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The Importance of Mangrove Conservation

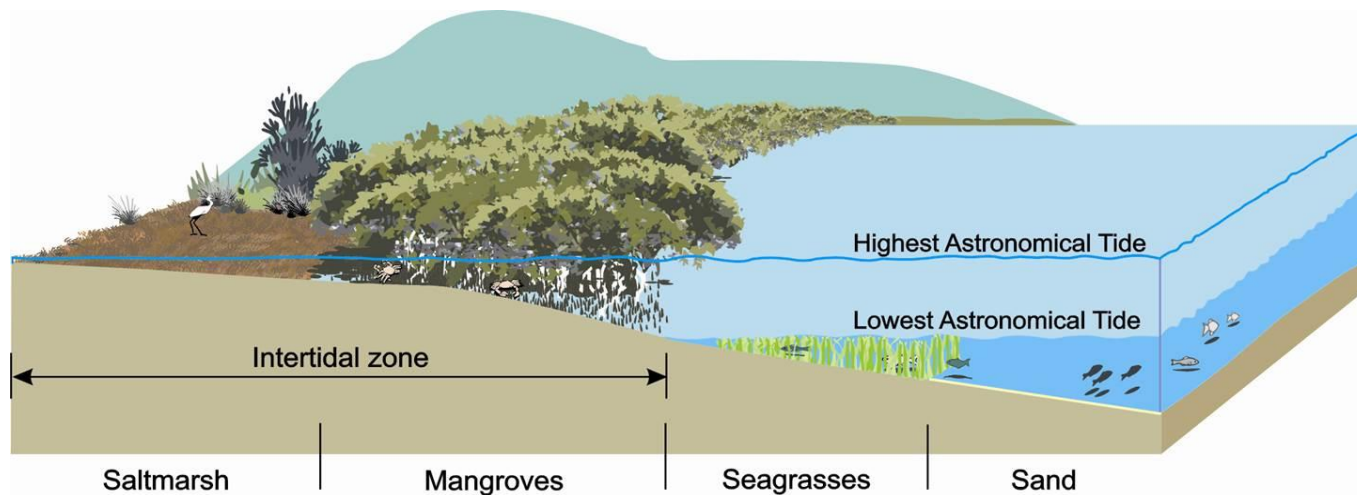
Ana Noel · UAA - KPC - KBC - SBB

Conservation Ecology · Spring 2022 · Undergraduate Seminar

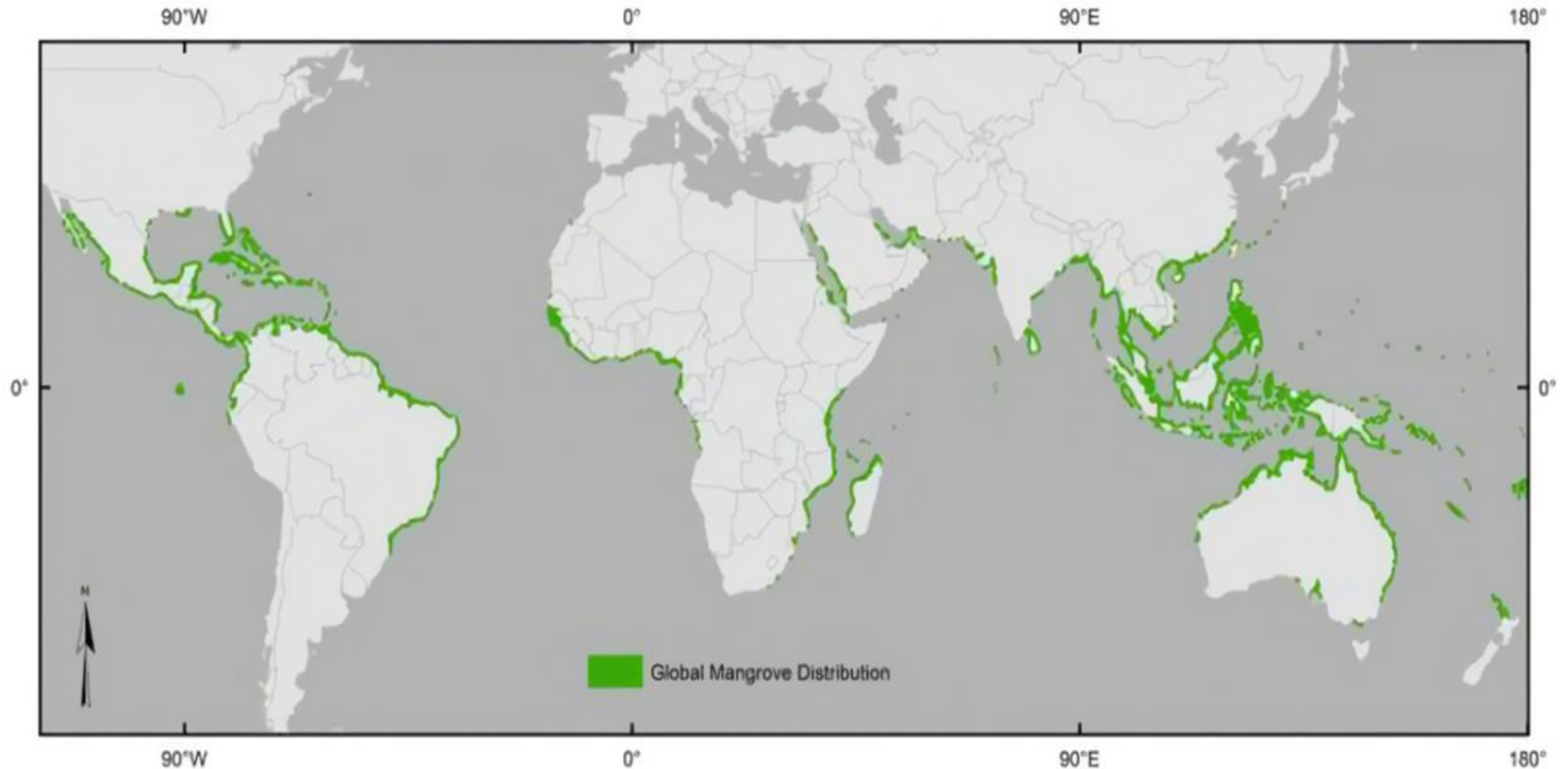
What is a Mangrove? (Kathiresan and Bingham, 2001)



- Wetland ecosystem (Macintosh and Ashton, 2002)
- Intertidal zone (Macintosh and Ashton, 2002)
- Tropical and subtropical latitudes (Macintosh and Ashton, 2002)
- Most productive ecosystems
- High salinity
- Extreme tides
- Strong winds
- High temperatures
- Muddy, anaerobic soil



Mangrove Distribution

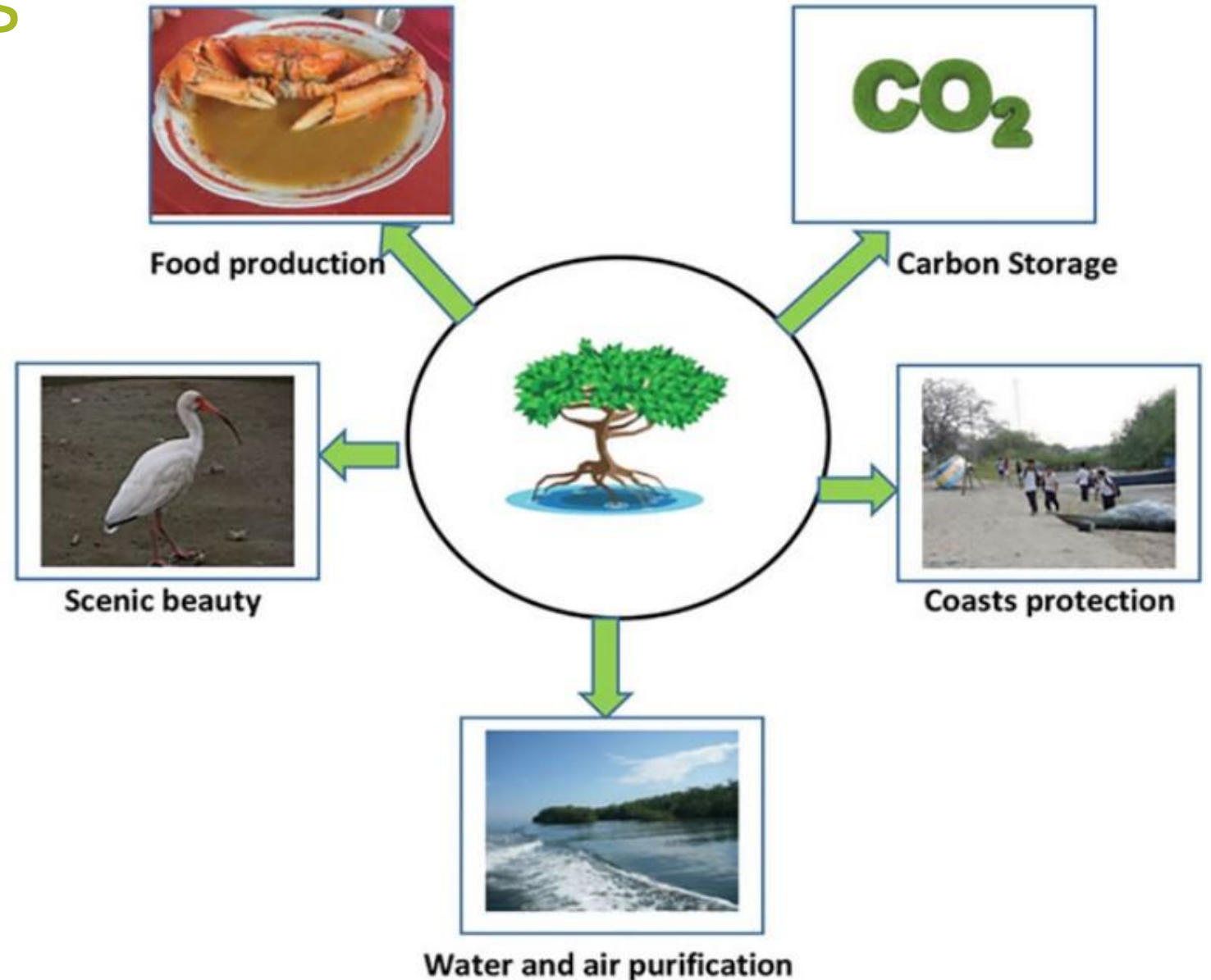


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Ecosystem Services

(Sandilyan and Kathiresan, 2012)

- Absorb CO₂
- Break down toxins/pollutants
- Filter water
- Provide nutrients
- Medicinal value
- Provide raw materials
- Aesthetic and recreation values
- Species diversity
- Nursery area
- Protection from floods and storms
- Protection from erosion



(Rodríguez, 2018)

Erosion Control



OFFSHORE DYNAMICS



NEARSHORE DYNAMICS



HABITAT



IMPACTS



CONSEQUENCES

IMPACT WITH MANGROVES



IMPACT WITHOUT MANGROVES



Offshore

Nearshore

Onshore

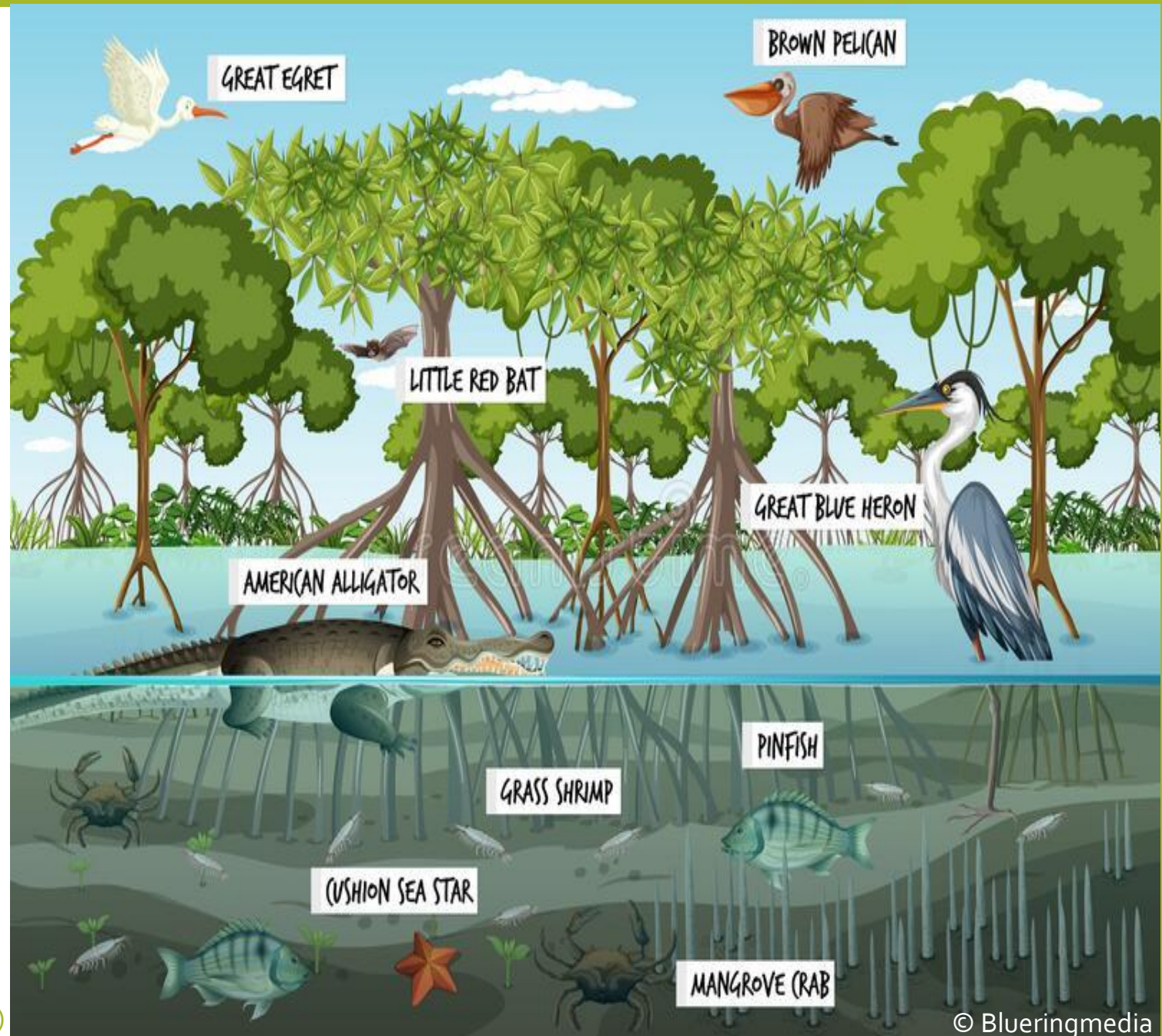
Species Diversity (Sandilyan and Kathiresan, 2012)

- High biodiversity
 - 90% of marine organisms spend a portion of their life in mangroves
 - Endemic and critically endangered species
 - Nursery area
- Protects fragile ecosystems like coral reefs
- Maintains fisheries
 - 80% of global fish catches rely on mangroves



Mangrove Taxa

- True mangrove species
- Palms
- Ferns
- Bacteria
- Algae
- Fungi
- Invertebrates
- Fish
- Amphibians
- Birds
- Reptiles
- Insects
- Mammals



Indian Mangrove Flora and Fauna

No.	Groups	No. of species
Flora		
1.	Mangroves	39
2.	Mangrove associates	86
3.	Sea grasses	11
4.	Marine algae	557
5.	Bacteria	69
6.	Fungi	103
7.	Actinomycetes	23
8.	Lichens	32
Fauna		
9.	Prawns and lobsters	55
10.	Crabs	138
11.	Insects	707
12.	Molluscs	305
13.	Other invertebrates	745
14.	Fish parasites	7
15.	Fin fish	543
16.	Amphibians	13
17.	Reptiles	84
18.	Birds	426
19.	Mammals	68
Total number of species		4,011



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Critically Endangered (CR) Species Recorded Across the Global Mangrove Forests

	Common Name	Species Name
Flora		
1.	Mangrove species	<i>Sonneratia griffithii</i>
2.	Mangrove species	<i>Bruguiera hainseii</i>
Invertebrate		
3.	Giant land crab	<i>Cardisoma carnifex</i>
Amphibian		
4.	Mangrove frog	<i>Eleutherodactylus carib</i>
Birds		
5.	Sapphire-bellied hummingbird	<i>Lepidopyga lilliae</i>
6.	Mangrove finch	<i>Camarhynchus heliobates</i>
Mammals		
7.	Pygmy three-toed sloth	<i>Bradypus pygmaeus</i>
8.	Garrido's hutia	<i>Mysateles garridoi</i>
9.	Cabrera's hutia	<i>Mesocapromys angelcabrerai</i>



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(González et al., 2012)

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Locally Extinct Species from the World's Largest Mangroves Sundarbans due to Mangrove Degeneration

	Common Name	Species Name
Reptiles		
1.	Green turtle	<i>Chelonia mydas</i>
2.	Hawksbill turtle	<i>Eretmochelys imbricata</i>
3.	Loggerhead	<i>Caretta caretta</i>
4.	Leatherback sea turtle	<i>Dermochelys coriacea</i>
Birds		
5.	Lesser adjutant stork	<i>Leptoptilos javanicus</i>
6.	Knob-billed duck	<i>Sarkiodrnis melantous</i>
7.	White-winged duck	<i>Cairina suctulata</i>
Mammals		
8.	Asian water buffalo	<i>Bubalis bubalis</i>
9.	Javan rhinoceros	<i>Rhinoceros sondaicus</i>
10.	Swamp deer	<i>Cervus deruchea</i>
11.	Hog deer	<i>Axis porcinus</i>
12.	Barking deer	<i>Muntiacus muntja</i>



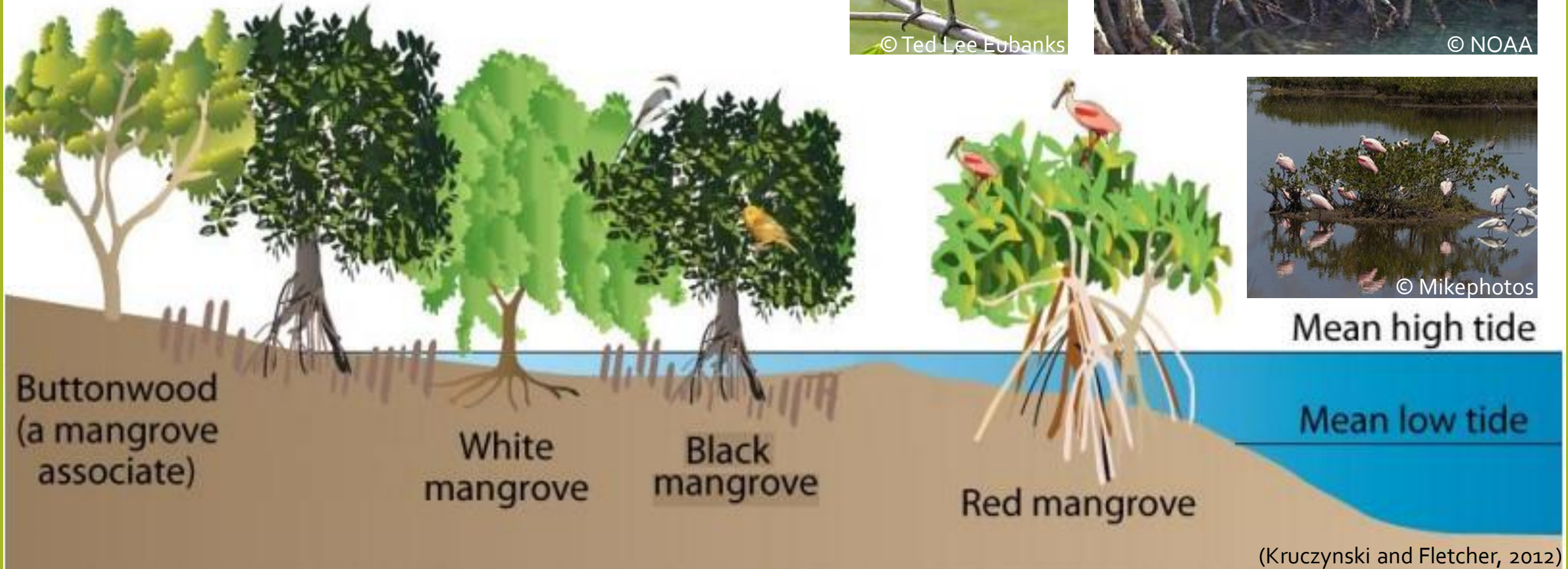
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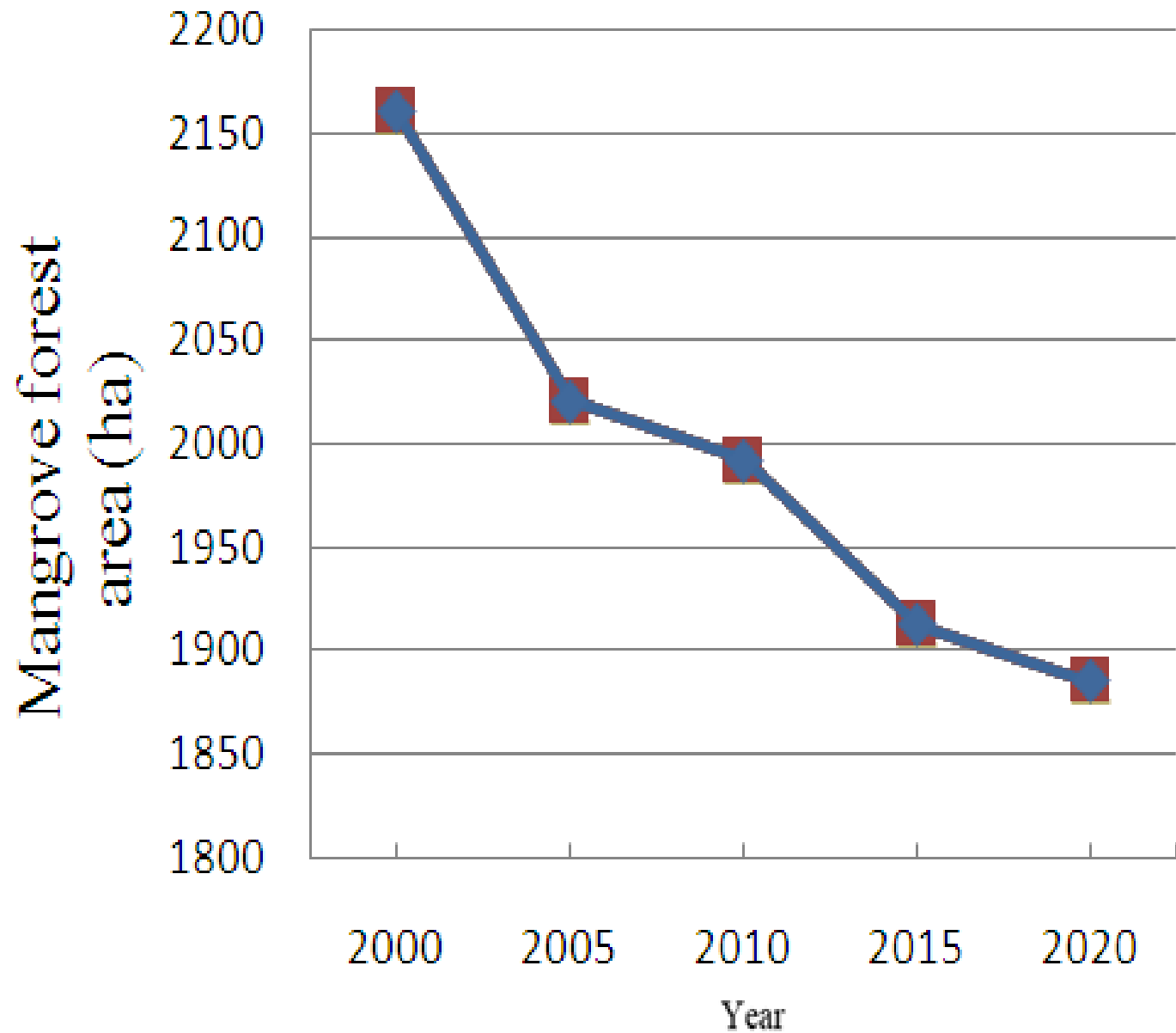
Mangrove Trees and Roots

Roots (Srikanth et al., 2016)

- Salt exclusion
- Stability
- Deposit soil
- Collect nutrients
- Gas exchange
- Retain oxygen



(Kruczynski and Fletcher, 2012)



Mangrove Loss

(Sudia et al., 2021)

Threats to Mangroves (Sandilyan and Kathiresan, 2012)

Natural

- Random/rare
- Cyclical
- Worsened by humans

- Cyclones and tsunamis
- Disease
- Parasites

Threats to Mangroves (Sandilyan and Kathiresan, 2012)

Natural

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Human induced

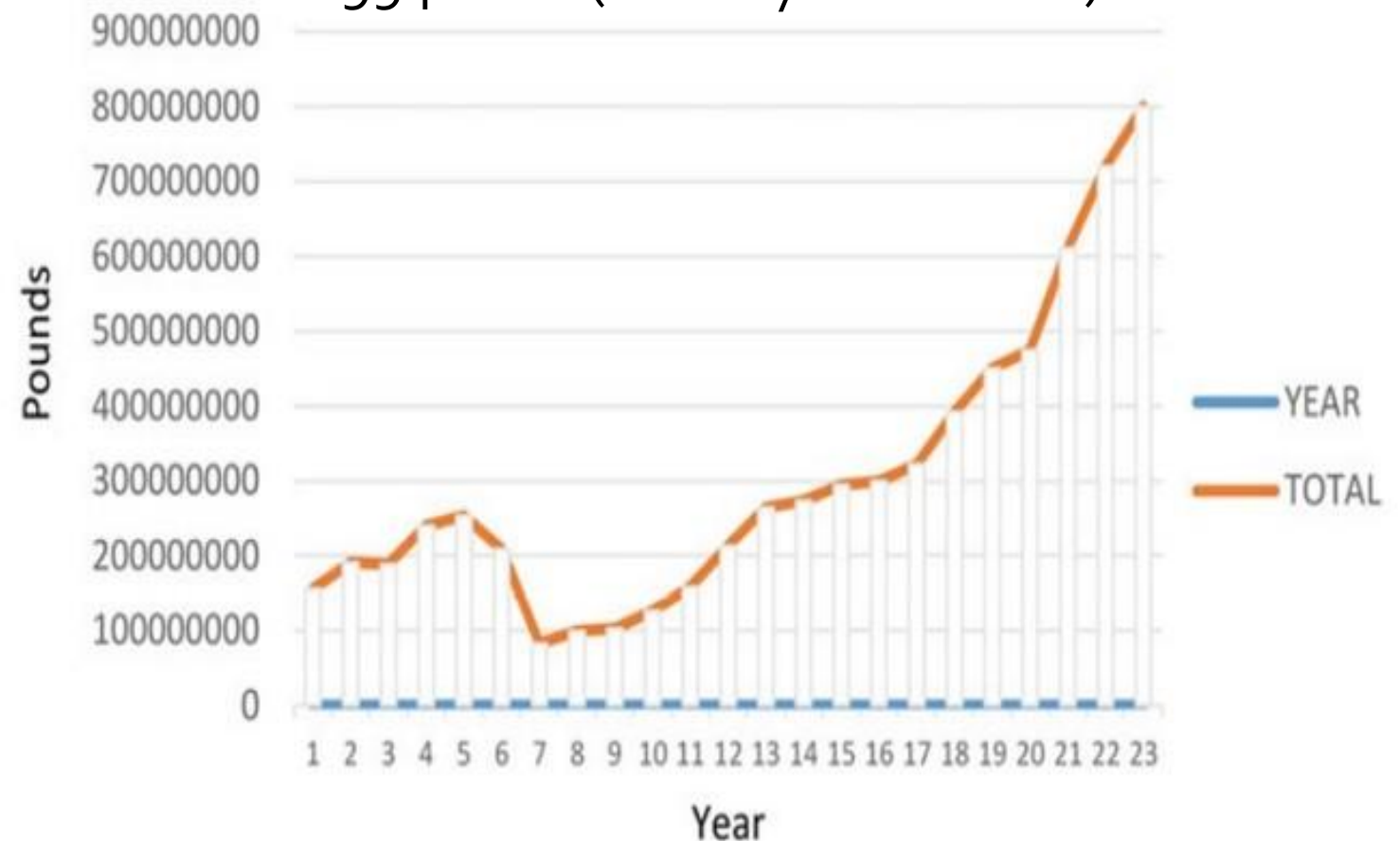
- Persistent for long periods or forever

- Cyclones and tsunamis
- Disease
- Parasites
- Invasive species
- Cattle grazing
- Wood cutting
- Overexploitation
- Urbanization
- Pollution
- Mining
- Global warming
- Habitat destruction
- Agriculture
- Aquaculture
- Oil spills
- Pesticides

Shrimp Farming: Ecuador (Rodríguez, 2018)

- Greatest threat to mangroves
- Results in forest fragmentation
- Contamination
- Water pollution
- Deforestation
 - Loss of 80% of carbon

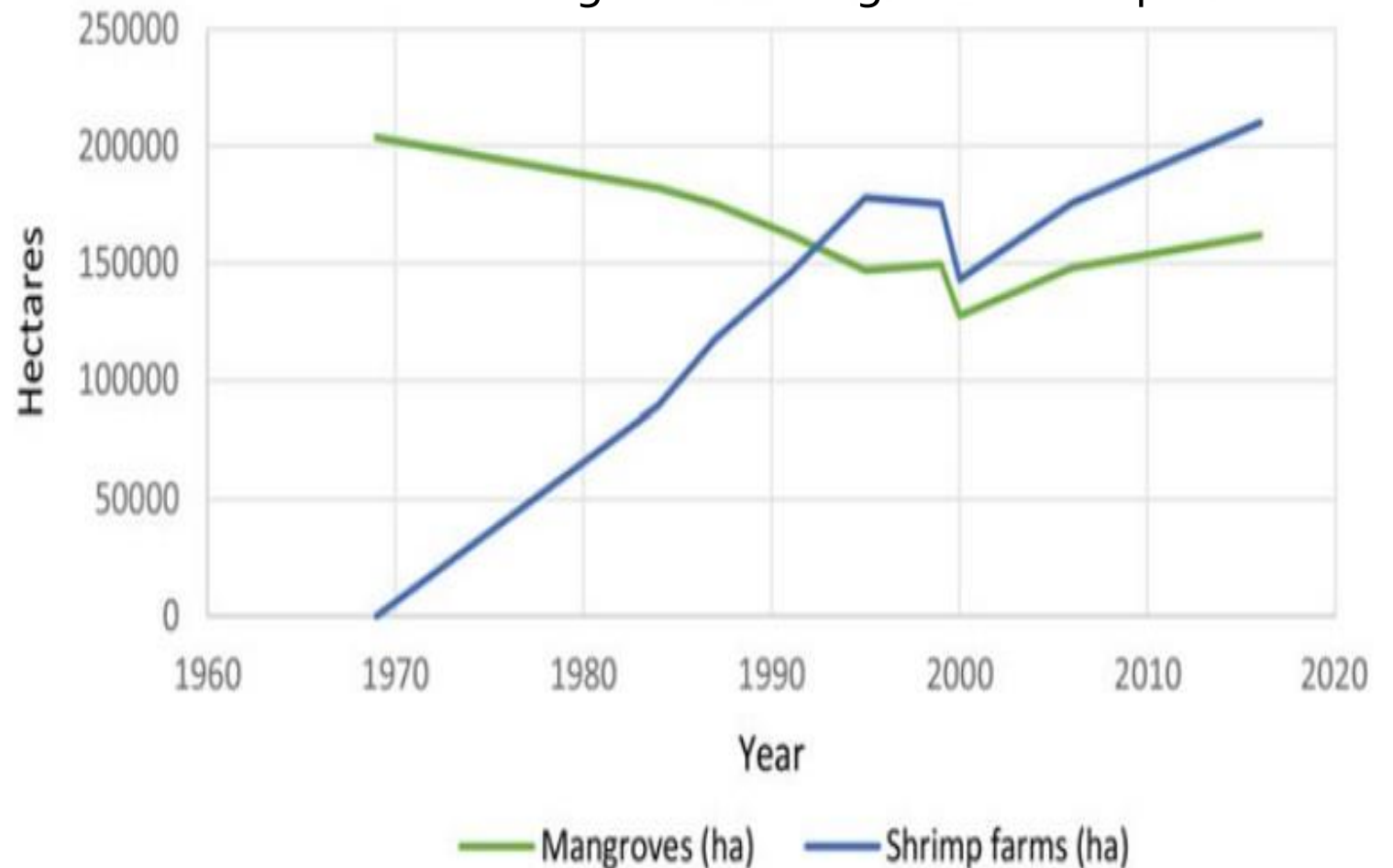
Ecuador's Shrimp Export from 1994-2016 (January-December)



Shrimp Farming: Ecuador (Rodríguez, 2018)

- Greatest threat to mangroves
- Results in forest fragmentation
- Contamination
- Water pollution
- Deforestation
 - Loss of 80% of carbon
- Protected area
- Management

Evolution of Mangrove Coverage and Shrimp Farms



Shrimp Farming: Thailand

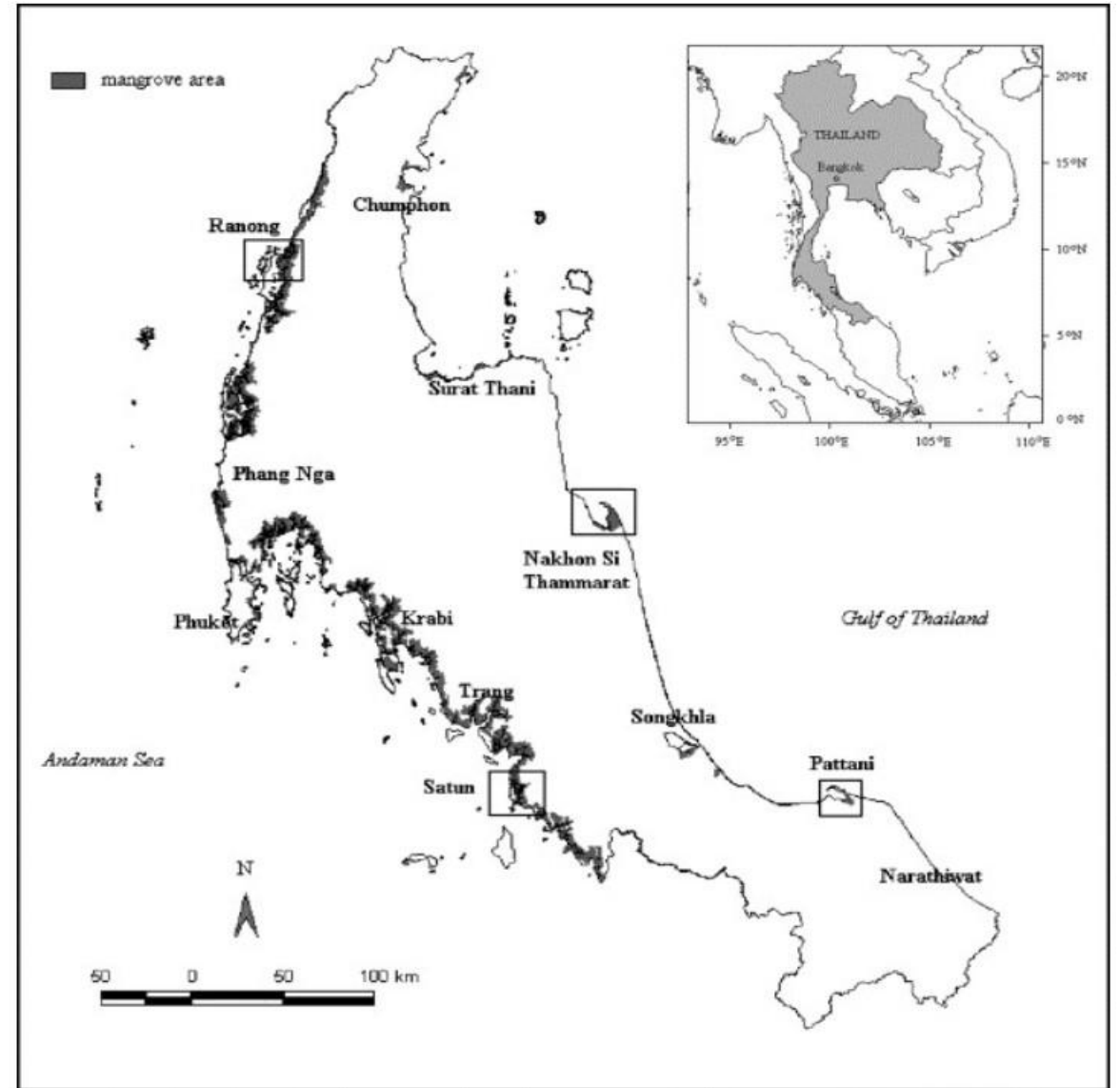
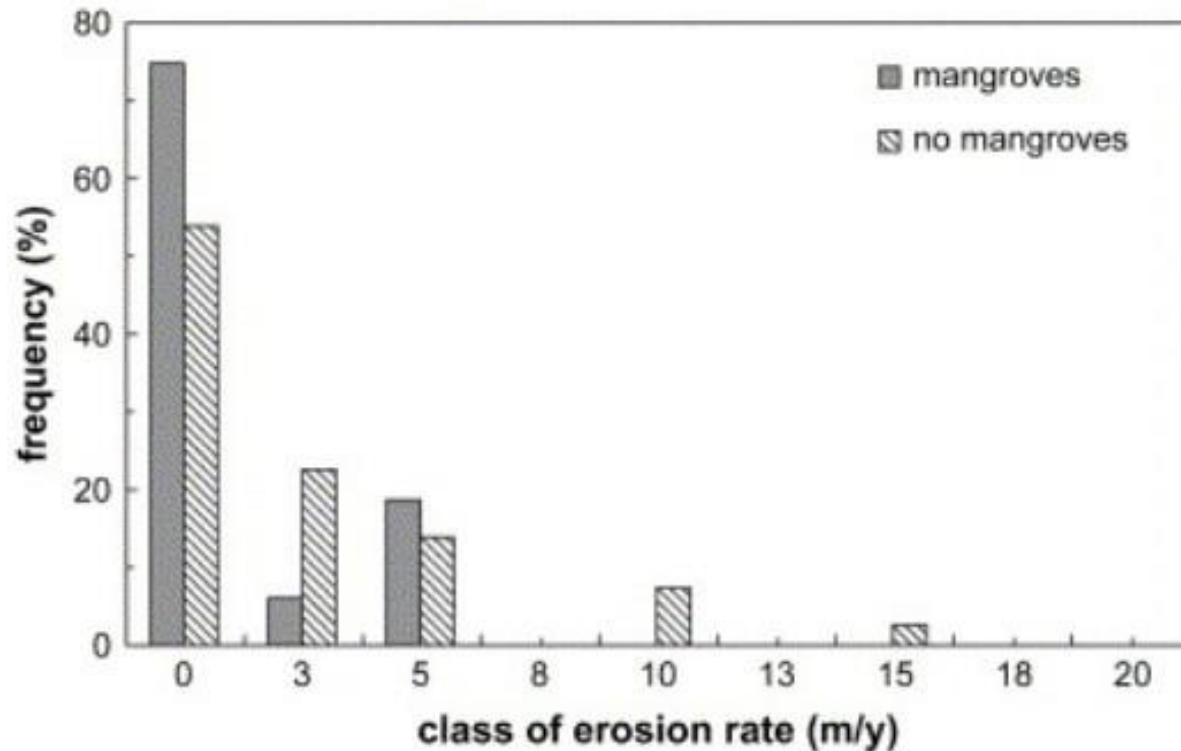
(Sathirathai and Barbier, 2001)

- Publicly owned state property
- Royal Forestry Department
 - Responsibility to protect mangroves
 - Little enforcement
 - Local people cannot protect from shrimp farming
 - Land use conflicts
- Economic value > shrimp farming
- Protection
- Management



Island Erosion: Southern Thailand (Thampanya et al., 2016)

- 1961: 60% coastline had mangroves
- Past 3 decades
 - 50%
 - >10% on east coast
- Erosion
 - 3.6 m/y on east coast



Erosion Prevention: Techniques and Challenges (Robertson, 2010)

- Man-made sand dunes
 - No support
 - Relocate sand
- Beach nourishment (Speybroeck et al., 2006)
 - Loss of invertebrates
 - Invasive
 - Erosion still occurs
 - Have to reapply sand
- Seawalls
 - Erosion of beach and wall
 - Large waves
- Replantation (Jia et al., 2018)



China: Mangrove Conservation

(Jia et al., 2018)

- Since 1900s, 60% of Chinese mangroves lost
 - Human induced
 - Converted to paddy fields and aquaculture
- Laws and regulations
 - Action Plan for China Biodiversity Protection
 - Forestry Action Plan for China's Agenda of the 21st century
 - Plan for China Ecological Environment
 - Action Plan for China Wetland Protection
- Replantation program
 - 20-30% success rate in beginning
 - 71% survival after



Challenges: Mangrove Replantation (Jia et al., 2018)

- Exotic mangrove species planted
 - *Sonneratia apetala*
 - Fast growing
- Natural disasters destroy mangroves
- Artificial seawalls
 - Between mangroves and terrestrial land
 - Blocks freshwater flow
 - Break mangrove forests in half
 - Susceptible to sea-level rising
- Low survival rate: <44% (Chen et al., 2009)
 - Salinity
 - Temperature
 - Tidal zones
- Low biodiversity: lack of species planted
 - Sensitive to insect attacks



Effects of Species Loss

(Polidoro et al., 2010)

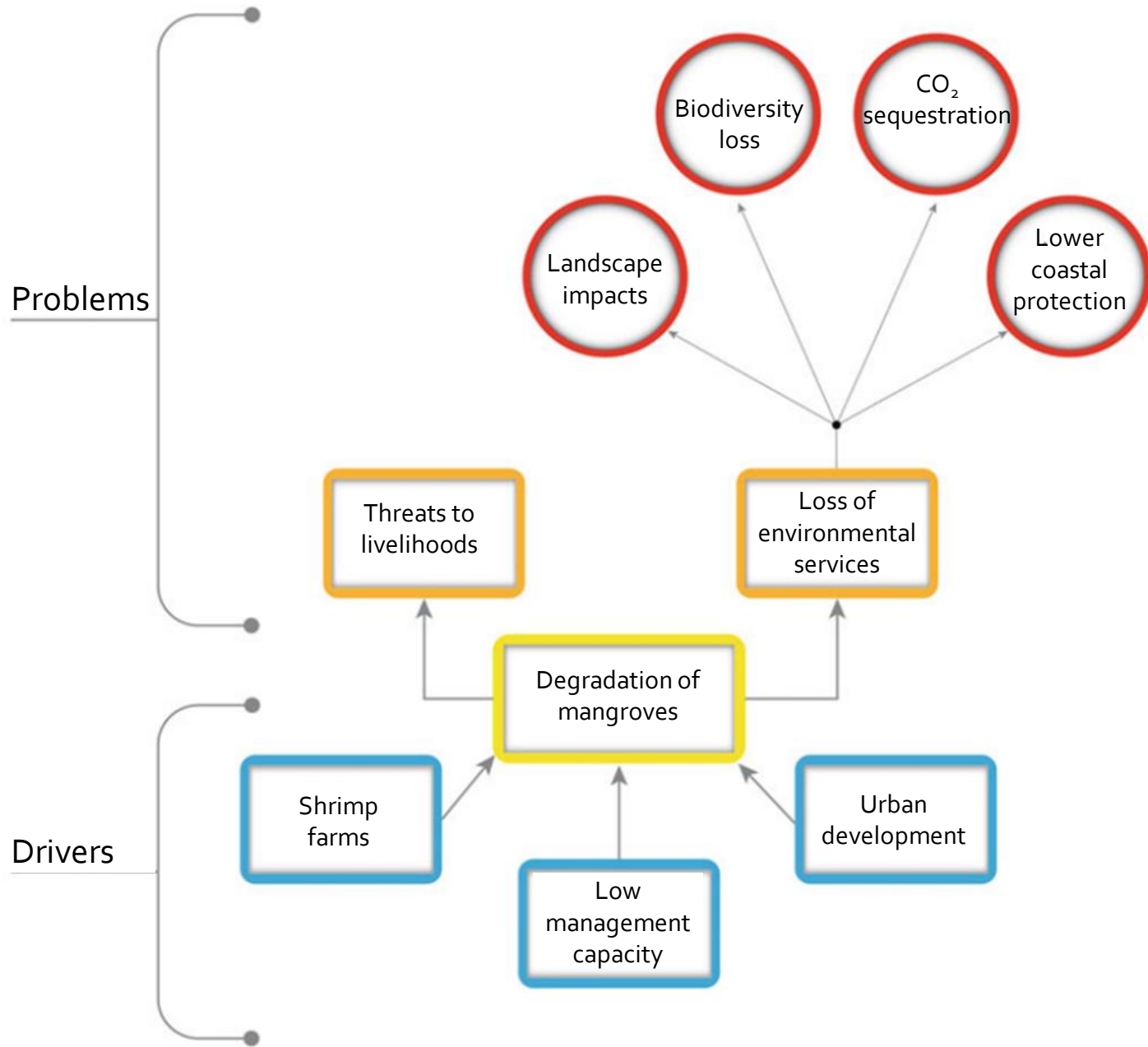
- Low biodiversity
 - *Avicennia*: water quality services
 - *Heritiera globosa*: reduced protection from floods, erosion
 - Ecosystems cannot be restored
- Sesarmid crab (*Clistocoeloma sinense*) (Alongi, 2002)
 - Endangered: population decline due to habitat destruction (Yuhara et al., 2014)
 - Keystone species
 - Prey on trees to increase growth
 - Recycle nutrients
 - Bioturbate soil to stimulate decomposition
 - Consume ~70% of annual leaf litter (Tue et al., 2012)



Species Importance

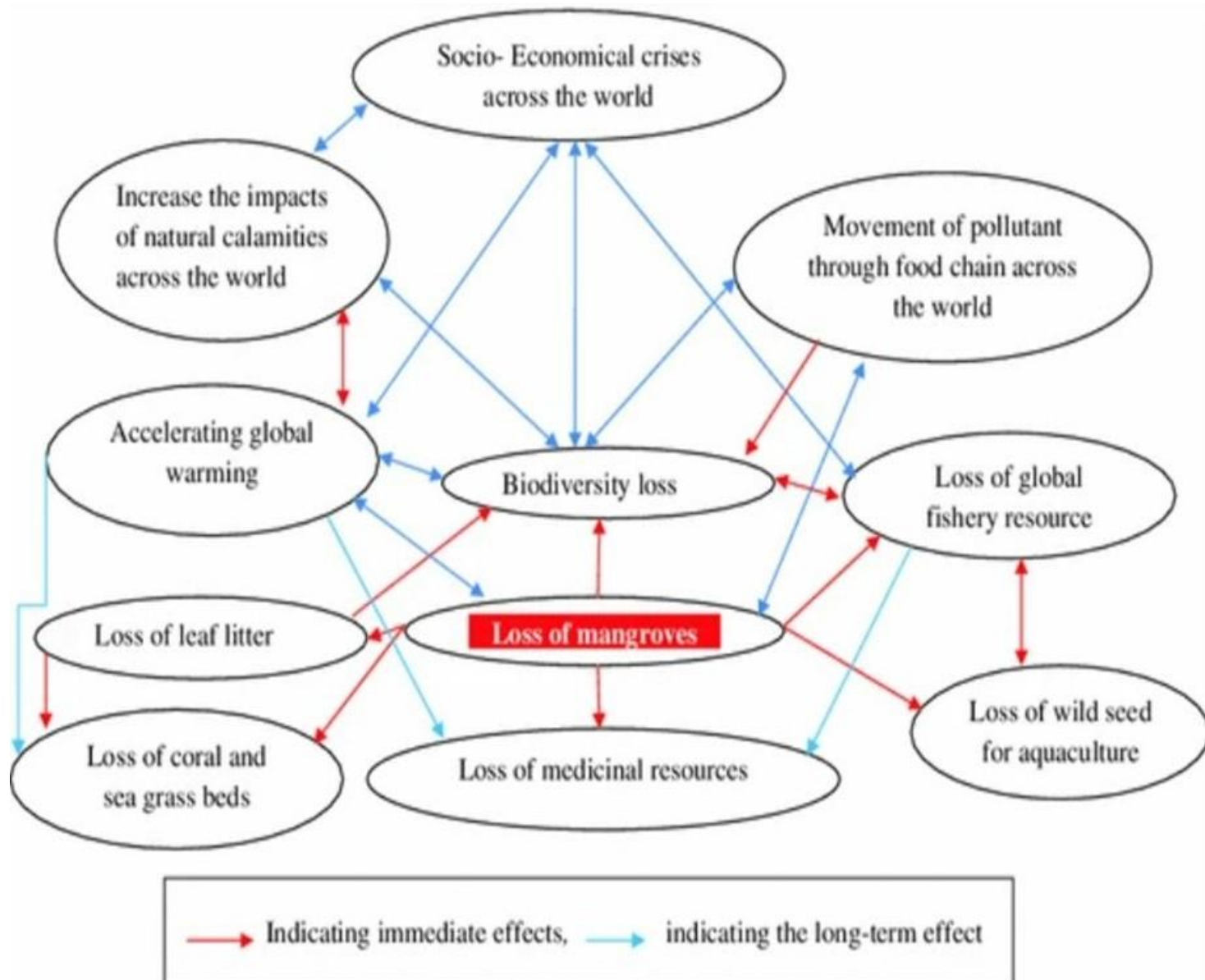
- Leatherback (*Dermochelys coriacea*) and green (*Chelonia mydas*) sea turtles help fisheries (Chiaverano et al., 2018)
 - Jellyfish blooms → leatherback and green sea turtles eat jellyfish → ↑ fish species
- Blue mussels (*Mytilus edulis*) can be used to tell if water is contaminated (Staggs et al., 2015)
 - PCR testing for *Cryptosporidium* spp. and *Toxoplasma gondii*
- Mangroves act as filters to clean water (Chauhan and Ramanathan, 2008)
 - Devoid of heavy metal





Consequences of Human Activities

(Rodríguez, 2018)



Negative Impacts of Mangrove Loss

(Sandilyan and Kathiresan., 2012)



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Conservation Methods (Islam et al., 2018)

- Replant lost mangroves (Jia et al., 2018)
 - Variety of species
 - Growth-promoting bacteria (Bashan and Holguin, 2002)
- Ban/manage harmful activities
 - Logging
 - Fishing
 - Shrimp farming
- Protect species
- Perform water quality tests
- Reduce pollution
- Public awareness
- Listen to local people (Sathirathai and Barbier, 2001)
- Research





Questions?

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