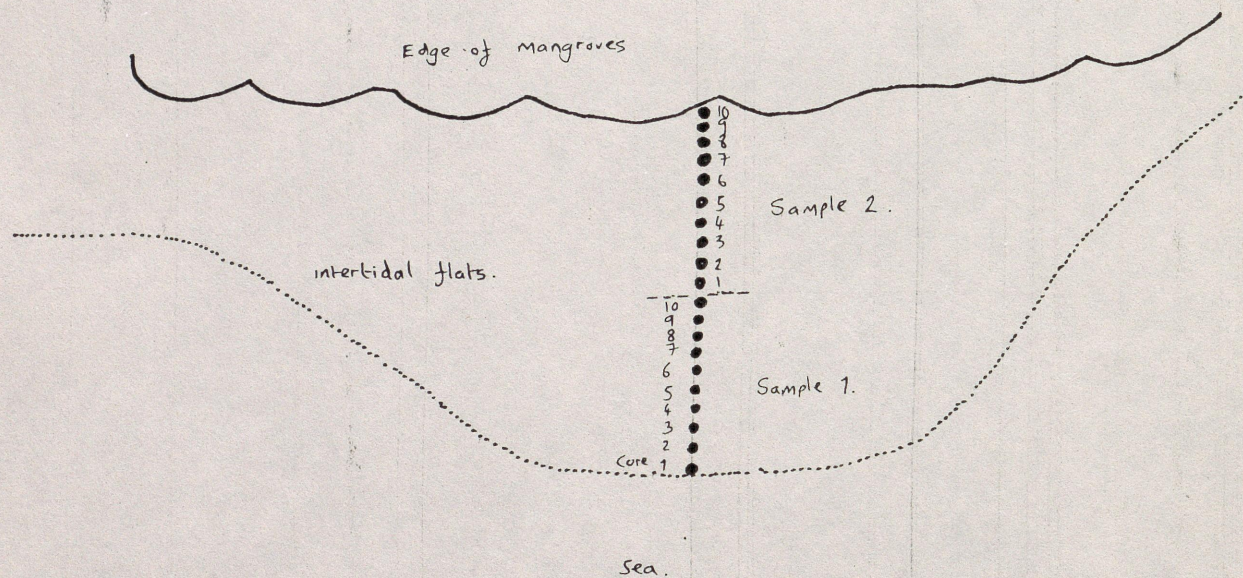
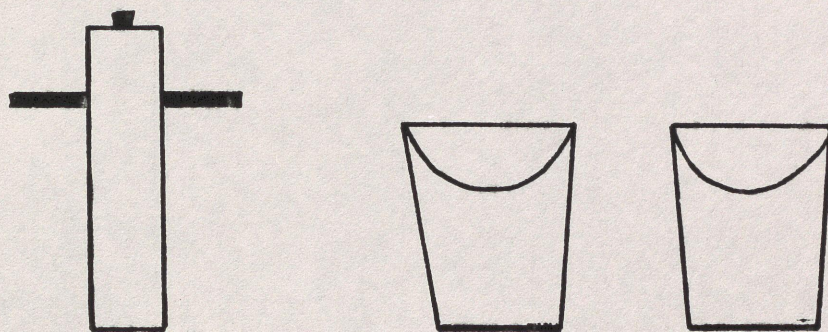


Diagram 1: Position of biomass cores generally taken in intertidal wetlands.

How to collect each core

Equipment needed

- corer (1)
- plastic buckets (2)



- At 10 metre intervals (measured by pacing) the corer is pushed c40cm into the mud (with the rubber bung removed). The bung is then replaced and the corer (with mud core inside) removed from the ground.
- The corer is positioned over a plastic bucket and the bung removed. The contents then slide into the bucket (sometimes, particularly in stiff clays the corer must be shaken to remove the contents).
- Water is collected in the other bucket and poured into the bucket with the core. This is then mixed with the hands to form an emulsion of liquid mud and water. When no hard lumps of mud remain the contents are ready for sieving.

NOTES:

How to sieve and store the core contents

Equipment needed :-

- sieve with 1mm mesh (1)
 - plastic trays (2)
 - Stainless steel tweezers (1)
 - small plastic bags
 - formalin 10%
-
- Part of the water/mud emulsion is poured from the plastic bucket into the sieve.
 - Using an area of shallow standing water e.g a pool on the mudflat the sieve and contents are vibrated vigorously. This removes the silt and small particles leaving only large pieces of inorganic matter e.g wood or shell fragments and the macro-fauna.
 - The contents of the sieve are pushed into one corner and washed into a plastic tray for initial sorting. Any remaining organisms in the sieve are picked out with the tweezers (N.B. Some polychaete worms are able to become entangled in the mesh and need to be removed after each sieving.)
 - In the plastic tray all large pieces of inorganic matter are removed and the rest is poured into a plastic bag and stored in 5% formalin.
 - After each 10 cores the contents are placed in one larger plastic bag and sealed and labelled as Sample 1, 2, 3 etc. For the construction of sampling equipment see Information Sheet 3.

Notes:

Problems associated with benthic biomass sampling :-

- Time : In intertidal areas sampling must be started only when enough time is available to complete at least 1 sample (i.e. 10 cores). However 2 or 3 samples/site is desirable. Always begin sampling at the time of the lowest tide and begin the first core on the water edge and work toward the landward edge i.e. the mangrove fringe.
- As a rough guide: with practice each core (i.e. taking the core, making an emulsion, sieving and bagging in 5% formalin) should take a 4 man team 5 minutes. Therefore ca 1 hr/sample.
- Ensure that all living matter is removed from the sieve after sieving. Some animals such as polychaete worms become entangled in the mesh and must be removed using tweezers.
- Do not mix the mud/water emulsion too vigorously - fragile molluscs shells and thin polychaete worms may break-up.
- Ensure that the contents of each core are stored in 5% formalin. If not in hot weather many animals will rot and samples will be useless.
- Do not spill any of the mud/water emulsion it may contain living animals. It is important to preserve as much as is possible of all living matter in each sample.

Notes:

WORKSHEET 13 : ASSESSMENT OF ASH-FREE DRY WEIGHTS OF ZOO-BENTHIC BIOMASS

This part of the procedure is conducted in the laboratory

Sorting samples

Equipment needed :-

- sorting trays
- tweezers
- petri dishes
- 5% formalin



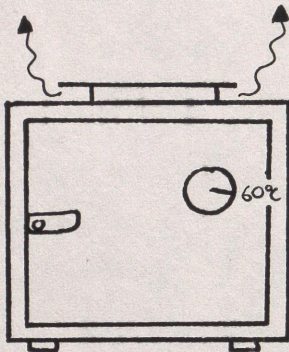
- Each sample is divided amongst laboratory workers and placed into plastic sorting trays with 2cm of water.
- The petri dishes are laid out on the work bench with a small quantity of water and formalin inside.
- Using the tweezers the contents of the sample are carefully sorted and each different animal groups placed in a petri dish i.e crabs in one, shrimps in another, polychaete worms another, etc.
- This process is continued until all of one sample is sorted. These petri dishes can then be labelled as Sample 1 and placed to one side.
- The process is continued for subsequent samples.

NOTE : Samples must NOT be mixed up. To prevent this, label carefully and place on different tables.

Drying samples

Equipment needed :-

- ventilated drying oven (temperature range to include 60 Deg Centigrade).

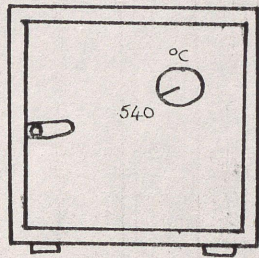
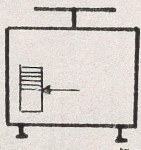


- Each series of labelled petri dishes/sample are placed on different shelves in a ventilated drying oven.
- They are left for 2 days at 60 Deg C with the ventilator fully open to allow the escape of moisture and to allow the samples to dry to a constant weight.

Burning to assess Ash-Free Dry Weight

Equipment needed :-

- accurate weighing balance
- ashing oven (temperature range from to exceed 540 Deg C)
- stainless steel or pottery crucibles



- Each crucible is weighed empty (weight A grammes)
- The contents of each petri dish (i.e. dried crabs, dried shrimps, dried worms) are placed into separately weighed crucibles and reweighed (weight X grammes)

- All crucibles are then placed in the ashing oven. At 540 Deg Centigrade for 2 hours and burnt until only ash remains.
- The crucibles and ash contents are then removed and re-weighed (weight Y grammes)
- The Ash Free Dry Weight can then be calculated for each invertebrate group or an a whole using the formula).

$$\begin{aligned} \text{A.F.D.W.} &= [\text{weight X} - \text{weight A}] - [\text{weight Y} - \\ (\text{Ash Free Dry Weight}) & \quad \text{weight A}] \end{aligned}$$

$$\begin{aligned} \text{A.F.D.W.} &= (\text{weight X} - \text{weight A}) - (\text{weight Y} - \text{weight A}) \\ &= (22\text{g} - 10\text{g}) - (15\text{g} - 10\text{g}) \\ &= (12\text{g}) - (5\text{g}) \\ &= 7\text{g AFDW of crabs in Sample 1} \\ &===== \end{aligned}$$

Calculation of Ash Free Dry Weight per square metre of intertidal flats.

- The surface area of one core = $2 \pi r^2$ (= 3.141)
 the radius of each core = 5.5 cm
 the surface area of one core = 34.55 square cm's
 the surface area of one sample (= 10 cores)
 = 345.5 sq cm.
 = 3.455 sq m.

So in order to assess the AFDW/square metre of mudflat of or crabs in Sample 1 (calculated from previous example) :

$$\begin{array}{rcl} \text{AFDW of crabs in Sample} & = & 7 \text{ g} \\ \text{AFDW of crabs}/3.455\text{m}^2 & = & 7 \text{ g} \\ \text{AFDW of crabs}/1 \text{ m}^2 & = & 7 \text{ g} \\ & & \text{-----} \\ & & 3.455 = 2.02 \text{ g} \\ & & \text{=====} \end{array}$$

NOTES: