Adaptation to Climate Change

Observations in a Darwin Initiative Project: 'Conserving Giant Clams Through a Community Reserve in the Lakshadweep Islands, India'

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Bombay Natural History Society – est. 1883

Mission

Conservation of nature,
primarily biological diversity,
through action
based on research, education and public awareness

BNHS and Darwin Initiative

- Giant clam conservation
- Vulture conservation
- Jerdon's Courser conservation
- Important Bird Areas (IBA) – India
  http://www.bnhs.org/

Leadership for Environment and Development – est. 1992

Mission

To create, strengthen and support networks of people and institutions **promoting change** towards sustainable development that is economically sound, environmentally responsible and socially equitable.

LEAD and Darwin Initiative

- Giant clam conservation, Lakshadweep, India

  http://www.lead.org/page/89

- Conserving coral reef through community enterprise, Bali, Indonesia

  http://www.lead.org/page/139

‘Project Giant Clam’ - Rationale

- Conservation must be linked with development. Protected areas can not be separated from their social, economic and political context, and they can not survive indefinitely in a sea of human needs.

What is Unique about Giant Clams?

- Exclusively in tropical seas, on coral reefs
- In shallow waters
- Permanently anchored
- Symbiotic association with Zooxanthellae
- Synchronised spawning
- Long adult life
- Short larval life
- Slow growth rate

Giant Clams in India

1. *Tridacna maxima*
2. *Tridacna squamosa*
3. *Hippopus hippopus*

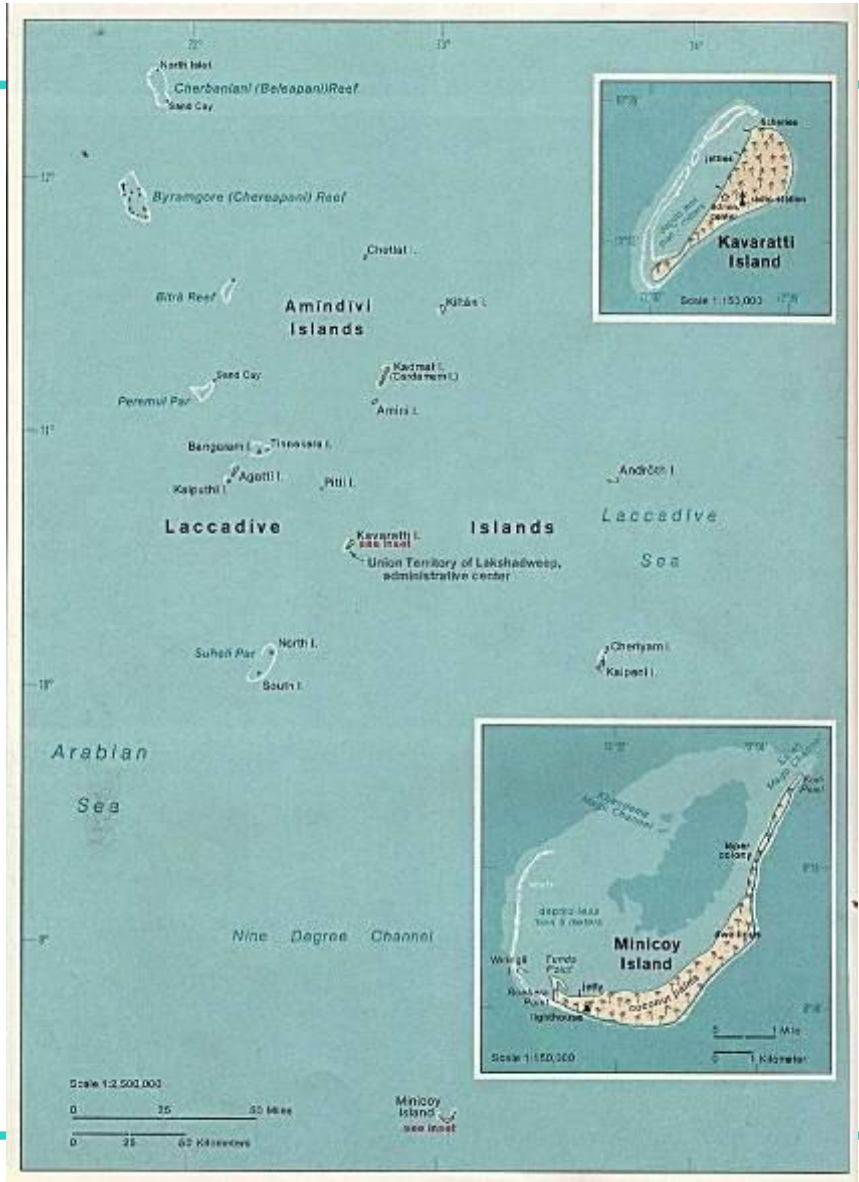
Photo: Deepak Apte

Project Site

The Lakshadweep archipelago consists of 36 islands

Photo: Deepak Apte

Project Site



Atoll Formation

Photo: Deepak Apte

Project Components

- Research
- Education
- Tuna & bait fish
- Tourism

Research

1. Giant clam: distribution, density, breeding population, recruitment, mortality, size class, associates, predators, anchorage, reef canopy preference, mantle profile.

2. Habitat profile and recovery pattern

Methodology

Total count:

Line transect to obtain a representative sample of population (1% lagoon area)

Transect:

100 m x 20 m fixed width

Photo: Deepak Apte

Assumptions

(a) Size classes used for present study

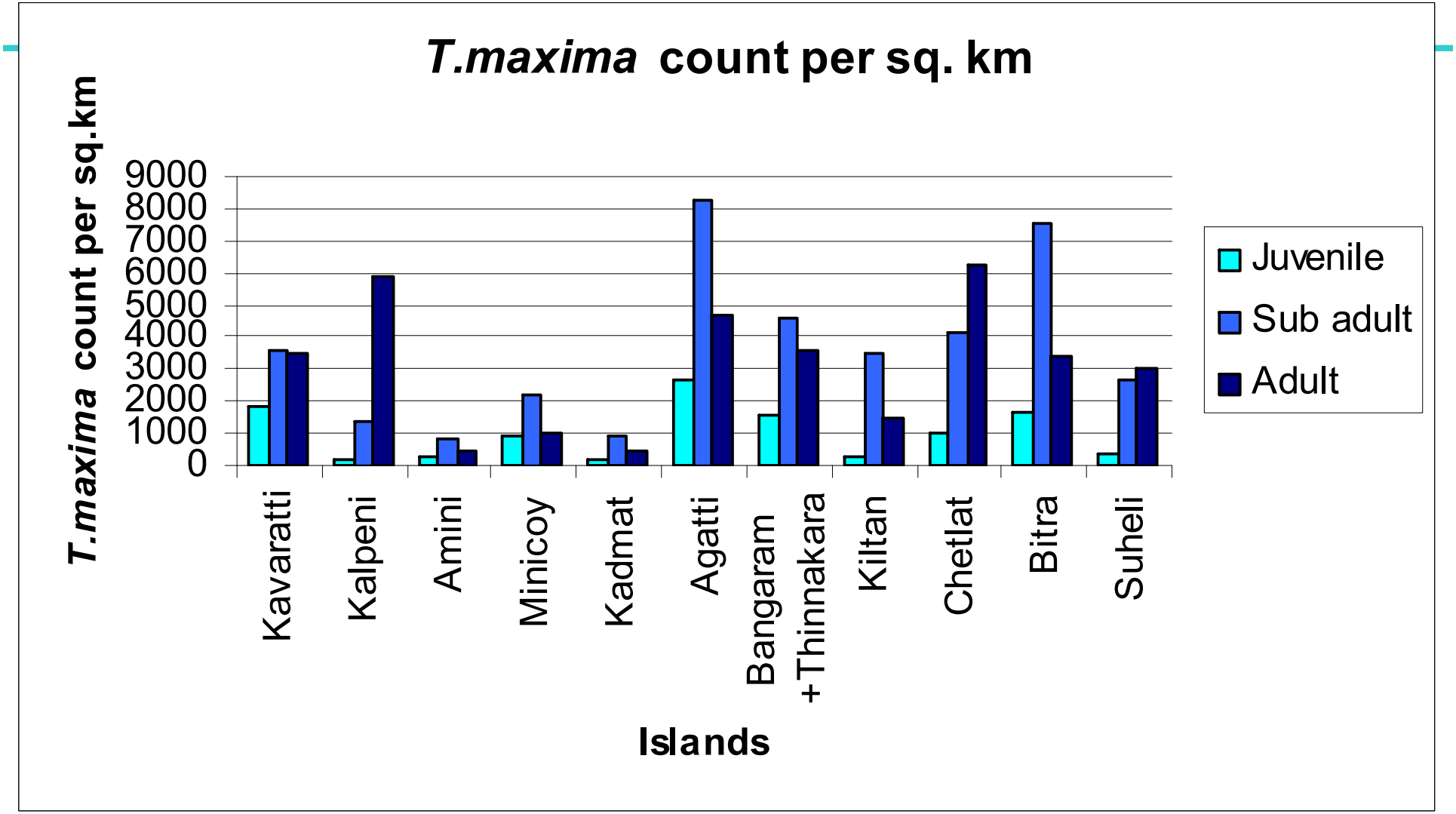
- Juveniles < 100 mm
- Sub-adult < 200 mm
- Adult > 200 mm

(b) 70% area is reduced from total confined (lagoon) water due to dominance of sand and seagrass

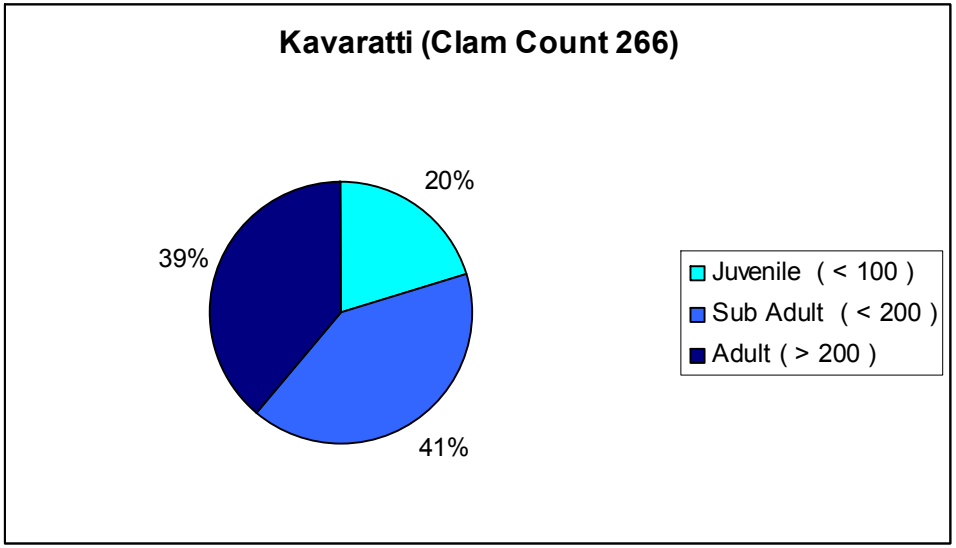
Potential Area (km^2) for *T. maxima*

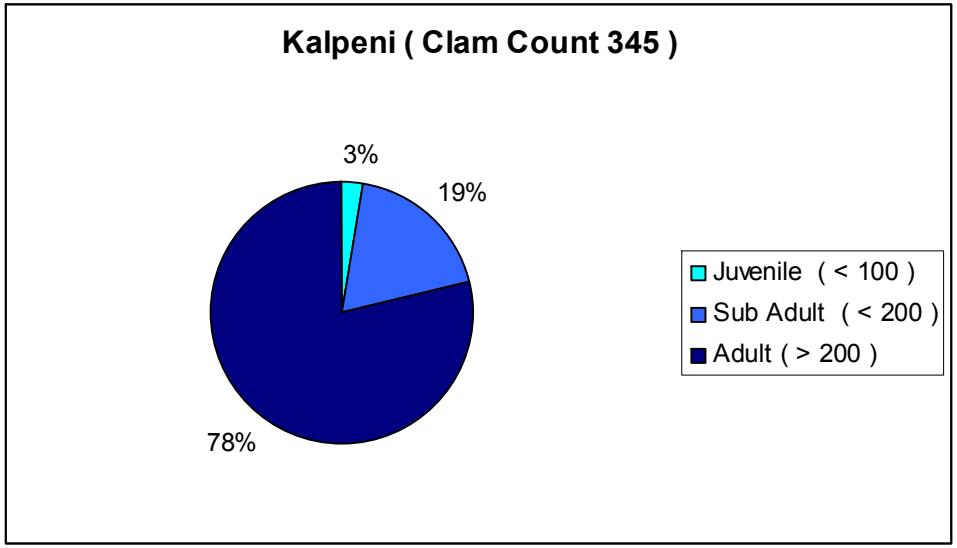
Island	*Lagoon Area*	*70% Lagoon area*	*Potential area*
Kavaratti	*4.960*	*3.47*	*1.49*
Kalpeni	*25.60*	*17.92*	*7.68*
Minicoy	*30.60*	*21.42*	*9.18*
Kadmat	*37.50*	*26.25*	*11.25*
Agatti	*17.50*	*12.25*	*5.25*
Bangaram	*46.25*	*32.37*	*13.88*
Kiltan	*1.76*	*1.23*	*0.53*
Chetlat	*1.60*	*1.12*	*0.48*
Bitra	*45.61*	*31.92*	*13.69*
Suheli	*78.96*	*55.27*	*23.68*

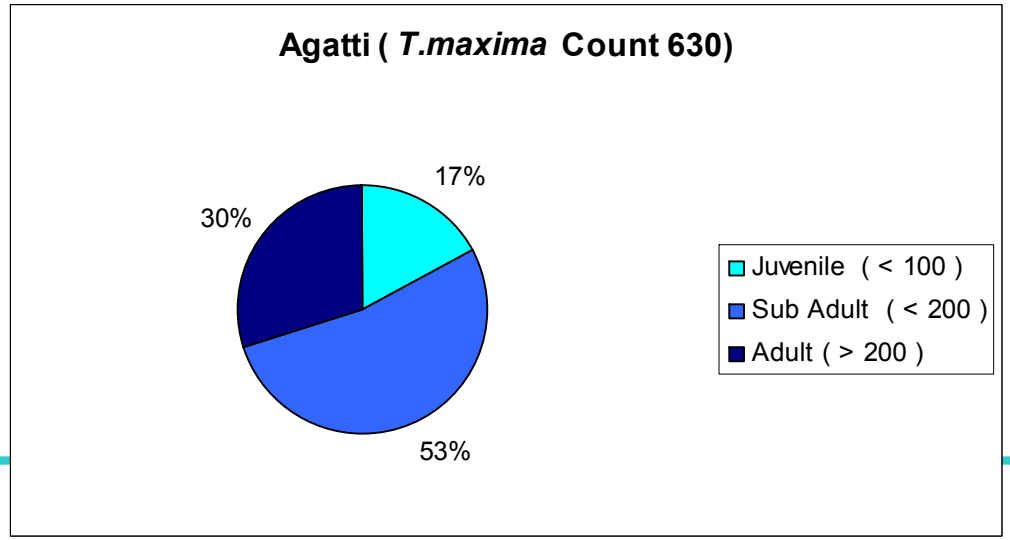
Density (count/km^2) **of** ***T. maxima***



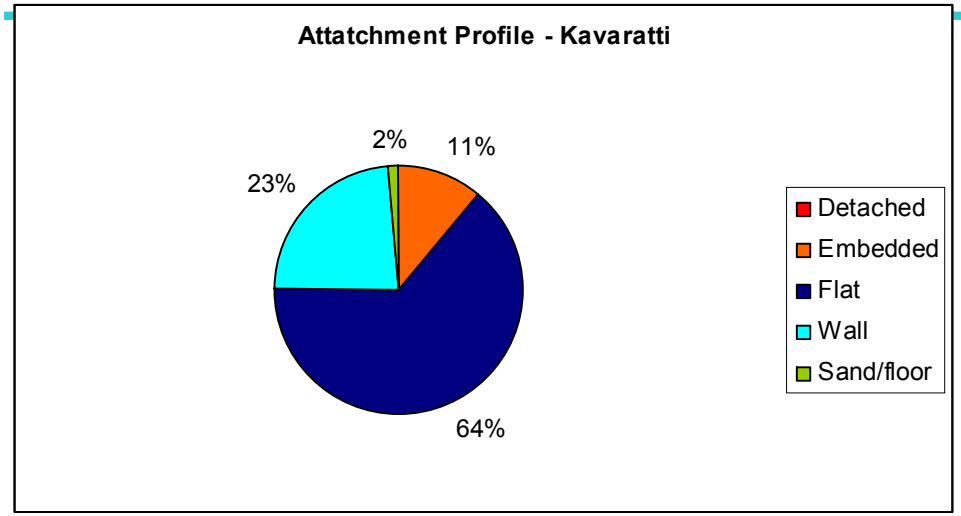
Distribution of *T. maxima*

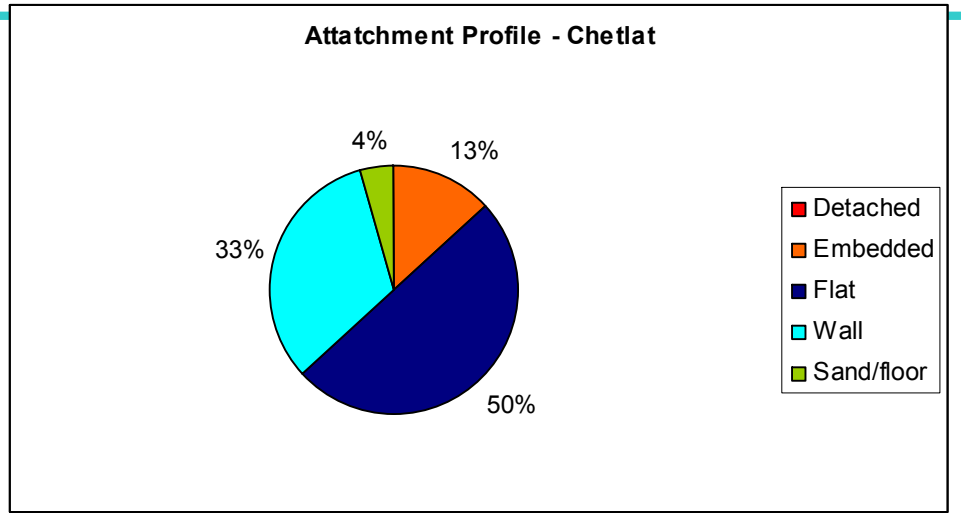


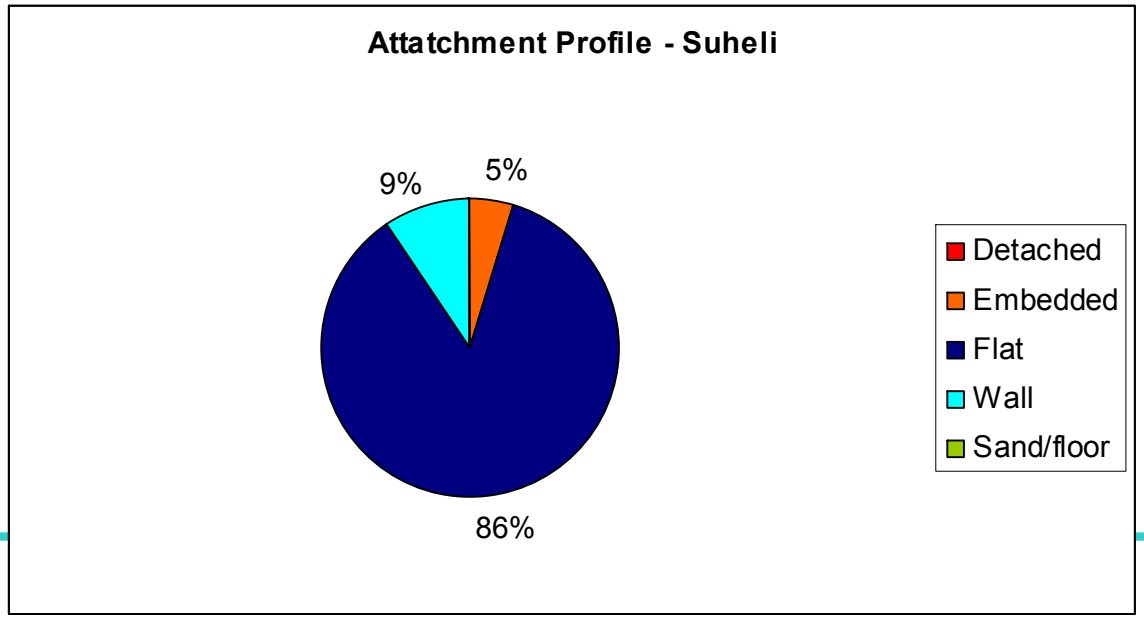




Attachment Profile







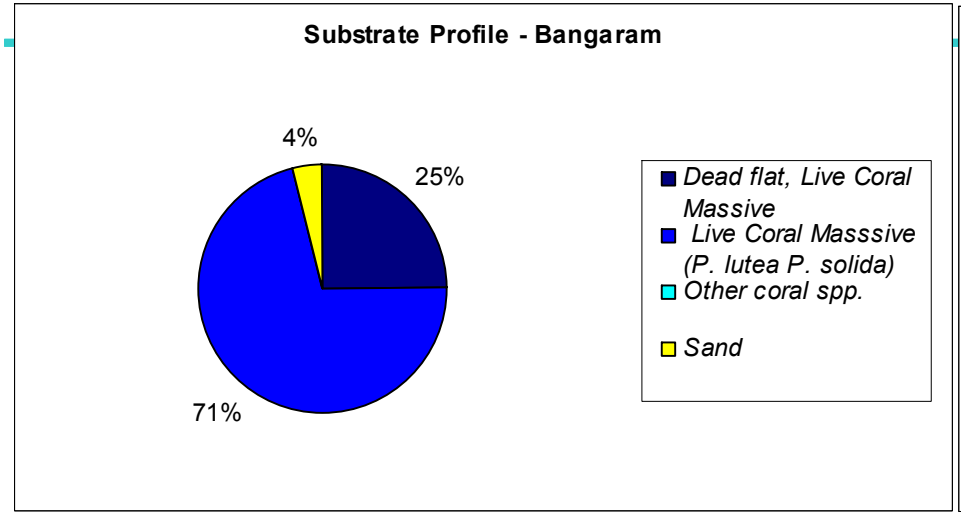
Substrate

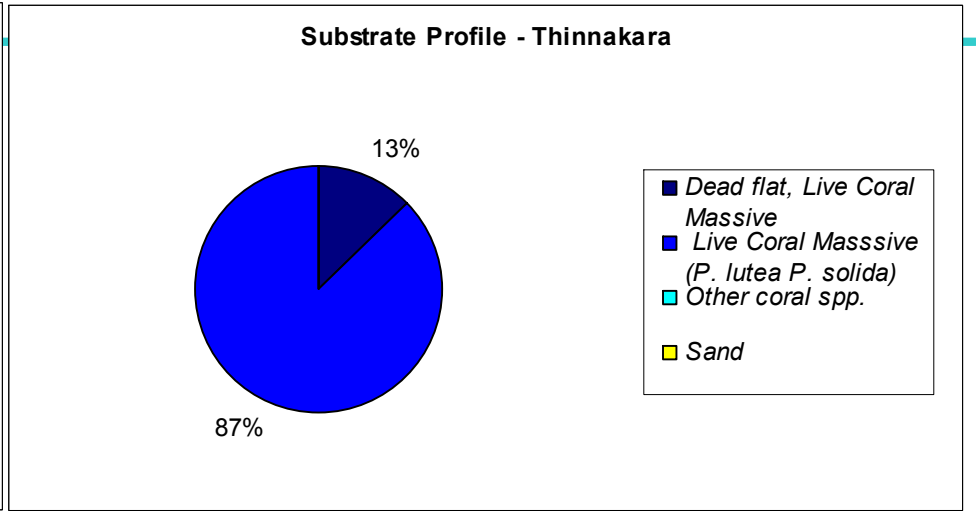
Porites solida

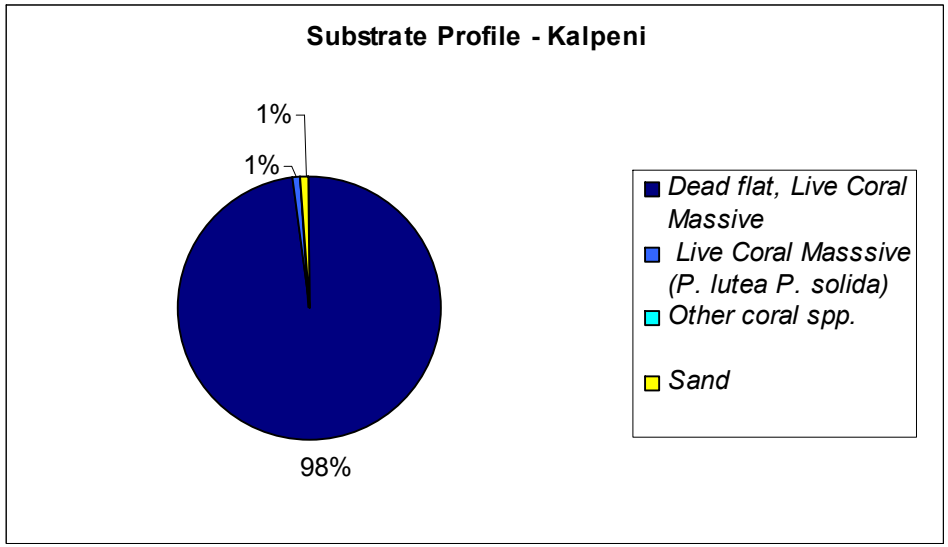
Porites lutea

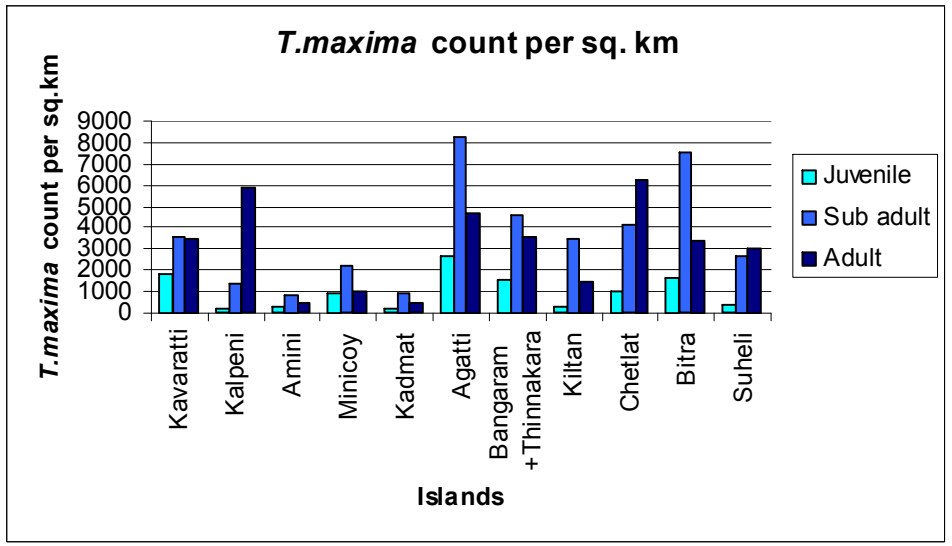
Photo: Deepak Apte

Substrate Profile





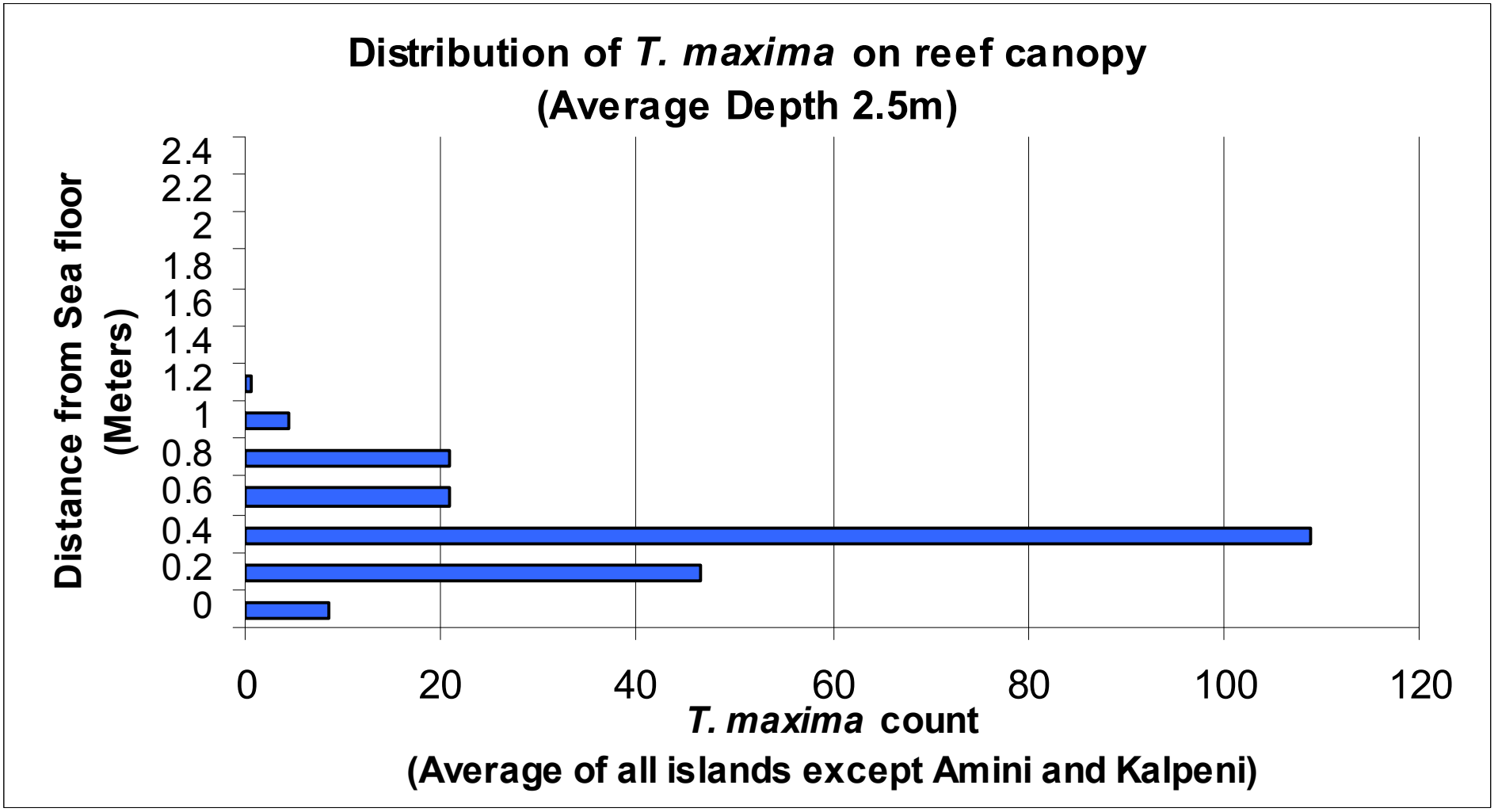




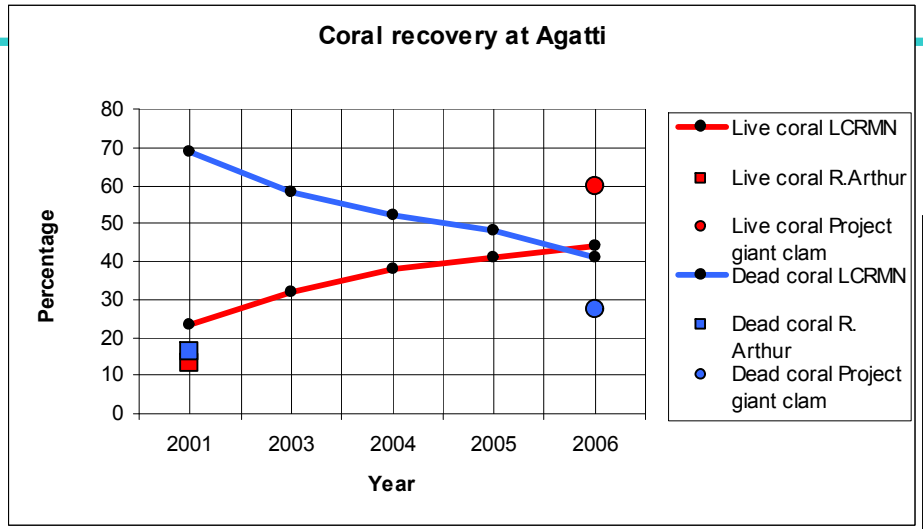
Reef Canopy

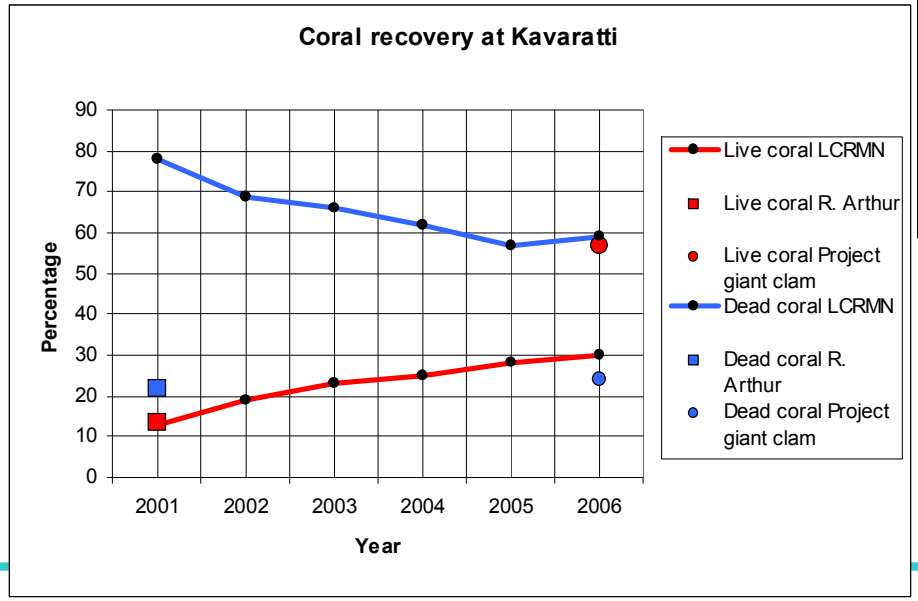
Photo: Deepak Apte

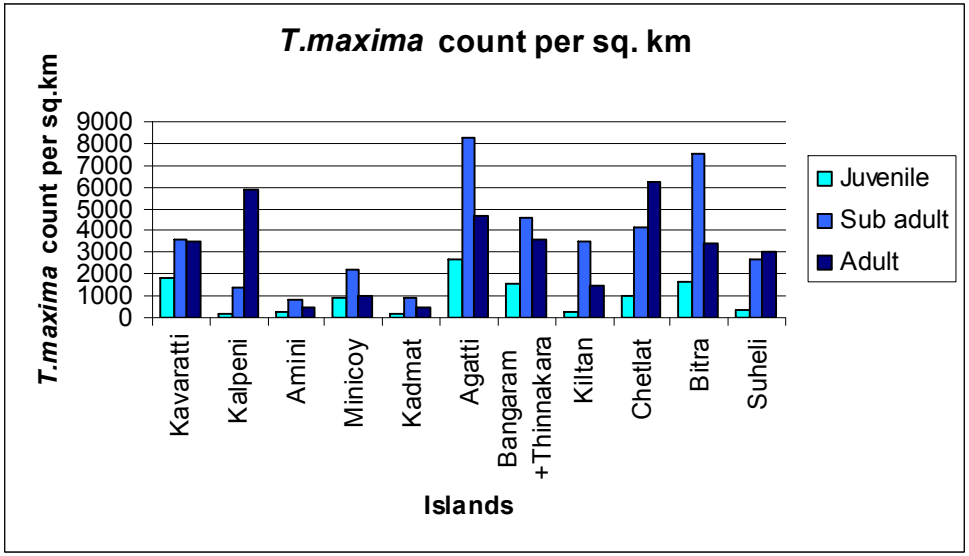
Giant Clam Distribution on Reef Canopy



Reef Recovery

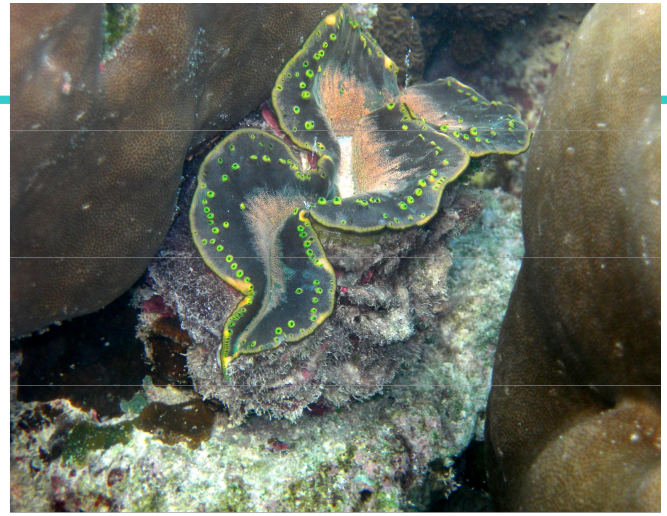


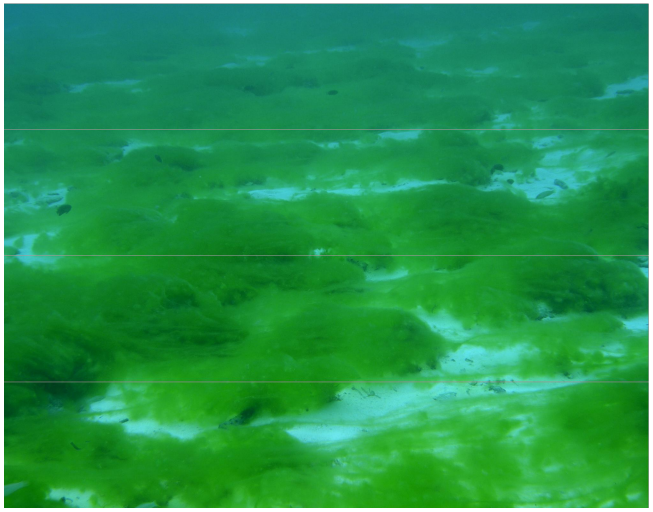




Kalpeni

- Habitat loss after series of cyclones in the last five decades
- High temperature regimes
- Large scale fishery of giant clams





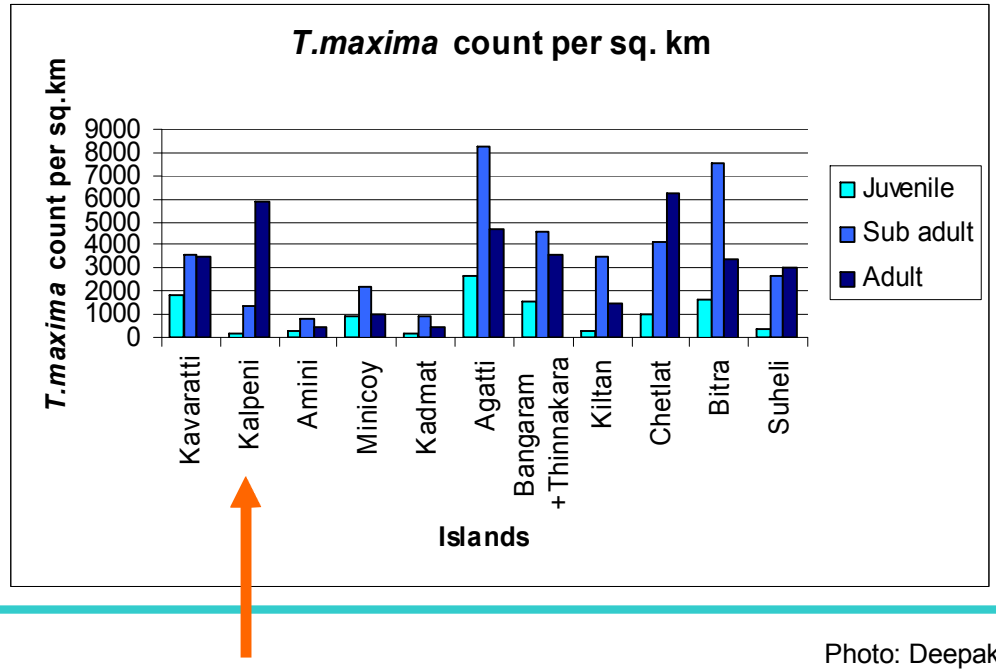


Photo: Deepak Apte

Minicoy

- Artificial channels
- Village boundary walls
- Channel dredging
- Dominance of blue coral *Heliopora coerulea*

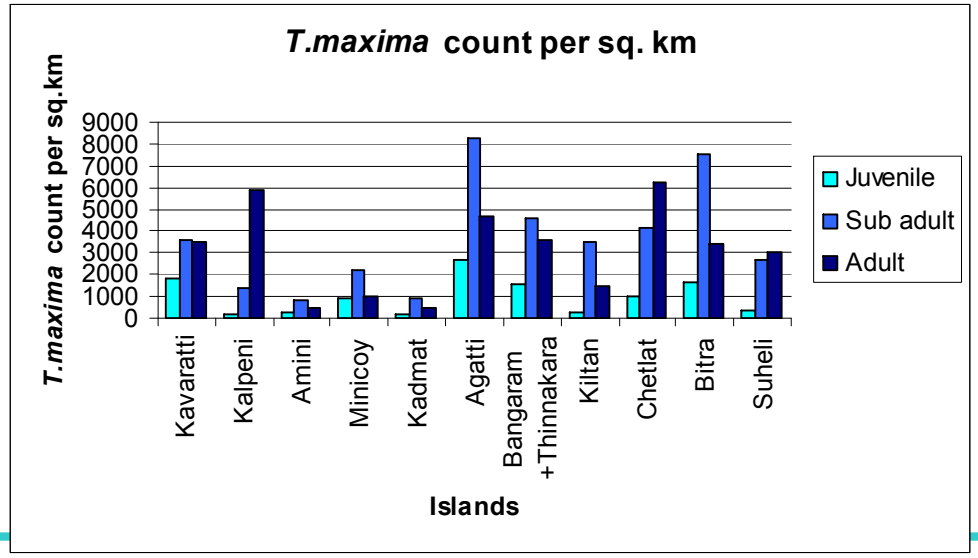


Photo: Deepak Apte

Fishery and Bait Fish

Photo: Jafer Hisham

Climate Change and Implications

Sea level rise

- 1 meter predicted sea level rise (IPCC) ➔ 11-21% land loss in Lakshadweep ➔ ?

Temperature rise

- Loss of massive corals & *Acropora* ➔ loss of baitfish
- Increasing water temperature regimes (El Nino) ➔coral dieback ➔ loss of food fish

Storm frequency rise

- Increased sedimentation ➔ loss of habitat

Are there any Visible Clues?

Photo: Deepak Apte

Immediate Causalities?

Adaptive Capacity

- ‘The ability of a system to adjust to climate change, including climate variability and extremes, to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.’ *IPCC*
- ‘Adaptive capacity in ecological systems is related to genetic diversity, biological diversity, and the heterogeneity of landscape mosaics’ *Resilience Alliance*
- ‘In social systems, the existence of institutions and networks that learn and store knowledge and experience, create flexibility in problem solving and balance power among interest groups play an important role in adaptive capacity’ *Resilience Alliance*

Factors that Increase Adaptive Capacity

- Learning to live with change and uncertainty;
- Nurturing diversity for resilience;
- Combining different types of knowledge for learning;
- Creating opportunity for self-organization towards social-ecological sustainability;

Education

- >1,000 participants to date
- Nature film shows
- Travelling film festival
- Painting competitions
- Lagoon and beach clean-ups
- Lecture series for youth and whole community
- Need for teacher training
- Lakshadweep does not have its own curriculum (follows Kerala's)

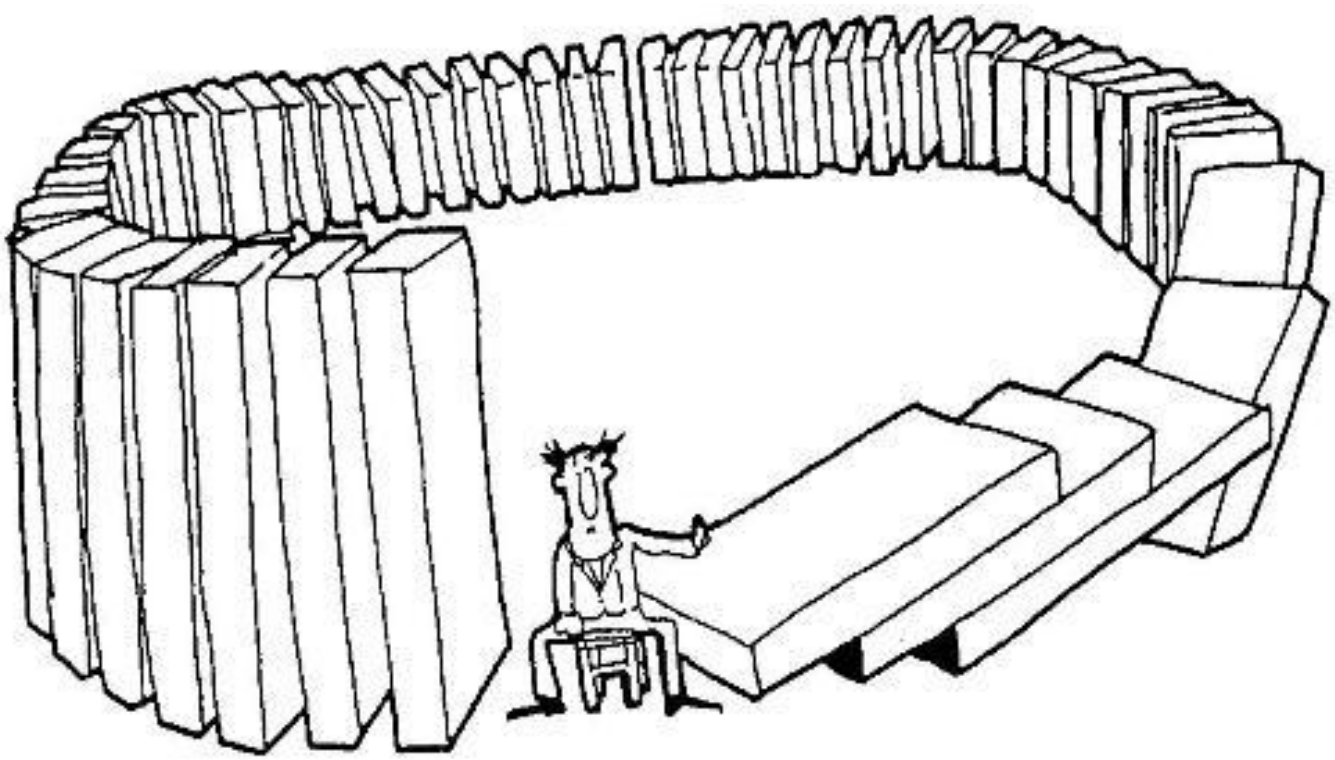
Photo: Jafer Hisham

Tourism

- Biodiversity dependent
- *'Low volume, high value'*
- Data on carrying capacity
- Training needs analysis
- Tour-guide training
- Tour-guide manual
- Ecological footprint
- Management plan

Photo: Jafer Hisham, Andrea Deri

Short Term Gain, Long Term Contribution to Climate Change



Mechanisms to Increase Adaptive Capacity

Further examples from ‘Project Giant Clam’

By increasing:

- Education that combines scientific knowledge with indigenous knowledge
- Engagement in monitoring
- **Community-based management and conservation of biodiversity and development**

By reducing:

- Coral mining
- Over-fishing
- Dredging
- Pollution

Acknowledgement

- Lakshadweep Administration
- Dept. of Sci. and Tech.
- Dept of Environment and Forests
- Dept of Tourism
- Dolphin Dive Center, SPORTS
- Ministry of Environment and Forests
- Ministry of Defense
- Ministry of Home Affairs
- Public Works Department
- Sandy Beach Eco-tourism Society
- Department of Port
- Dept of Education
- Mr. Parimal Rai, IAS – Honorable Administrator
- Mr. Madhup Vyas, IAS, CDC
- Mr. Santosh Mathews, IAS
- Dr. S.I. Koya, Director, Sci & Tech
- Mr. A.K. Tewari, ADM
- Mr. Shaukat Ali
- Mr. Sikander Hussain
- Chairperson, Dweep Panchayat – Kavaratti, Minicoy, and other islands
- Island Community

Thank you for your attention.

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Photo: Deepak Apte