Floral Biology and Pollination Ecology of *Rhizophora mucronata* in Gulf of Kachchh, Gujarat, India

by

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Presented by

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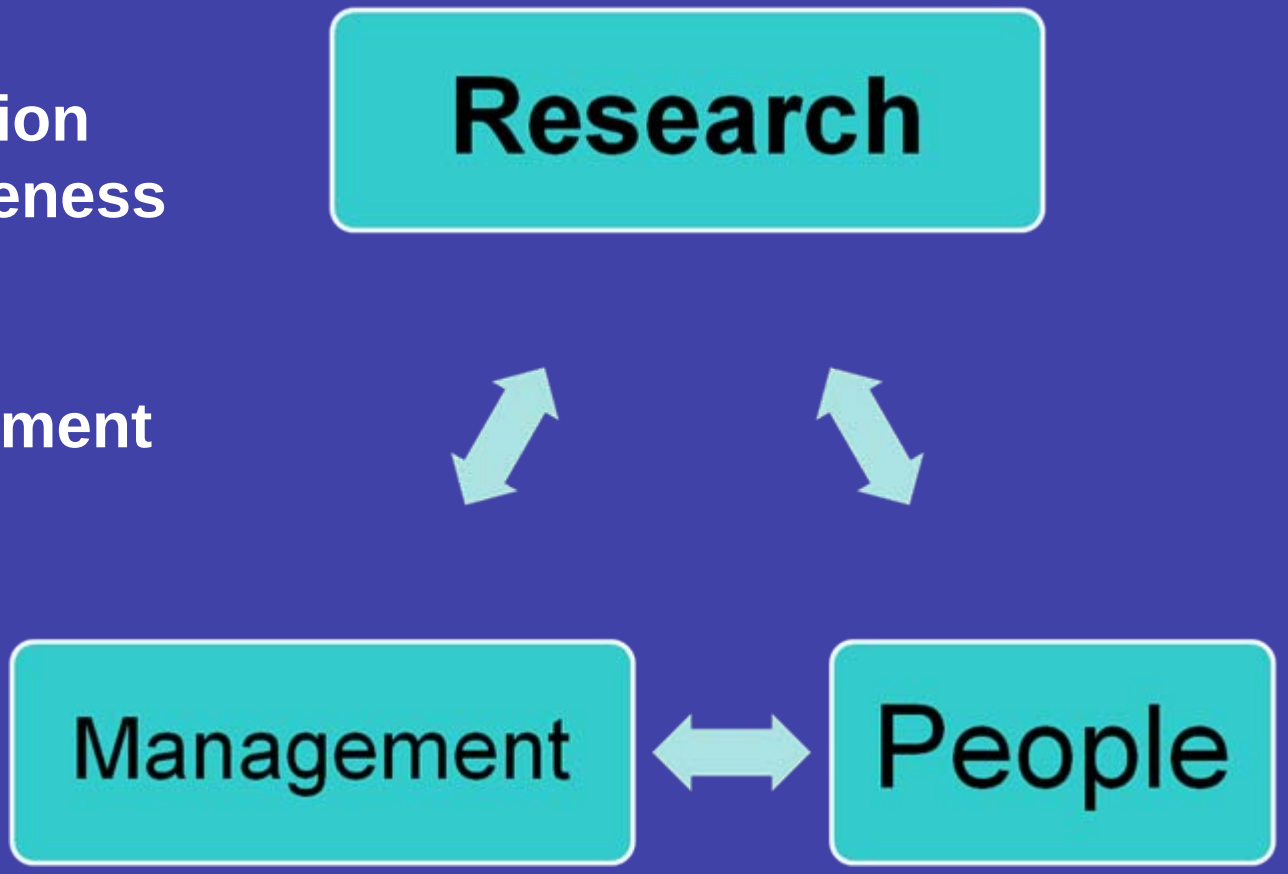
Gujarat Ecological Education and Research (GEER) Foundation

MANDATES

- Ecological Research
- Ecological Education and Awareness
- Research Inputs to management



Present work is part of ongoing research project titled

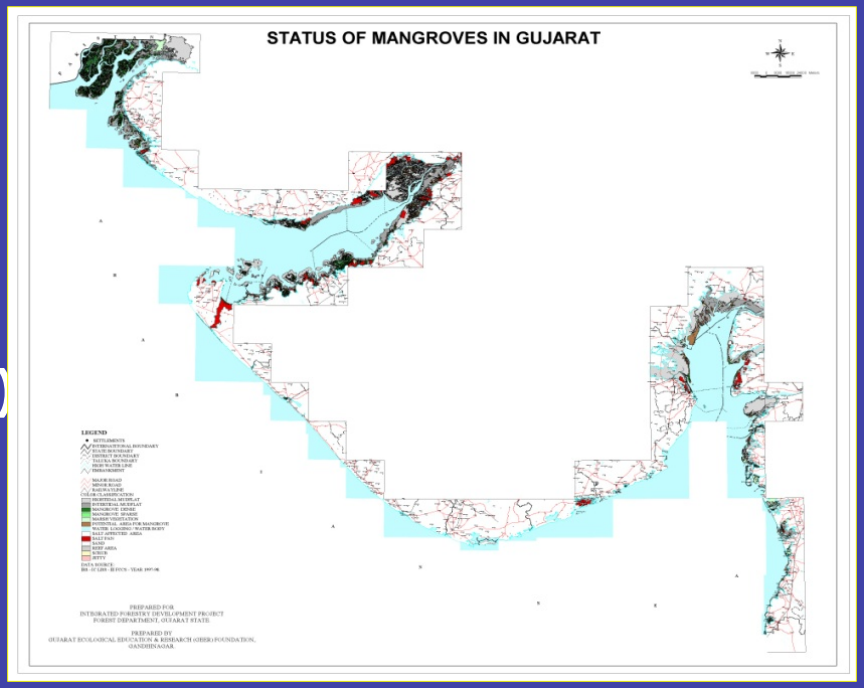
"Study of Pollination Biology and Reproductive Ecology of Major Mangrove Species of Gujarat"

Sponsored By

Ministry of Environment and Forest
Government of India

Indian Coast

Long coastline – about 8000 kms.
38 important mangrove sites
4 major coral reefs



Gujarat Coast

- Longest coastline in India-1650km (22%)
- 66 % of India's coastal wetlands
- 2 gulfs out of 3 in India.
- 2 gulfs cover 60% of state's coastline.
- Major ecosystems: coral reefs & mangroves.
- High tidal amplitude, gentle slope in coastal areas, large intertidal zone
- Occupies 165000 km^2 of Indian continental shelf of 468000 km^2 (35.3%).
- Highly industrialized state- tremendous pressure on these ecosystem.
- Frequent natural threats - cyclone, earthquake, drought, warm streams..

Relative Abundance of Mangrove Species in Gujarat

Abundant species

Avicennia marina

A. alba

A. officinalis

Species with localized abundance

Rhizophora mucronata ,

Ceriops tagal ,

Acanthus illicifolius

Species which are rare at state level

Aegiceras corniculatum

Sonneratia apetala

Bruguiera gymnorrhiza

Recently recorded mangrove species

Excoecaria agallocha

Ceriops decandra

Rhizophora apiculata

Previously reported but not seen in recent past

Bruguiera cylindrica

Species diversity is low-only 13 species

Objectives

Examination of floral phenology, floral biology and pollination ecology of *R. mucronata*

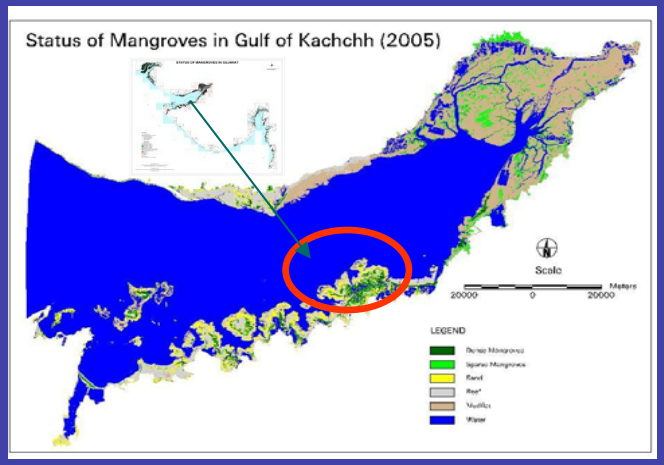
Examination of the nature of floral exudate of *R. mucronata*

Temporal relation among anthesis, anther dehiscence, stigma receptivity, nectar (if present) secretion and visitation pattern of floral visitors

Mangrove Species Under Study

Rhizophora mucronata

STUDY AREA, GULF OF KACHCHH, GUJARAT



Location of research stations

Pirotan Island

Bhensbid Island

Sikka Coastal

METHODOLOGY

Flowering phenology -30 trees

Flowering processes-

Anthesis, Anther dehiscence & Stigma receptivity(H_2O_2 method)

-300 samples for each process (in four time zones)

Pollen and ovule production (heamocytometer, light microscopy)

- 60 flowers (for each)

Pollen load on petal hair (light microscopy) – 207 flowers (of different floral stages)

Visitation pattern of pollinator- diurnal and nocturnal

Pollen load on floral visitors (light microscopy)

Nature of floral exudate- (Paper chromatography)

Observations were made during flowering season of R. mucronata in mangrove forests

Results

Floral Phenology Of *Rhizophora mucronata*

Immature buds

(November to April)

Anthesis

Mature buds

(May - July)

Anther Dehiscence

Pollination

Contd…

Petal senescence and exudate secretion (May - July)

(September –October)

Fertilization and seed setting

(August)

Propagule development and recruitment

November –December (next year)

Floral biology

Floral Biology of *R. mucronata*- 12 stages

(110±29 hrs)

(11±4 hrs)

(11±5 hrs)

(10±1 hrs)

(16±2 hrs)


St-6

(20±5 hrs)


St-7

(18±4 hrs)


St-8

(19±3 hrs)


St-9

(26±6 hrs)


St-10

(46±9 hrs)

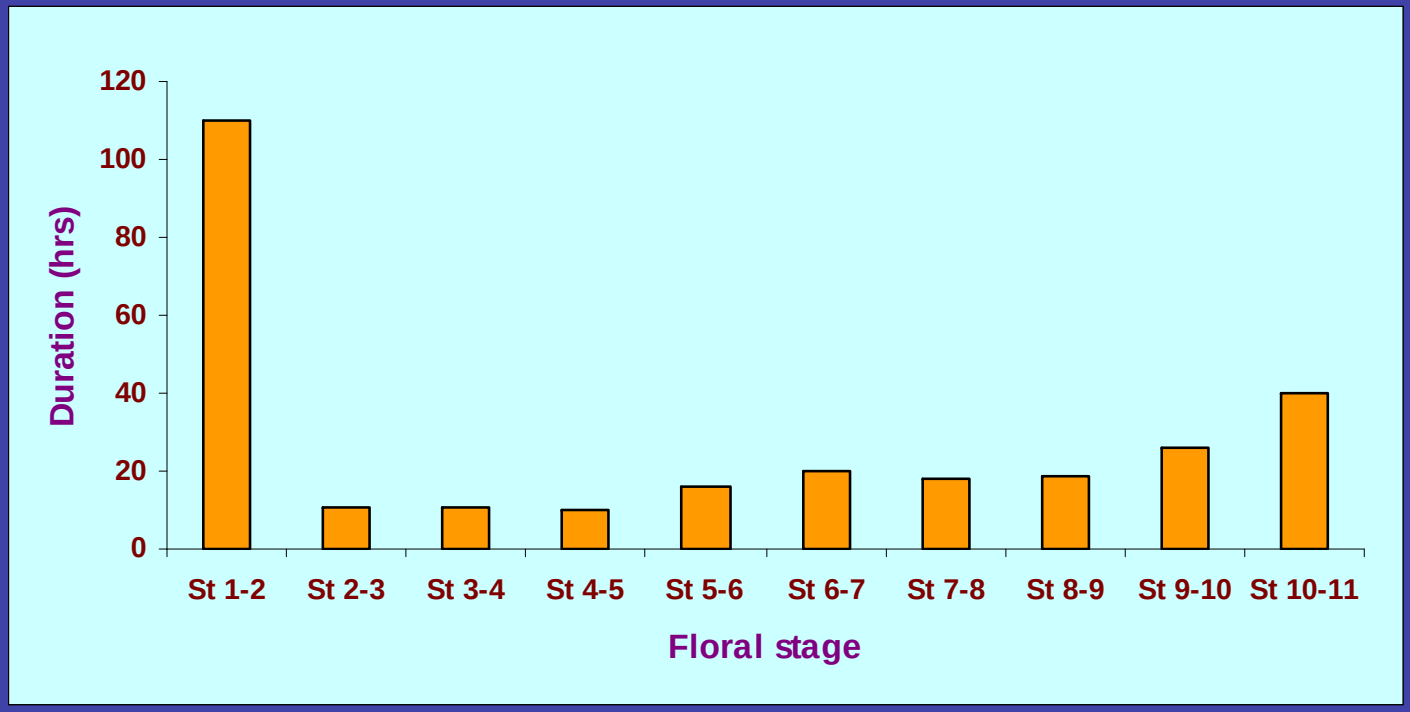

St-11

(45-60 days)


St-12

Stage	weeks
1-11	2
11-12	6-8

Pace Of Transformation Of Floral Stages



Transformation period from St 1 to St 2 is 110 hrs
Transformation period from St 2 to St 11 is about 12 hours
Transformation from St 11 to St 12 is 45 to 60 days
The transformation was found to be faster in day time than in night

Anthesis

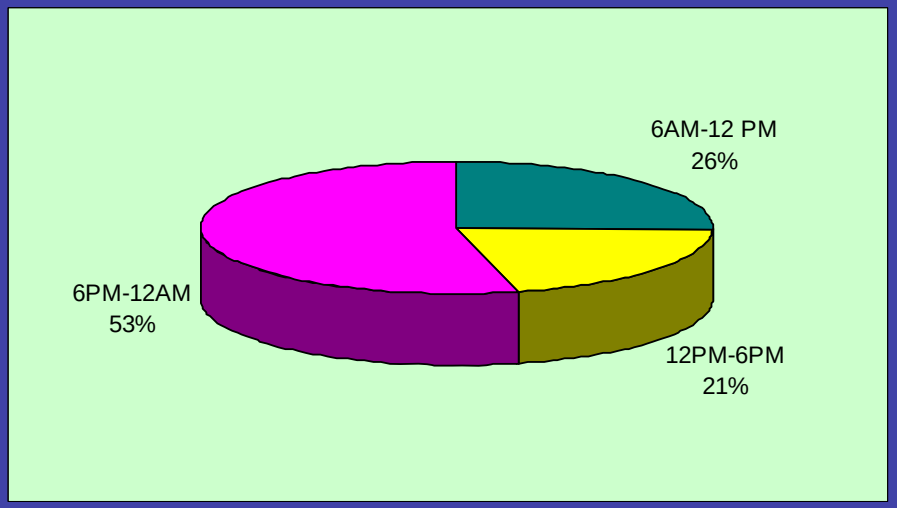
St-3

St-4

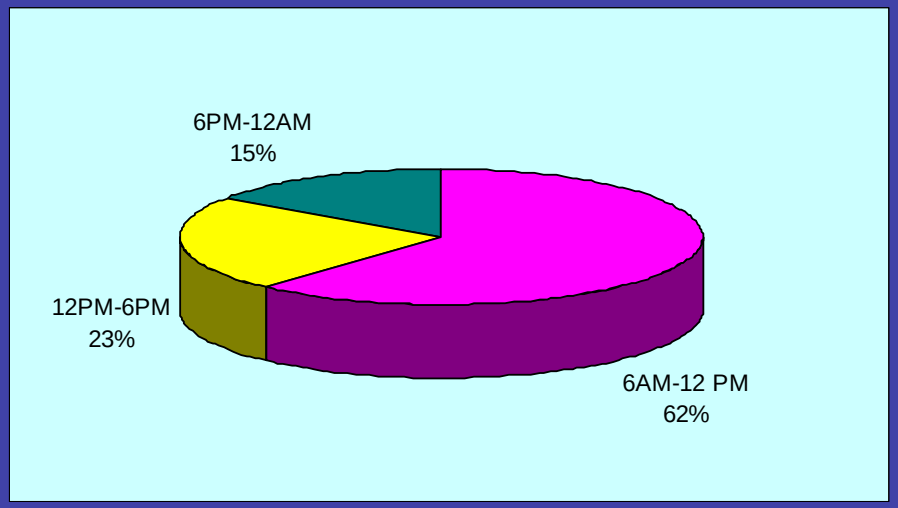
Anthesis starts by a slit at the apex of the bud

Anthesis

Initiation of anthesis



Completion of anthesis



Anthesis reported in day and night both
More than 50% anthesis initiate after 6 pm
More that 60% of anthesis get completed between 6 am to 12 pm

More than 80% Flowers tend to remain open during day period

Anther Dehiscence

Anther dehiscence via longitudinal opening

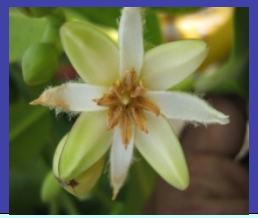
Opening by breaking of epidermal layer of anther wall of lower portion

The epidermal layer of anther wall fall on the stigma and partially prevent the self pollination

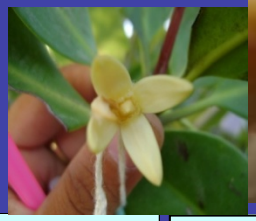
The Role of Petals

S 3

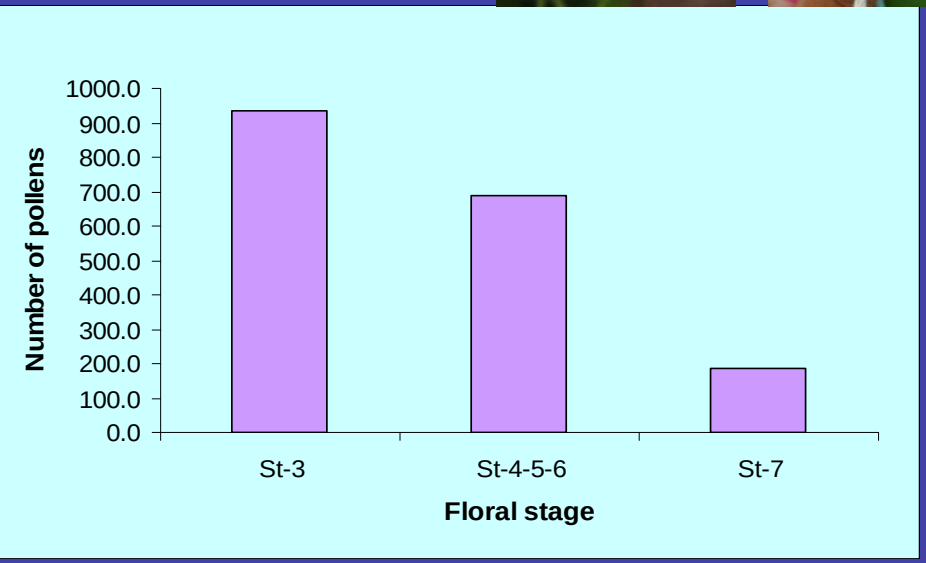
S 5



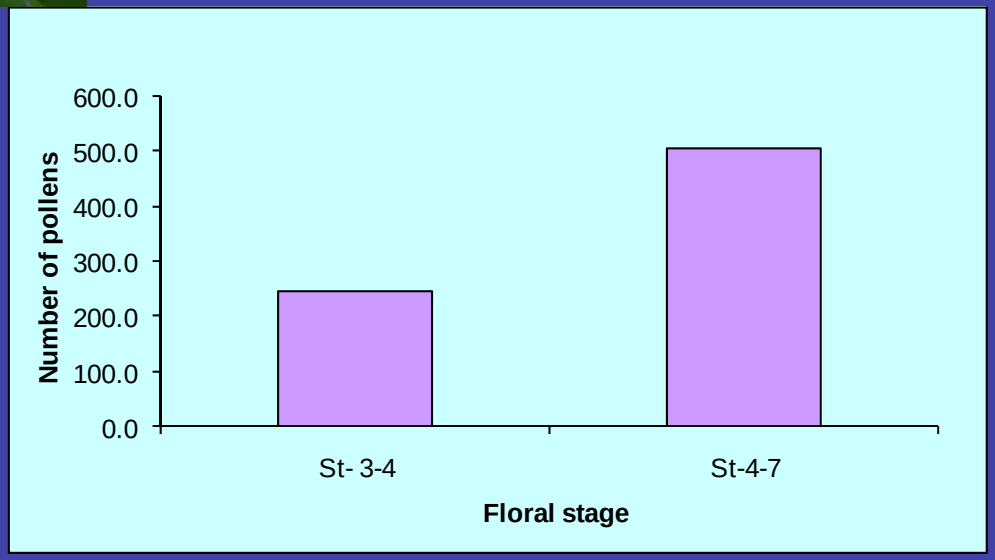
S 6



S 7



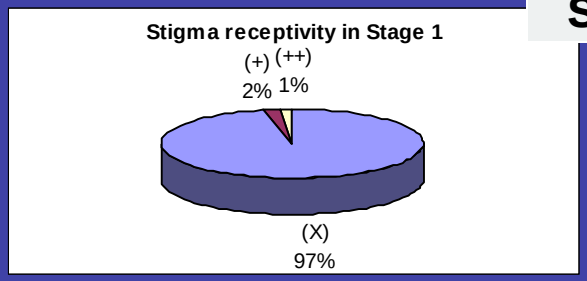
Pollen load on petals in different floral stages



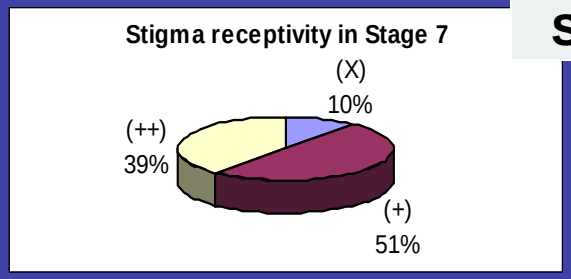
Pollen dispersal by petals in different floral stages

Regulate pollen dispersal after anther dehiscence

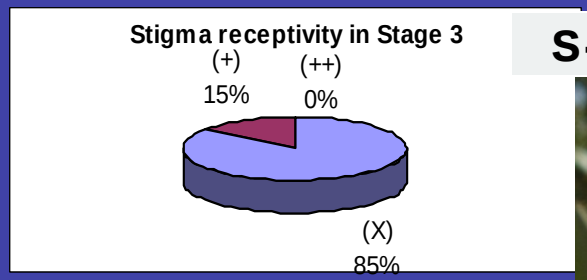
Stigma Receptivity In Different Floral Stages



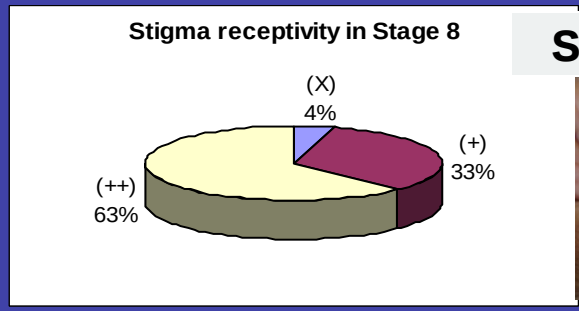
S-1



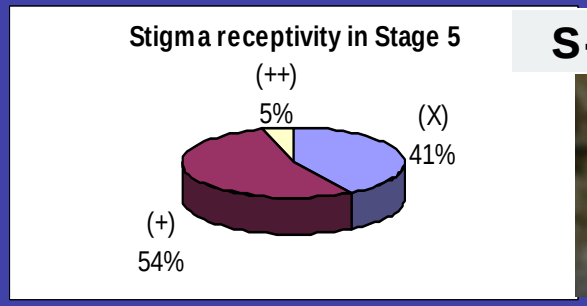
S-7



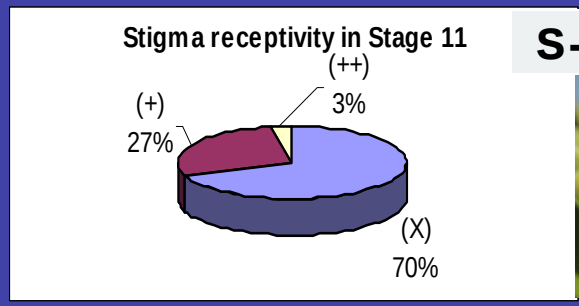
S-3



S-8



S-5



S-11

X- Stigma non receptive

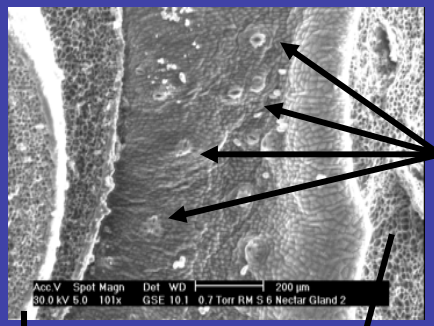
+- Receptivity initiated but very mild

++- Strong stigma receptivity

The Role Of Exudates after Petal Fall

1. Shown presence of sugar- nectar
2. Different proportion of monosaccharide in different floral stages

Location of Nectary

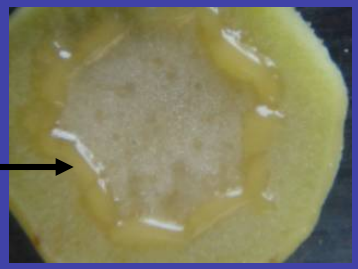


Nectaries

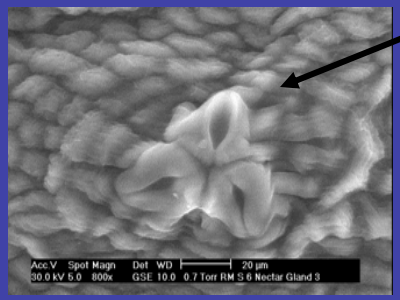
Ovary base

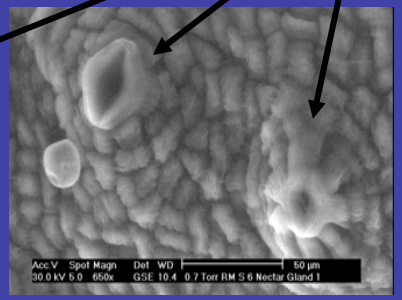
Petal base

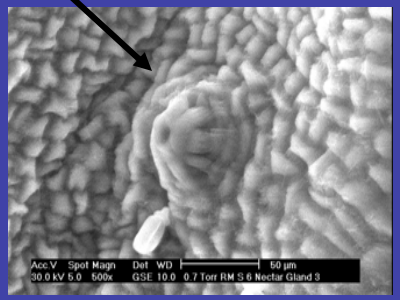
Floral Exudate



Floral nectary







Secretion after petal and anther fall seems to be a pollinator reward

Floral visitors of *R. mucronata*

- **Total recorded visitor - 18**
- **Diurnal visitors -8**
  - **Honey bees 2**
  - **Bees 2**
  - **Butterfly 1**
  - **Birds 1**
  - **Beetle 2**
- **Nocturnal visitors- 1**
  - **Moth 1**
- **Diurnal and nocturnal-9**
  - **Spider 7**
  - **Ants 2**

Out of these, bee and ant were found to be most frequent floral visitors

Diurnal floral visitors of *R. mucronata*

Beetle

Ants

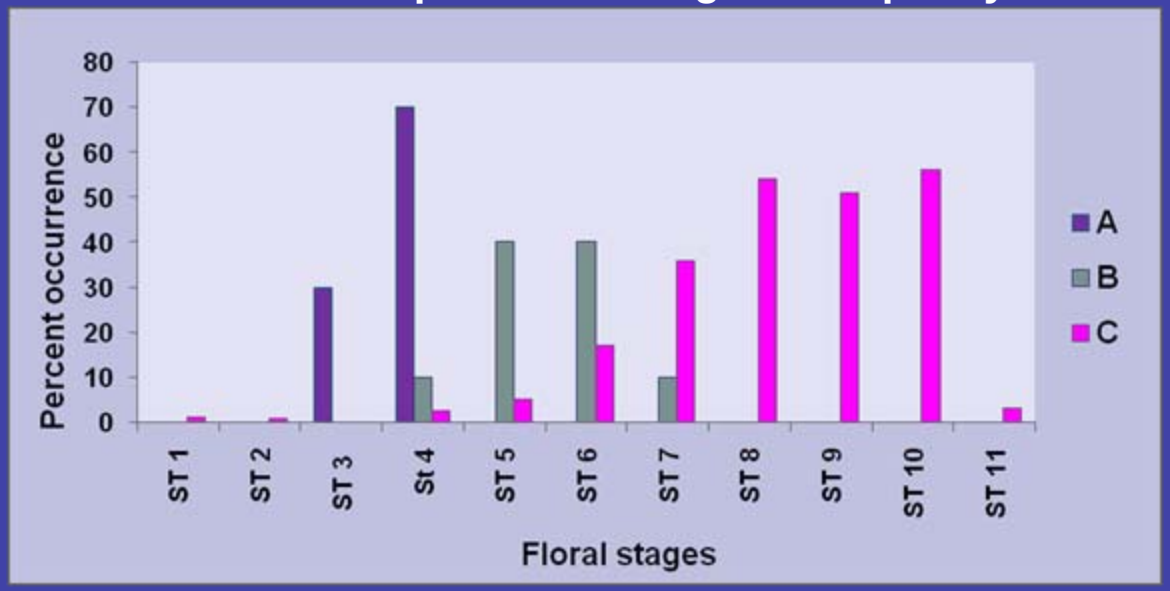
Spiders- feeding on floral visitors

Tetraganatha sp

Aragope anusuja

Temporal Relation between Pollen dispersal, Stigma receptivity, Floral visitors

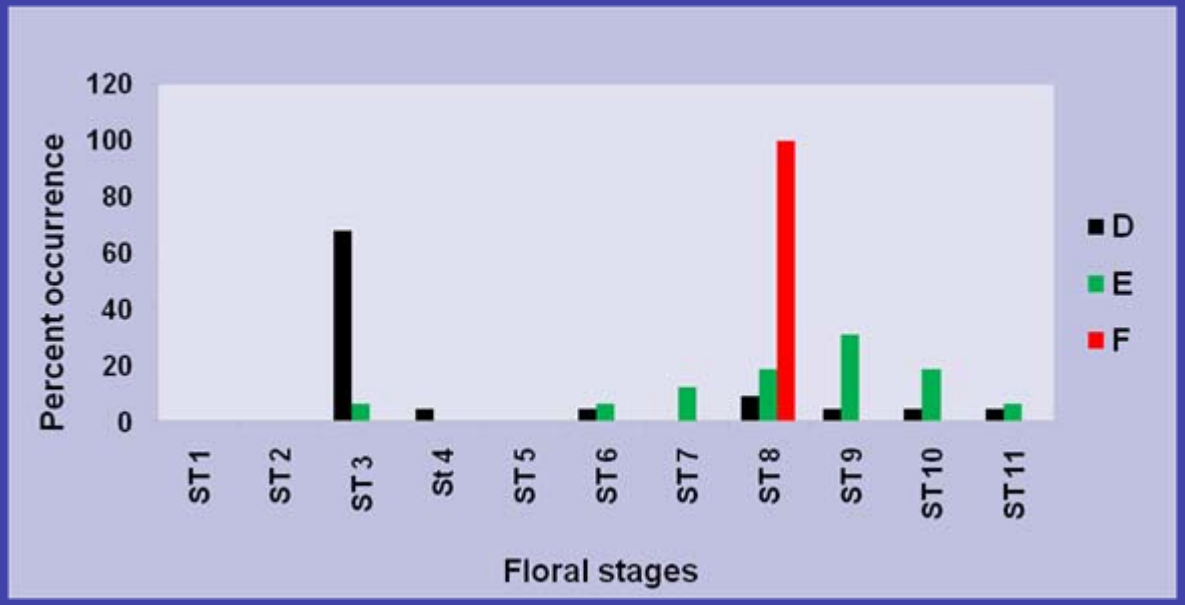
Pollen Dispersal and Stigma receptivity



A-Pollen dispersal by Anther

B- Pollen dispersal by Petal hair

C- High stigma receptivity



D- Bee (floral visitor)

E- Ant (floral visitor)

F- Nectar secretion

Floral visitors and nectar secretion

Inferences from Floral biology

- *Pollen dispersal by anther and stigma receptivity are totally out of phase- Protandry*
- *Pollen dispersal by petal hair and stigma receptivity are generally out of phase (overlapping in S-4 to S-6 holding possibilities of self breeding)*
- *Stigma receptivity, nectar secretion are synchronous- S-8*
- *Floral visitor & nectar secretion are synchronous - validating Insect pollination*
- *High possibility of cross pollination*
- *Significant possibility of insect pollination*

- *Visitation by bees during S-3 is for pollen collection*
- *Visitation by bees during S-8 to S-9 is for nectar collection*
- *Visitation by ants during S-8 to S-10 is for nectar*
- *Ants were not seen around stigma - not direct pollinators.*
- *Insect predators such as spiders, birds may play the role of indirect pollinators*
- *Wind is an important factor- could play positive as well as negative role*
- *Wind pollination is less assured as compared to biotic (insect) pollination*
- *Wind pollination is less efficient than biotic (insect) pollination*

Is the species evolving from abiotic pollination system to biotic pollination system???

Relevance of the Study

- ***The information about the floral biology and floral phenology is the prerequisite for in situ conservation of any species***
- ***It appears that the pollination system of the species is not very efficient***
- ***Hence such species need to be conserved ex situ also***
- ***The pollination is acting not only as the reproductive process but also as a productive process where various organisms get their food directly (visitor feeding on pollen or/ and nectar) or indirectly (organisms feeding up on floral visitors)***
- ***The function of the ecosystem could be appreciated in a more comprehensive way***

Potential Area for Mangrove Afforestation (Area in km^2)

Criteria for identifying potential mangrove afforestation area

1. Mudflats
2. Past history of mangrove forests
3. Tidal inundation

Potential area for mangrove afforestation in km^2-637.15

Field Difficulties

Field Conditions

Research stations get submerged during high tide every day

Unexpected Tidal Flooding

Unexpected flooding of camping site at field the stations

Field Observations

Group discussions during field observations

Early morning observations

Counting of floral stages

Collecting floral visitors

Late evening observations

Other Field Supports

Provision & water supply

Make Shift Laboratory

Communication arrangement

Hazardous Field Conditions

Team member protecting him from poisonous insects

Saw scale viper (poisonous) on mangrove tree

The team

GEER Foundation
1.Mr. C. N. Pandey
2.Dr. Harshad Salvi
3.Ms. Richa Pandey
4.Mr. Shailesh Dodiya
5.Ms Urvi Bhatt
6.Ms Anjali Sharma
7.Mr. Sunil Panchal
8.Mr. Irshad N. Theba
9.Mr. Sandeep Patel
10.Ms Yamini Verma
11.Mr. Nilesh
12.Mr. Juma bhai
13.Mr. Virag
14. Mr. Junusbhai and his team

Technical Guidance
1.Dr. B. K. Jain
2.Dr. K. S. Rao
3.Dr. K. S. S. Mohan
4.Dr. Reddy
5.Dr. Y Jasrai
6.Dr. K. Kathiresan

Students from Various Universities
1.Mr. Niraj
2.Mr. Chetan
3.Mr. Prateek
4.Mr. Sujeet
5.Mr. Amit
6.Mr. Hitesh
7.Mr. Harshad Solanki
8.Mr. Jayesh
9.Mr. Shashikant
10.Ms. Puja
11.Ms Reshma


Thanks….