REPORT OF THE INTERNATIONAL MANGROVE CENTER WORKSHOP ON MANGROVE CONSERVATION AND RESTORATION, 18 – 27 JUNE, 2025

Dates: 18 – 27 June, 2025

Venues: Shenzhen, coastal areas of Guangxi

Organizers: International Mangrove Center (IMC), Urban Planning and Natural Resources Bureau of Shenzhen Municipality, Guangdong Neilingding Futian National Nature Reserve Administration Bureau, and the National Academy of Forestry and Grassland Administration

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1. Introduction

1.1. Background and rationale

Mangroves are vital ecosystems that sustain fisheries and marine biodiversity, shield coastlines, and act as powerful carbon sinks. They provide nursery habitats for endangered species, help prevent coastal erosion, and store more carbon than many terrestrial forests. However, fifty percent of Mangrove Ecosystems units are at risk of collapse.

In response to these growing challenges, the establishment of the International Mangrove Center (IMC) marks a major milestone in international efforts to safeguard mangroves. The IMC is the world's first independent, non-profit, intergovernmental organization dedicated exclusively to mangrove conservation, restoration, and the wise and sustainable use of mangrove ecosystems. It operates as an ecosystem-based Ramsar Regional Initiative under the Convention on Wetlands.

During COP14 of the Ramsar Convention, Chinese President Xi Jinping proposed the creation of the IMC in Shenzhen. The proposal, reflected in Draft Resolution XIV.19 and jointly led by China, Cambodia, and Madagascar, was subsequently adopted. On 6 September 2023, the Ramsar Standing Committee endorsed the regional initiative through Decision SC62-22. This milestone was followed on 6 November 2024 by the signing ceremony of the Establishment Agreement of the IMC in Shenzhen, marking the formal launch of the center.

The mission of the IMC is to promote international cooperation and joint action in mangrove conservation and restoration; to enhance the implementation of the Convention on Wetlands; and to support the delivery of global environmental commitments, including the Kunming-Montreal Global Biodiversity Framework, the Paris Agreement, and the 2030 Agenda for Sustainable Development and its Sustainable Development Goals (SDGs).

Recognizing that capacity building is fundamental to effective mangrove conservation, the IMC has made training and knowledge exchange a central pillar of its work. Strengthening the technical expertise of member countries is essential for addressing the complex pressures facing mangroves and for advancing evidence-based, collaborative solutions.

The 3rd term IMC Workshop represents a continuation of the IMC's commitment to fostering dialogue among nations and building the collective capacity needed to address global environmental challenges. By convening experts, practitioners, and policymakers, the workshop creates opportunities for cross-border learning and the dissemination of best practices in mangrove conservation, restoration, and sustainable management.

1.2. Workshop objectives

The workshop was designed to achieve the following key objectives:

- **Knowledge Transfer**: Facilitate the exchange of scientific knowledge, technical expertise, and practical experience in mangrove conservation and restoration among participating countries
- **Capacity Enhancement**: Strengthen the technical and institutional capacities of government officials and experts responsible for mangrove and wetland management
- **Best Practice Dissemination**: Showcase successful approaches to mangrove action planning, blue carbon initiatives, climate change adaptation, and ecosystem-based management
- **Network Building**: Foster relationships among member countries to promote future cooperation and collaborative research initiatives
- **Field Learning**: Provide hands-on learning experiences through site visits to exemplary mangrove conservation areas in China
- **Strategic Planning**: Engage participants in discussions on the IMC's strategic direction and priority areas for research and pilot projects

2. Program and methodology

The workshop employed a comprehensive learning methodology spanning ten days (June 18-27, 2025), combining theoretical instruction, interactive discussions, and extensive field-based learning. The program was structured around several key components:

Theoretical Sessions: Expert-led lectures covering fundamental and advanced topics in mangrove science, conservation policy, and management practices

Interactive Q&A Sessions: Dedicated time for participants to engage directly with lecturers, pose questions, and share experiences from their respective countries

Panel Discussions: Facilitated group deliberations on strategic issues including the IMC Strategic Plan and research priorities for mangrove restoration

On-Site Teaching: Seven field visits to significant mangrove sites across Guangdong and Guangxi provinces, providing practical exposure to diverse conservation approaches

Cultural Experiences: Integration of Chinese cultural education and local community engagement to provide broader context for conservation work

Case Study Sharing: Opportunities for participants to present their countries' mangrove conservation experiences and challenges

The workshop moved through three geographic locations—Shenzhen, coastal areas of Guangxi (Beihai, Weizhou Island, Qinzhou, Fangchenggang), and Nanning—allowing participants to observe different mangrove ecosystems and management contexts.

The training brought together a diverse cohort of 24 participants from three countries: Cambodia, Madagascar, and China, demonstrating a strong commitment to gender balance, with 15 women and 9 men representing government institutions and technical experts.

3. Opening Ceremony

The workshop officially commenced on June 19th with a formal opening ceremony held at the Futian Hall of the Shenzhen Guohui Hotel. This ceremony served multiple important functions beyond simply marking the workshop's beginning. It established the formal, professional character of the program while also creating a welcoming atmosphere for international participants. It provided context about the workshop's purposes and the IMC's broader mission. It introduced key individuals and organizations involved in organizing and supporting the workshop. Most importantly, it symbolized the collaborative spirit and mutual respect that would characterize the learning experience ahead.

Opening remarks were delivered by Mr. ZHU Weihua, Deputy Director General of the Shenzhen Municipal Bureau of Planning and Natural Resources; Mr. Mon Samut, Deputy Director at the General Directorate of Natural Protected Areas of the Ministry of Environment Cambodia; and Prof. Bao Daming, representing the International Mangrove Center. Prof. Bao welcomed participants from Madagascar, Cambodia, and various regions of China, acknowledging the importance of their engagement and the wealth of knowledge and experience they brought to the workshop. He outlined the workshop's objectives and structure, emphasizing the IMC's commitment to serving as a platform for knowledge exchange. He highlighted the critical importance of mangrove ecosystems and the urgent need for enhanced conservation efforts worldwide, situating the workshop within the broader global context of biodiversity loss and climate change. His remarks established an atmosphere of shared purpose and mutual respect that would characterize the workshop's collaborative learning environment.

Following the formal remarks, participants gathered for a group photograph, a seemingly simple moment that carried symbolic significance.

PHOTO 1 : IMC WORKSHOP OPENING CEREMONY

4. Summary of thematic sessions

The thematic sessions offered a broad and in-depth exploration of mangrove ecosystems, covering ecosystem functions and services, restoration techniques, climate resilience, blue carbon, wildlife conservation, and the protection of migratory birds. These sessions were led by renowned Chinese and international experts from universities, research institutions, and global organizations.

4.1. Framework Overview of the International Mangrove Center

Professor BAO Daming, Vice Chairman and Secretary General of China Wetlands Association, Director General of IMC presented the foundational framework for the International Mangrove Center, emphasizing IMC as the world's first independent, non-profit, inter-governmental organization exclusively dedicated to mangrove conservation. The presentation outlined the IMC's establishment process, governance structure, and operational mandate within the global environmental architecture.

Key elements included the IMC's origins following President Xi Jinping's proposal at COP14 of the Ramsar Convention, the adoption of Resolution XIV.19 co-led by China, Cambodia, and Madagascar, and the formal signing ceremony held in Shenzhen on November 6, 2024. The mission of the IMC is to promote international cooperation and joint actions in mangrove conservation, restoration, and wise and sustainable use

The presentation detailed the IMC's four core objectives: promoting knowledge sharing and strengthening joint research cooperation; enhancing technology transfer, scientific and technical cooperation, and training; developing education, information, communication, and public awareness mechanisms; and building capacity while conducting pilot projects on priorities for mangrove conservation, restoration, and wise and sustainable use.

PHOTO 2 : PROF. BAO DAMING, VICE CHAIRMAN AND SECRETARY GENERAL OF CHINA WETLANDS ASSOCIATION, DIRECTOR GENERAL OF IMC

4.2. National Mangrove Status and Conservation Strategy in China

Mr. JI Wenyuan from the Department of Wetland Management, National Forestry and Grassland Administration (NFGA), provided a comprehensive overview of China's mangrove conservation achievements and future directions.

The presentation explored the National Land Inventory results (2018-2024) documenting 30,300 hectares of mangroves distributed across five provinces and regions—Hainan, Guangdong, Fujian, Zhejiang, and Guangxi—with 97% concentrated in Guangdong, Guangxi, and Hainan. The data demonstrated an 8,300-hectare increase compared to 2002, positioning China among the few countries globally achieving net mangrove area expansion over the past two decades.

Discussion topics focus on the comprehensive protection measures and policy frameworks implemented at national and provincial levels, strategic planning for continued expansion and restoration including the Special Action for Mangrove Protection and Restoration (2020-2025), coordination mechanisms among different government departments and administrative levels, and approaches to addressing persistent challenges including site selection, species diversity enhancement, and long-term monitoring and adaptive management strategies.

PHOTO 3 : MR. JI WENYUAN, DEPARTMENT OF WETLAND MANAGEMENT, NATIONAL FORESTRY AND GRASSLAND ADMINISTRATION (NFGA)

4.3. Ramsar Convention Implementation and International Cooperation

Ms. CHEN Lin from the Department of International Cooperation, National Forestry and Grassland Administration (NFGA), traced China's progressive engagement with international wetland conservation frameworks and its evolution as a global leader in implementing the Ramsar Convention. The presentation outlined China's institutional development and achievements in wetland site designation and management.

Key elements included China's accession timeline, 1992 as the 67th Contracting Party, establishment of the Ramsar Management Authority in 2005, formation of the National Ramsar Committee in 2007, and creation of the Department of Wetland Management in 2018. The session highlighted impressive designation achievements: 82 Wetlands of International Importance, 13 International Wetland Cities, and 58 Wetlands of National Importance.

Participants engaged in discussions about mechanisms for coordinating Ramsar implementation across multiple government agencies and administrative levels, approaches to integrating international commitments with national conservation priorities

PHOTO 4 : MS. CHEN LIN, DEPARTMENT OF INTERNATIONAL COOPERATION, NATIONAL FORESTRY AND GRASSLAND ADMINISTRATION (NFGA)

4.4. Chinese National Context and Cultural Foundations

Mr. ZHENG Xinmin, Deputy Secretary of NFGA, explored essential background on China's geographical, political, and cultural context. The presentation illustrated how China's governance structure and cultural values inform environmental stewardship approaches.

Key topics included China's geographical profile as an East Asian nation bordering the Pacific Ocean with 9.6 million square kilometers of land area, making it the third-largest country globally. The political system operates under Communist Party leadership incorporating the People's Congress system, multi-party cooperation and political consultation, and regional autonomy for ethnic minorities. The administrative structure comprises three tiers: provinces, counties, and township, senabling coordinated policy implementation. China's demographic profile includes 56 ethnic groups with Han people constituting 91.11% of the population.

The cultural values that inform environmental ethics, including the 4,700-year history of tea culture demonstrate long-term sustainable resource use and highlight approaches to balancing rapid economic development with environmental protection objectives across different regions and administrative levels.

PHOTO 5 : MR. ZHENG XINMIN, DEPUTY SECRETARY OF NFGA

4.5. Urban Wetland Conservation Planning in Shenzhen

Mrs. DENG Jinjie from Shenzhen Center for Design presented the city's ambitious wetland conservation strategy, demonstrating how a major urban center can integrate ecological protection with economic development. The session highlighted Shenzhen's role as host city for the IMC and its commitment to exemplary coastal wetland governance.

Key elements included Shenzhen's wetland inventory totaling 347.88 square kilometers, with coastal wetlands accounting for 76.62% representing typical South Asian tropical ecosystems including mangroves, coastal mudflats, coral reefs, estuaries, and bays. The city's strategic location on the East Asia-Australia migratory bird flyway establishes it as a critical "transit station" supporting internationally significant bird populations.

Participants discussed mechanisms for integrating wetland conservation with urban development planning and infrastructure projects, approaches to managing recreational use and tourism while maintaining ecological integrity, strategies for engaging urban populations in wetland conservation through education and citizen science, and models for financing urban wetland conservation and restoration through innovative funding mechanisms.

PHOTO 6 : MRS. DENG JINJIE, SHENZHEN CENTER FOR DESIGN

4.6. Climate Change Mitigation Through Mangrove Blue Carbon

Professor LIN Guanghui from Tsinghua University focused on the critical intersection between mangrove conservation and climate change mitigation, with particular emphasis on blue carbon ecosystem services. The presentation positioned climate change as one of the greatest threats to humanity while demonstrating how mangroves provide nature-based solutions through exceptional carbon sequestration capacity.

Key elements included comprehensive analysis of blue carbon, mangroves demonstrating superior carbon storage in both biomass and sediments compared to terrestrial forests. The session featured China's pioneering blue carbon trading initiative:

Discussion topics covered methodologies for quantifying and verifying mangrove blue carbon sequestration and storage, development of blue carbon trading mechanisms and market frameworks to finance conservation and restoration, approaches to achieving synergistic benefits combining carbon sequestration, biodiversity protection, and community livelihood improvement, and strategies for integrating mangrove blue carbon into national and international climate change mitigation commitments including Nationally Determined Contributions under the Paris Agreement.

PHOTO 7 : PROF. LIN GUANGHUI, TSINGHUA UNIVERSITY

4.7. Citizen Science and Bird Watching for Mangrove Conservation

Dr. WANG Haibin from China Wildlife Conservation Association demonstrated how citizen science through bird watching contributes valuable data and public engagement for mangrove conservation. The presentation highlighted the transformation of bird watching from recreational activity to systematic monitoring supporting professional conservation management.

The presentation covered China's extensive bird watching community comprising approximately one million organized members nationally, with structured societies at various administrative levels and extensive networks of independent observers connected through digital platforms. The presentation emphasized mangroves as priority destinations for bird watchers due to exceptional avian diversity, particularly during migration seasons.

Participants engaged in discussions about practical methods for recruiting, training, and coordinating volunteer bird watchers to maximize data quality and coverage, development of standardized protocols and digital platforms for data collection, management, and analysis, approaches to integrating citizen science data with

professional monitoring programs to inform adaptive management decisions, and strategies for leveraging bird watching enthusiasm to build broader public awareness and political support for mangrove conservation investments.

PHOTO 8 : DR. WANG HAIBIN FROM CHINA WILDLIFE CONSERVATION ASSOCIATION

4.8. Ecosystem Dynamics and Structural Complexity

Professor A. Aldrie Amir from Universiti Kebangsaan Malaysia, provided theoretical foundations for understanding mangrove habitat dynamics, connectivity, and complexity essential for effective conservation and restoration. The presentation situated mangroves within broader wetland classification systems while emphasizing their unique characteristics and ecological processes.

The session explored natural gap dynamics in mangrove forests, where canopy gaps created by tree mortality or storm damage provide opportunities for seedling establishment and growth, maintaining forest age diversity and structural heterogeneity. This continuous cycle of disturbance and regeneration sustains youthful forest conditions and ecological resilience, enabling adaptation to changing environmental conditions.

Discussion focused on the role of anthropogenic disturbances and approaches to distinguishing harmful degradation from disturbances that might mimic natural gap dynamics at appropriate scales, importance of connectivity among mangrove patches and between mangroves and adjacent terrestrial and marine ecosystems. Successful

restoration should recreate conditions supporting natural regeneration rather than imposing artificial uniformity.

PHOTO 9 : PROF. A. ALDRIE AMIR, UNIVERSITI KEBANGSAAN MALAYSIA,

4.9. Restoration Science and Practice

Professor WANG Wenqing from Xiamen University presented China's comprehensive approach to mangrove restoration, combining ambitious targets with evolving scientific understanding and practical experience. The session integrated policy frameworks with technical considerations affecting restoration success.

The presentation examined two major national restoration programs: the Special Action for Mangrove Protection and Restoration (2020-2025), and the Coastal Shelterbelt System Construction Project Plan (2016-2025). Chinese restoration practices have evolved to incorporate greater species diversity, improve seedling survival rates, and enhance ecosystem functionality. Critical challenges were identified, particularly site elevation as a fundamental factor influencing success, with lower elevation and higher salinity significantly reducing seedling survival.

Discussion topics encompassed technical approaches to site selection and preparation, including hydrological assessments and soil condition evaluations, strategies for species selection considering ecological suitability, functional diversity, and climate change adaptation.

PHOTO 10 : PROF. WANG WENQING, XIAMEN UNIVERSITY

4.10. Governance and Institutional Frameworks

Mrs. Verónica, Forestry Officer from the Ministry of Environment, Panama, provided insights into mangrove management governance and institutionality from a Latin American perspective. The presentation illustrated how countries with substantial mangrove resources navigate complex governance challenges balancing ecological conservation with socioeconomic development.

Key elements included Panama's demographic and resource profile: 4.5 million inhabitants in 2024, 46,338 square kilometers of forest cover (2021), and 187,064 hectares of mangrove forest (2021). The session explored institutional arrangements for mangrove governance involving the Ministry of Environment and multiple stakeholders across government levels, civil society, and private sector actors.

Discussion addressed the complex relationships between mangrove ecology, human populations dependent on coastal resources, and environmental challenges including climate change, pollution, and land-use conversion.

PHOTO 11 : MRS. VERÓNICA, FORESTRY OFFICER FROM THE MINISTRY OF ENVIRONMENT, PANAMA

4.11. Wildlife Conservation and Migratory Birds

Professor ZHOU Haichao from Shenzhen University highlighted the critical role of mangroves in supporting wildlife populations, with particular emphasis on migratory birds utilizing the East Asian-Australasian Flyway. The session explored the intersection between mangrove conservation and international wildlife conservation efforts, emphasizing that China hosts 1,505 bird species with more than 820 exhibiting migratory behavior.

Key elements included sophisticated monitoring techniques such as satellite tracking and bird-banding programs revealing the importance of mangrove wetlands for species including Great Cormorants and Chinese Egrets. Research demonstrated that mangrove wetlands serve as important wintering habitats along major flyways. The presentation emphasized that mangrove restoration requires focusing not merely on expanding area but on enhancing biodiversity and habitat quality to support avian populations.

Participants discussed practical methods for assessing and enhancing habitat quality for migratory species, including food availability, roosting sites, and freedom from

disturbance, implementation of effective monitoring programs integrating traditional survey methods with modern technologies.

PHOTO 12 : PROF. ZHOU HAICHAO, SHENZHEN UNIVERSITY

4.12. Ecological Character Maintenance and Monitoring

Professor LYU Cai from Beijing Forestry University addressed the fundamental concepts and practical approaches for maintaining ecological character in mangrove wetlands. The presentation provided theoretical foundations for understanding ecosystem services and implementing systematic monitoring programs aligned with Ramsar Convention requirements.

Key elements included comprehensive review of wetland definitions and categories establishing the conceptual framework for classification and management, analysis of ecosystem services provided by mangroves including provisioning services (fisheries, timber, fuelwood), regulating services (coastal protection, carbon sequestration, water filtration), cultural services (recreation, spiritual values), and supporting services (nutrient cycling, primary production).

Discussion topics encompassed communication strategies for translating monitoring results into management actions and policy decisions, making ecological character concepts accessible to decision-makers and the public.

PHOTO 13 : PROF. LYU CAI, BEIJING FORESTRY UNIVERSITY

5. Countries presentation

- **China: Integrated Monitoring and Evaluation**

China has established a comprehensive integrated monitoring system covering forests, grasslands, wetlands, and desert resources. The first national integrated forest and grassland ecological monitoring and evaluation was completed across all 31 provinces, autonomous regions, and municipalities, culminating in the 2021 China Integrated Forest and Grassland Ecological Monitoring and Evaluation Report. This milestone demonstrates China's capacity for large-scale environmental monitoring and provides models for other countries developing national monitoring systems.

- **Cambodia: Conservation and Restoration Experience**

Cambodia maintains approximately 78,405 hectares of mangroves (2010 data), with the majority located in Koh Kong Province. The country experienced approximately 12% mangrove loss between 1993 and 2011, driven by shrimp farming, charcoal production, salt farming, tourism development, infrastructure expansion, and unsustainable use. However, recent initiatives have reduced loss rates through reforestation, charcoal production bans, and deactivation of non-profitable aquaculture ponds. Cambodia's restoration approach follows established guidelines, emphasizes multi-species plantations, and includes monitoring of planted mangrove survival and growth. Significant NGO, agency, and community involvement, including private sector participation, characterizes Cambodia's collaborative approach.

- **Madagascar: Community-Based Restoration**

Madagascar possesses 390,000 hectares of mangroves (2019), representing 1.4% of the country's total forest cover and 2% of global mangrove distribution. Ranked fourth in Africa and second in the Western Indian Ocean region with 37% of the area's mangroves, Madagascar faces significant restoration challenges. The country's approach emphasizes community-based and assisted natural regeneration, particularly for degraded inland mangroves with limited seawater connectivity. Specific interventions include building tidal channels to improve hydrological conditions, soil quality, and seedling transport, facilitating natural propagule settlement and growth. These efforts simultaneously aim to improve local population living conditions and develop sustainable livelihoods, demonstrating integration of conservation and development objectives.

6. Group work and panel discussions

The International Mangrove Workshop incorporated two strategic panel discussions as essential components of its participatory capacity-building methodology. These sessions transformed participants from passive learners into active contributors, ensuring that the

International Mangrove Center's future direction would reflect genuine member country needs and priorities.

6.1. Panel Discussion 1: IMC Strategic Plan

Facilitated by Professor LYU Cai from Beijing Forestry University on June 21st, this session engaged twenty-four participants from China, Madagascar, and Cambodia in examining the four foundational objectives of the IMC's mandate.

Objective 1: Promote Knowledge Sharing and Strengthen Joint Research Cooperation

Participants endorsed the workshop model while recommending complementary mechanisms including a comprehensive online portal with technical guidelines and case studies in multiple languages, virtual learning through webinars and remote technical assistance, bilateral study visits between member countries, and systematic documentation of lessons learned. Knowledge sharing must be genuinely reciprocal and multi-directional, recognizing valuable expertise exists at all levels including traditional ecological knowledge from coastal communities. Joint research cooperation should focus on collaborative multi-country projects examining restoration across different contexts, data sharing mechanisms, researcher exchanges, and IMC coordination of collaborative efforts addressing practitioner-identified questions.

Objective 2: Enhance Technology Transfer and Scientific and Technical Cooperation, and Training

Recommendations included more hands-on practical activities during field visits, specialized advanced workshops for experienced practitioners, and post-workshop technical support during implementation. Technology transfer priorities encompassed propagation and planting techniques, hydrological restoration methods, cost-effective monitoring suitable for resource-constrained settings, and GIS applications for site assessment. Scientific cooperation should establish practitioner and researcher networks, remote technical consultation mechanisms, peer-to-peer mentorship, and collaborative demonstration projects. Training should address field practitioners, managers, policymakers, and researchers at multiple levels.

Objective 3: Develop Education, Information, Communication, and Public Awareness Mechanisms

Participants recognized that effective conservation requires public understanding and support. The IMC should develop comprehensive strategies targeting coastal communities, youth, policymakers, the general public, and the private sector. Recommended mechanisms included compelling communication materials highlighting mangroves' climate, coastal protection, and livelihood benefits, online platforms and social media,

documentary films, educational curricula for schools, and public events like World Wetlands Day. Communication should be culturally appropriate, available in local languages, showcase success stories alongside challenges, and prominently feature community voices rather than relying exclusively on expert perspectives.

Objective 4: Build and/or Enhance Capacity, and Conduct Pilot Projects

Effective conservation requires capacity building at multiple levels. Beyond individual technical training, institutional capacity needs include organizational systems, inter-agency coordination mechanisms, supportive policy frameworks, and adequate resource allocation. Research capacity building should support graduate training, mentorship relationships, research infrastructure, and collaborative projects. Community capacity building through local leader engagement and sustainable resource management training would strengthen grassroots efforts.

PHOTO 14 : GROUP WORK ON THE IMC STRATEGIC PLAN

6.2. Panel Discussion 2: Needs of Mangrove Restoration Research and Pilot Projects

Facilitated by Professor LEI Guangchun from Beijing Forestry University on June 26th, this session focused specifically on advancing restoration science and practice. Professor LEI noted that despite ambitious international restoration targets, outcomes remain highly variable due to significant knowledge gaps and inadequate adaptation to local conditions.

Critical Knowledge Gaps

Fundamental questions remain about factors determining restoration success or failure, predicting site restoration potential, when natural regeneration versus planting is appropriate, and early success indicators. Standard techniques often fail in challenging degraded sites with hypersalinity, compaction, or altered hydrology. Many projects employ simplified monocultures lacking natural ecosystem complexity. Understanding of restoration timelines over decades rather than short funding cycles is inadequate. Socioeconomic dimensions including community engagement, benefit sharing, livelihood integration, and governance structures lack evidence-based guidance. Climate change considerations including species selection for future conditions and resilience strategies require urgent attention.

Priority Research and Collaborative Opportunities

High priorities include comparative multi-site research across countries identifying success factors through systematic comparison, ecosystem function recovery research beyond forest structure measurement, long-term monitoring networks with standardized protocols, cost-effective scalable approaches including natural regeneration techniques appropriate for resource-constrained settings, and integration with livelihoods and blue carbon examining carbon sequestration potential and accessible methodologies for community-based projects. These could be addressed through coordinated multi-country initiatives with IMC coordination.

Future Work with IMC: Pilot Project Opportunities

Participants identified several high-priority pilot project concepts. Multiple countries expressed interest in restoration of degraded mangrove, hydrological restoration, and integration with sustainable aquaculture. Climate-resilient restoration pilots would explicitly incorporate climate projections into site selection and design, examining species potentially pre-adapted to future conditions. Blue carbon integration projects would implement restoration following international carbon accounting methodologies while developing community-based governance ensuring equitable benefits. Community-based restoration models would emphasize participatory planning, livelihood integration, and governance promoting long-term stewardship. Landscape-scale restoration would address connectivity considerations and integration with broader coastal zone management.

Implementation and Impact

Both discussions produced concrete recommendations with clear implementation pathways. Immediate actions include the IMC secretariat compiling recommendations, circulating them to participants for input, developing action plans with timelines and resource requirements, and soliciting detailed pilot project concept notes. Medium-term development involves finalizing the strategic plan, securing funding, establishing pilot projects, launching collaborative research, and developing knowledge management systems. The long-term vision encompasses a thriving community of practice with regular cross-border collaboration, robust evidence base for restoration practice, effective capacity at multiple levels in member countries, sustainable financing mechanisms, and strong integration of conservation into broader development planning.

PHOTO 15 : GROUP WORK IDENTIFYING NEEDS FOR MANGROVE RESTORATION RESEARCH AND THE PILOT PROJECT

7. Cultural Experiences and field Visits

Within the framework of the IMC Workshop, participants took part in both in-depth technical sessions focused on mangrove conservation and restoration, and enriching cultural and field activities. These moments allowed them to explore firsthand the links between environmental stewardship, cultural traditions, and contemporary development in China.

Through a comprehensive field program, participants visited various mangrove ecosystems and conservation sites, allowing them to gain hands-on, practical knowledge directly from on-site observations.

- **Visit to the International Mangrove Center Office**

The program commenced with a visit to the IMC headquarters in Shenzhen, providing participants with firsthand understanding of the institutional infrastructure supporting the center's operations. This initial site visit served to ground theoretical discussions about IMC's structure and functions in the physical reality of the organization's operational base.

The IMC office is strategically located in Shenzhen, China's pioneering special economic zone known for innovation, international connectivity, and environmental leadership.

PHOTO 16 : VISIT TO INTERNATIONAL MANGROVE CENTER OFFICE

- **Guangdong Shenzhen Futian Mangrove Ramsar Site**

The first field site visit took participants to the Futian Mangrove Ramsar Site, located within Shenzhen's urban landscape. This site exemplifies successful conservation of ecologically significant wetlands within a rapidly developing megacity context, providing powerful lessons about urban wetland management and the connectivity between people and mangroves. The Futian Mangrove Nature Reserve, designated as a Ramsar Site and part of the larger Shenzhen Bay area, encompasses approximately 368 hectares of mangrove wetland at the mouth of the Shenzhen River. Located in one of China's most economically dynamic cities, the site exists in striking juxtaposition with dense urban development, high-rise buildings visible across the wetland expanse.

The Futian experience offers valuable lessons relevant to the IMC's mandate across all four pillars. For knowledge sharing, the site demonstrates innovative approaches to urban wetland management applicable to many coastal cities globally facing similar challenges. Documentation and dissemination of Futian's management approaches, monitoring protocols, and stakeholder engagement strategies provide practical guidance for other urban mangrove sites.

PHOTO 17 : VISIT TO THE FUTIAN MANGROVE RAMSAR SITE IN FUTIAN DISTRICT, SHENZHEN, GUANGDONG PROVINCE

- **Shankou Mangrove Nature Reserve**

The field program continued to Shankou Mangrove Nature Reserve in Guangxi Province, providing contrast to the urban Futian site. The reserve supports China's most extensive and well-developed mangrove forests, with greater structural complexity, species diversity, and ecological integrity compared to many other Chinese sites.

The site provides critical ecosystem services including fisheries support, coastal protection, water filtration, and carbon sequestration.

Recent challenges include climate change impacts such as sea-level rise requiring adaptation strategies; invasive species establishment threatening native communities; balancing tourism development with conservation objectives; and maintaining adequate funding for expanded management activities.

Between field site visits, participants engaged in a cultural exchange experience providing insight into the traditions, customs, and cultural heritage of coastal communities in the Guangxi region. This component recognized that effective mangrove conservation requires understanding and respecting the cultural contexts within which conservation occurs, including the deep connections between coastal peoples and mangrove ecosystems.

PHOTO 18 : FIELD VISIT TO THE SHANKOU MANGROVE NATURE RESERVE

- **Guangxi Marine Biodiversity Science Education Base**

The field program included a visit to Guangxi Marine Biodiversity Science Education Base, shifting focus from mangroves to closely associated seagrass ecosystems and the endangered marine mammals they support. This site visit illustrated the importance of ecosystem connectivity and integrated coastal management, recognizing that mangrove conservation cannot be separated from management of adjacent marine habitats.

The Guangxi Marine Biodiversity Science Education Base is not just a single building but a multi-functional center integrating:

- A Scientific Research Institute: Conducting vital studies on marine life.
- A Conservation Hub: Working to protect endangered species and habitats.
- A Public Education Museum: Engaging and inspiring the public.

Its primary mission is to educate students, tourists, and the local community about marine ecology and the importance of ocean conservation.

PHOTO 19 : VISIT TO GUANGXI MARINE BIODIVERSITY SCIENCE EDUCATION BASE

- **Weizhou Island Autonomous Region Level Nature Reserve**

The field program included a visit to Weizhou Island, China's youngest volcanic island, hosting an Autonomous Region level Nature Reserve protecting coral reef ecosystems. The island's volcanic origin creates unique geological features including columnar basalt formations, volcanic beaches, and distinctive landscapes attracting tourism.

Reserve staff presented information about coral diversity, reef structure, and associated biodiversity. The island faces significant challenges balancing conservation with rapid tourism development. Weizhou's scenic beauty, unique geology, marine biodiversity, and relatively accessible location have driven tourism growth.

The Weizhou Island visit reinforced lessons about ecosystem connectivity and integrated management. While coral reefs differ substantially from mangroves, both face similar threats including climate change, pollution, overexploitation, and development pressures, suggesting opportunities for shared conservation strategies and approaches.

PHOTO 20 : VISIT TO WEIZHOU ISLAND AUTONOMOUS REGION LEVEL NATURE RESERVE

- **Qinzhou Blue Bay project**

The field program included a visit to Qinzhou Bay Park, an urban coastal park demonstrating integration of mangrove conservation with recreational infrastructure and urban development. This site provided perspectives on accessible public engagement with mangroves and the role of urban parks in conservation and environmental education.

Despite recreational uses, the park maintains conservation values. Mangrove areas support bird populations utilizing the site for feeding, resting, and nesting. Water quality improvements resulting from wetland protection benefit both ecological and recreational values. The park serves as a biodiversity corridor connecting with other coastal wetlands in the Qinzhou Bay area.

PHOTO 21 : VISIT TO QINZHOU BAY PARK

- **Guangxi Beilun Estuary National Nature Reserve**

The field program concluded with a visit to Guangxi Beilun Estuary National Nature Reserve, one of China's most important mangrove conservation areas. This visit provided comprehensive observation of well-developed mangrove ecosystems and sophisticated conservation management, integrating lessons from previous site visits.

The Site is a coastal wetland with mangrove forest, intertidal mudflats and seagrass beds located on the East Asian – Australasian Flyway. Situated to the north of Beilun River, a transboundary river between Viet Nam and China, it represents the largest contiguous stretch of mangrove forest in coastal China. The mangroves help resist and alleviate the impacts of hazards and protect the coast from shoreline erosion

Biodiversity extends far beyond mangrove vegetation itself. The reserve supports one of China's most important stopover and wintering sites for shorebirds on the East Asian-Australasian Flyway. Marine biodiversity includes numerous fish, crustacean, and mollusk species.

PHOTO 22 : GUANGXI BEILUN ESTUARY NATIONAL NATURE RESERVE

8. Evaluation and feedback

The comprehensive program structure combining theoretical instruction, interactive dialogue, extensive field visits, and strategic planning discussions created a rich, multifaceted learning environment that addressed diverse learning needs and styles.

The field visits to diverse mangrove sites across Guangdong and Guangxi provinces represented a distinguishing strength of the workshop. Participants valued the opportunity to observe different mangrove ecosystem types, management approaches, and conservation contexts firsthand. Sites ranged from urban conservation areas like Futian Mangrove Ramsar Site to remote reserves like Beilun Estuary, from island ecosystems at Weizhou to estuarine environments, providing comparative learning opportunities impossible through classroom instruction alone.

The integration of cultural experiences including lectures on Chinese culture, folk cultural experiences, and numerous social events provided important context while building cross-cultural understanding and relationships. Chinese hospitality throughout the program created a welcoming atmosphere. The extended duration and geographic journey created shared experiences that strengthened group cohesion and lasting professional networks among participants, providing channels for continued technical exchange, peer support, and potential future collaboration.

While participants appreciated the comprehensive content, several noted that the intensive schedule with long days and substantial travel left limited time for reflection, informal discussion, and adequate rest. Future workshops might benefit from slightly longer duration, more explicit time for informal networking, built-in reflection periods.

Several participants expressed concern about maintaining momentum and applying learning after returning to their countries. They requested clearer mechanisms for post-workshop technical support, ongoing communication and knowledge exchange.

9. Conclusion

The International Mangrove Workshop's 3rd term successfully achieved its ambitious objectives of enhancing technical capacity, facilitating knowledge exchange, building professional networks, and engaging participants in strategic planning for international mangrove conservation. The workshop demonstrated the IMC's commitment to serving as an effective platform for international cooperation and capacity building while positioning member countries as equal partners in shaping the Center's future direction.

The workshop successfully strengthened participants' technical knowledge and practical understanding of mangrove conservation and restoration through comprehensive coverage of topics from policy frameworks to technical methodologies. Participants gained current scientific understanding of mangrove ecosystems, exposure to diverse conservation and restoration approaches, practical insights from extensive field observations, understanding of international cooperation frameworks, and enhanced awareness of emerging issues including climate change adaptation and blue carbon finance.

The workshop created valuable opportunities for multi-directional knowledge exchange among participants from different countries and professional backgrounds. Through interactive sessions, panel discussions, and informal conversations, participants shared national experiences and lessons learned, discovered common challenges and innovative solutions, identified opportunities for bilateral or regional collaboration, and gained appreciation for both universal principles and important contextual differences requiring adapted approaches. This peer learning complemented expert instruction and recognized that valuable knowledge exists at all levels and in all countries.

A fundamental achievement was the development of lasting professional relationships among participants that will support ongoing cooperation. The extended duration, shared field experiences, and substantive dialogue around real challenges created authentic connections characterized by mutual respect, trust, and shared commitment to conservation objectives. These networks provide channels for continued technical exchange, peer support and problem-solving, and potential future collaboration on research or projects.

The participatory panel discussions produced concrete recommendations that will inform the IMC's strategic plan and programmatic priorities across its four foundational objectives. By engaging participants as active contributors to strategic planning, the workshop fostered ownership and investment in the IMC's success, ensured the Center's direction reflects genuine member country needs, identified specific opportunities for collaborative initiatives, and demonstrated the IMC's commitment to consultative, member-driven approaches.

The workshop represents an important milestone in the IMC's development and the advancement of international cooperation in mangrove conservation, but it is fundamentally a beginning rather than an end. The true measure of success will be the extent to which workshop outcomes translate into improved conservation practice in member countries, sustained collaboration among participants and institutions, effective implementation of recommendations produced through panel discussions, and continued growth and strengthening of the IMC as a platform for international cooperation.

The twenty-four participants return to their countries equipped with enhanced knowledge and skills, valuable professional relationships, and renewed commitment to mangrove conservation. More importantly, they carry with them a sense of belonging to a broader international community of practice united by shared passion for protecting these remarkable ecosystems and the coastal communities that depend on them. This sense of collective purpose and mutual support may prove to be the workshop's most enduring and valuable contribution to advancing mangrove conservation globally.

PHOTO 23 : IMC CERTIFICATE AWARDING CEREMONY

Annex

ANNEX 1 : LIST OF PARTICIPANTS

Family Name	Given Name	Organization	Gender	Position	E-mail
MON	Samut	Cambodia	M	Deputy Director of Department, General Directorate of Natural Protected Area (GDNPA) of MoE	msamuthffi@gmail.com
MOEUNG	Sopheap		M	Acting Director, Preah Sihanouk Provincial Department of Environment	sopheap016588005@gmail.com
TITHUOT	Vathana		F	Head of Bureau, GDNPA	thvathana@gmail.com
PON	Chanthida		F	Head of Bureau, GDNPA	chanthida.pon11@yahoo.com
RIN	Sarem		M	Deputy Head of Bureau, GDNPA	rinsarem@gmail.com
MENG	Sokmean		M	Official, GDNPA	mengsokmean121592@gmail.com
PRUM	Sambath		M	Official, GDNPA	prumsambath1@gmail.com
KRUY	Lypheng		F	Official, Koh Kong Provincial Department of Environment	kruylyphengkk@gmail.com
UN	Dane		F	Official, GDNPA	undane07071998@gmail.com
PAO	Vorlin		F	Official, General Directorate of Administration and Finance	vorlinpao18@gmail.com
THOEUN	Sreyny		F	Official, GDNPA	sreyny1218@gmail.com
NDRENAMBININA	Tsiramby	Madagascar	M	Head of the Blue Economy	felicients@gmail.com

Family Name	Given Name	Organization	Gender	Position	E-mail
	Felicien			Department, Ministry of Environment and Sustainable Development	
RARIVOMANANA EP RAMAHAVERIAVONA	Hanitriniaina Tahina		F	Head of the Blue Economy Department, Ministry of Environment and Sustainable Development	hanitriniaina.rariv@gmail.com
RANAIVOSON EP RABARIJAONA	Rindra Manasoa		F	Technical support manager, Ministry of Environment and Sustainable Development	rindramanasoa@live.fr
ANDRIAMBELO EP RANAIVOSON	Fara Mihanta		F	Technical support manager, Ministry of Environment and Sustainable Development	fara_mihanta@yahoo.fr
NOELIARIVELO	Tomponiony Tolojanahary		F	International Conventions departement manager, Ministry of Environment and Sustainable Development	onynoeliarivelo@gmail.com
RAMANANTSARA EP RABEFARITRA	Faranirina Nadine Michelle		F	Head of the Regional Forestry Department Boeny Betsiboka, Ministry of Environment and Sustainable Development	faranadineramanantsara@gmail.com
RANDRIANJAFIMANANA	Nambinintsoa		M	National Technical Lead - Fisheries Management, BLUE VENTURES	tahiry@blueventures.org
ANDRIAMARO EP RAZAFINDRAKOTO	Luciano		F	Senior Director Department Science and Knowledge, Conservation Internationale	landriamaro@conservation.org
RAHARIFIDINARIVO	Landry Michael		M	Regional Coordinator and technical advisor on Lansdcape and Forest Restoration,	michael.raharifidinarivo@giz.de

Family Name	Given Name	Organization	Gender	Position	E-mail
				F4F/GIZ Boeny project F4F/GIZ	
RAVAOARINOROTSI HOARANA EP RAKOTOMALALA	Lalao Aigrette		F	Director of Blue Economy Department , BONDY INTERNATIONAL	lalao.aigrette@bondy.earth
ZHANG	Xiaoyun		F	Professor-level Senior Engineer, Wetlands Division, Planning Institute, National Forestry and Grassland Administration	
ZHU	Xingwen		M	Assistant Engineer of Central South Survey and Planning Institute of National Forestry and Grassland Administration	
YANG	Jingjun	China	M	Professional and technical personnel of Guangxi Zhuang Autonomous Region Academy of Forestry Sciences	

ANNEX 2 : AGENDA

Date	Day	Time	Activities	Lecturer/Moderator/Institute	Location
Jun 18th	Wed	All day	Arrival &Registration	Mr. JIANG Yi, Program Officer, National Academy of Forestry and Grassland Administration (NAFGA), China	Shenzhen Guohui Hotel
Jun 19th	Thur	09:00-09:20	Opening Ceremony	Mr. PENG Peng International Mangrove Center	Futian Hall, Shenzhen Guohui Hotel **Dress code: Business Casual or Traditional*
		09:20-09:30	Group Photo	Mr. JIANG Yi, Program Officer, National Academy of Forestry and Grassland Administration (NAFGA), China	Futian Hall, Shenzhen Guohui Hotel
		09:30-10:00	Tea Break		Futian Hall, Shenzhen Guohui Hotel
		10:00-10:30	Lecture 1:Overview of the International Mangrove Center	Mr. BAO Daming Vice Chairman and Secretary General of China Wetlands Association	Futian Hall, Shenzhen Guohui Hotel

Date	Day	Time	Activities	Lecturer/Moderator/Institute	Location
		10:30-11:15	Lecture 2: The Status, Challenges and Actions of Mangroves in China	Mr. JI Wenyuan, Department of Wetland Management, National Forestry and Grassland Administration (NFGA), China	Futian Hall, Shenzhen Guohui Hotel
		11:15-12:00	Lecture 3: The Implementation of the Convention on Wetlands and International Cooperation on Mangrove Conservation	Ms. CHEN Lin Department of International Cooperation, National Forestry and Grassland Administration (NFGA), China	Futian Hall, Shenzhen Guohui Hotel
		12:00-13:00	Welcome Banquet	Mr. JIANG Yi, Program Officer, NAFGA, China	Longhua Hall, Shenzhen Guohui Hotel
		14:00-15:30	Lecture 4: Introduction to China and the Chinese Culture	Mr. ZHENG Xinmin, Deputy Secretary, NAFGA, China	Qianhai Hall, Shenzhen Guohui Hotel
		15:30-16:00	Lecture 5: Wetland Conservation Plan in Shenzhen City	Mr. DENG Jinjie Shenzhen Center for Design	Qianhai Hall, Shenzhen Guohui Hotel
		16:00-16:30	On-Site Teaching 1: Visit the office of the IMC	Mr. WU Tong International Mangrove Center	HeTao Innovation and Technology Center Shenzhen City

Date	Day	Time	Activities	Lecturer/Moderator/Institute	Location
		16:30-18:00	On-Site Teaching 2: Guangdong Shenzhen Futian Mangrove Ramsar Site	Dr. YANG Qiong, Dr. XU Hualin Scientist of Futian Mangrove Site, China	Neilingding Futian National Nature Reserve
Jun 20th	Fri	9:00-10:00	Lecture 6: Mangrove Conservation and Climate Change	Prof. LIN Guanghui, Tsinghua University, China	Qianhai Hall, Shenzhen Guohui Hotel
		10:00-10:30	**Interactive Q&A** ①: Question and Answer based on the Lecture topic and Mangrove Conservation experience	Prof. LIN Guanghui, Tsinghua University, China	Qianhai Hall, Shenzhen Guohui Hotel
		10:30-11:30	Lecture 7: Bird Watchers, Valuable Partiners in Mangrove Management and Conservation	Dr. WANG Haibin China Wildlife Conservation Association	Qianhai Hall, Shenzhen Guohui Hotel
		11:30-12:00	**Interactive Q&A** ②: Question and Answer based on the Lecture topic and Mangrove Conservation experience	Dr. WANG Haibin China Wildlife Conservation Association	Qianhai Hall, Shenzhen Guohui Hotel
		14:00-15:00	Lecture 8: Mangrove Habitat Dynamics, Connectivity and Complexity	Prof. A. Aldrie Amir, Universiti Kebangsaan Malaysia, Malaysia	Qianhai Hall, Shenzhen Guohui Hotel
		15:00-15:30	**Interactive Q&A** ③: Question and Answer based on the Lecture topic and	Prof. A. Aldrie Amir,	Qianhai Hall,

Date	Day	Time	Activities	Lecturer/Moderator/Institute	Location
			Mangrove Conservation experience	Universiti Kebangsaan Malaysia, Malaysia	Shenzhen Guohui Hotel
		15:30-16:30	Lecture 9: Introduction to Mangrove Ecosystem and Restoration Practice	Prof. WANG Wenqing, Xiamen University, China	Qianhai Hall, Shenzhen Guohui Hotel
		16:30-17:00	**Interactive Q&A** ④: Question and Answer based on the Lecture topic and Mangrove Conservation experience	Prof. WANG Wenqing, Xiamen University, China	Qianhai Hall, Shenzhen Guohui Hotel
Jun 21st	Sat	9:00-10:00	Lecture 10: Mangrove management, governance, and institutionality	Ms. Verónica Forestry Officer, Ministry of Environment, Panama	Qianhai Hall, Shenzhen Guohui Hotel
		10:00-10:30	**Interactive Q&A** ⑤: Question and Answer based on the Lecture topic and Mangrove Conservation experience	Ms. Verónica Forestry Officer, Ministry of Environment, Panama	Qianhai Hall, Shenzhen Guohui Hotel
		10:30-11:30	Lecture 11: Monitoring and Protection of Migratory Birds in Mangrove Wetlands	Prof. ZHOU Haichao, Shenzhen University, China	Qianhai Hall, Shenzhen Guohui Hotel
		11:30-12:00	**Interactive Q&A** ⑥: Question and Answer based on the Lecture topic and	Prof. ZHOU Haichao, Shenzhen University, China	Qianhai Hall, Shenzhen Guohui Hotel

Date	Day	Time	Activities	Lecturer/Moderator/Institute	Location
			Mangrove Conservation experience		
		14:00-15:30	Panel Discussion 1: IMC Strategic Plan	Prof. LYU Cai, Beijing Forestry University, China	Qianhai Hall, Shenzhen Guohui Hotel
		15:00-17:00	Lecture 12: Mangrove Ecological Character Maintenance	Prof. LYU Cai, Beijing Forestry University, China	Qianhai Hall, Shenzhen Guohui Hotel
		17:00-18:00	Discussion: Mangrove Conservation Cases and Experience Sharing	Prof. LYU Cai, Beijing Forestry University, China	Qianhai Hall, Shenzhen Guohui Hotel
Jun 22rd	Sun	11:00-11:30	To Shenzhen North High Speed Railway Station		Shenzhen City
		12:00-17:30	Shenzhen to Beihai		Beihai City
		18:00-19:00	Dinner		Beihai City
Jun 23th	Mon	08:00-09:40	To Shankou Mangrove Ecological Nature Reserve		Beihai City

Date	Day	Time	Activities	Lecturer/Moderator/Institute	Location
		09:40-10:00	The Situation of Mangrove in Guangxi	Mr. SHANG Minglei Deputy Director, Forestry Bureau of Guangxi Zhuang Autonomous Region, China	Beihai City
		10:00-10:30	On-Site Teaching 3: Shankou Mangrove Nature Reserve Cultural Experience: folk cultural	Mr. ZHANG Hongke Shankou Mangrove Forest Reserve Management Centre	Yingluo Harbour and Dandouhai Area
		10:00-10:40	To Hepu Dugong National Nature Reserve		Beihai City
		10:40-12:30	On-Site Teaching 4: Hepu Dugong National Nature Reserve	Mr. TAO Liming Hepu Dugong Protected Area Management Center	Shatin Station, Dugong Reserve
		12:30-13:30	Lunch		Shatin Station, Dugong Reserve
		13:30-16:40	To Weizhou Island		Weizhou Island
		17:30-18:30	Dinner		Weizhou Island

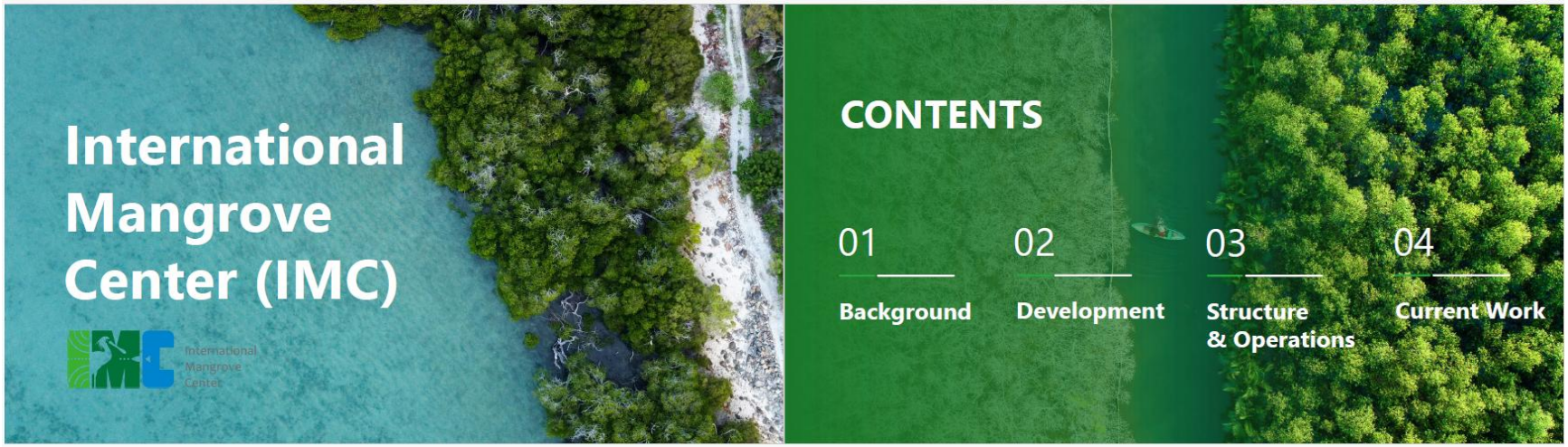
Date	Day	Time	Activities	Lecturer/Moderator/Institute	Location
Jun 24th	Tue	9:00-11:00	On-Site Teaching 5: Weizhou Island Autonomous Region level Nature Reserve	Mrs. LIU Xinyue Weizhou Island Autonomous Region level Nature Reserve	Weizhou Island
		11:00-11:30	Back to the hotel		Weizhou Island
		11:30-12:30	Lunch		Weizhou Island
		12:30-14:30	To Qinzhou City		Qinzhou City
		14:30-16:30	On-Site Teaching 6: Qinzhou Peacock Bay Park		Qinzhou City
		16:30-17:30	To Fangchenggang City		Longde International Hotel
		17:30-18:30	Dinner		Fangchenggang City
Jun 25th	Wed	9:00-10:00	To Guangxi Beilun Estuary National Nature Reserve		Fangchenggang City

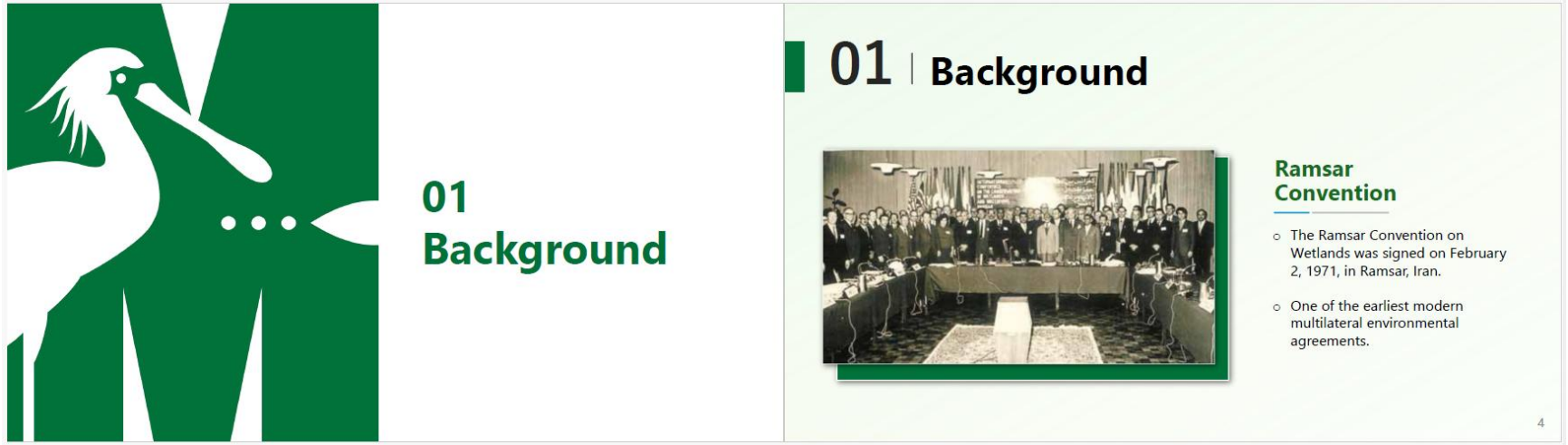
Date	Day	Time	Activities	Lecturer/Moderator/Institute	Location
		10:00-11:30	On-Site Teaching 7: Guangxi Beilun Estuary National Nature Reserve	Mr.TAN Qiwei Beilun Estuary National Nature Reserve Administration Office	Fangchenggang City
		11:30-12:00	Back to the hotel		Fangchenggang City
		12:00-13:00	Lunch		Fangchenggang City
		14:00-16:00	To Nanning City		Nanning WINWIN Hotel
		17:30-18:30	Dinner		Nanning City
Jun 26th	Thus	9:00-11:00	Panel Discussion 2: Needs of Mangrove Restoration Research and Pilot Project	Prof. LEI Guangchun, Beijing Forestry University, China	Lidu Hall Nanning WINWIN Hotel
		11:00-12:00	Closing Ceremony	Mr. JIANG Yi, Program Officer, NAFGA, China	Lidu Hall Nanning WINWIN Hotel **Dress code: Business*

Date	Day	Time	Activities	Lecturer/Moderator/Institute	Location
					Casual or Traditional
		14:00-17:00	Personal Arrangement	Mr. JIANG Yi, Program Officer, NAFGA, China	Nanning City
		18:00-19:30	Farewell Dinner	Mr. BAO Daming Executive Head, Provisional Secretariat, International Mangrove Center	Lidu Hall Nanning WINWIN Hotel
Jun 27th	Fri	All Day	Departure	Mr. JIANG Yi, Program Officer, NAFGA, China	Nanning City

ANNEX 3 : KEYNOTE LECTURE SLIDES

LECTURE 1: OVERVIEW OF THE INTERNATIONAL MANGROVE CENTER





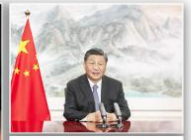
01 | Background

Significance of the IMC

- World' s first independent, non-profit, and inter-governmental international organization in mangrove conservation, serves as an ecosystem-based RRI of the Convention on Wetlands.
- Serve and support Contracting Parties of the Ramsar Convention, particularly global south countries.

02 Development

02 | Development



Proposal at COP14

- November 5, 2022, In COP14, the Chinese President Xi Jinping proposed establishing the International Mangrove Center in Shenzhen, and the draft resolution (XIV.19) to establish the IMC was adopted at the conference.

7

02 | Development

High Level Forum on Mangrove Conservatio

July 26,

International Workshop on Mangrove Conservation and Collaboration

May 15, 2023

8

02 | Development

Regional Initiative Proposal Adopted

On Sept. 6, 2023, the 62nd Standing Committee Meeting of the Ramsar Convention approved the regional initiative proposal Doc.25 Rev.2 for establishing the IMC in Shenzhen.

9

02 | Development

The Signing Ceremony of the EA of the IMC

On November 6, 2024, 18 founding member states signed the agreement and unveiled the plaque for the IMC.

02 | Development

1st Workshop on Mangrove Conservation and Restoration

July 25–August 8, 2024

2nd Workshop on Mangrove Conservation and Restoration

November 1–November 15, 2024

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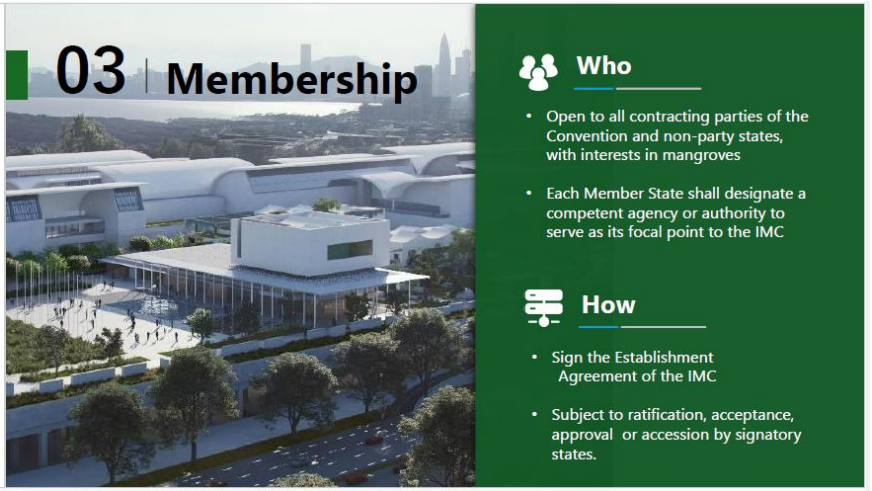
03 Structure & Operations


03 | Mission & Vision
Mission
To promote international cooperation and joint actions in mangrove conservation, restoration, and wise and sustainable use;
Strengthen the implementation of the Convention, and other relevant current and future environmental commitments, including but not limited to the Kunming-Montreal Global Biodiversity Framework, the Paris Agreement, the 2030 Agenda for Sustainable Development along with its Sustainable Development Goals (SDGs).
Vision
A world in which mangroves are conserved, restored, and wisely and sustainably used.


03 | Objectives
01
Promote knowledge sharing and strengthen joint research cooperation
02
Enhance technology transfer and scientific and technical cooperation, and training
03
Develop education, information, communication, and public awareness mechanisms
04
Build and/or enhance capacity, and conduct pilot projects

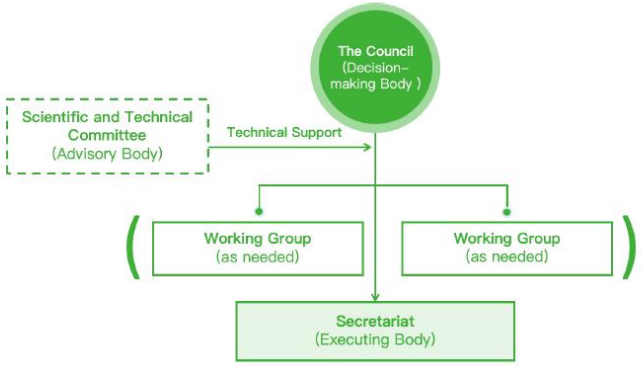

03 | 18 Founding Member States
Africa
Burkina Faso
Comoros
Guinea
Gabon
Lesotho
Liberia
Libya
Madagascar
Mozambique
Sierra Leone
Asia & Oceania
Cambodia
China
Laos
Pakistan
Samoa
Central & South America
Cuba
Nicaragua
Panama
15


03 | Membership
Who
Open to all contracting parties of the Convention and non-party states, with interests in mangroves
Each Member State shall designate a competent agency or authority to serve as its focal point to the IMC
How
Sign the Establishment Agreement of the IMC
Subject to ratification, acceptance, approval or accession by signatory states.

03 | Observers

UNEP, FAO, UNESCO, IUCN, WWF, Ramsar, WWT, BirdLife International, Wetlands International, International Water Waste Infrastructure

03 | Structure



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03 | Operations

The Council

- Governing and decision-making body of the IMC.
- Composed of Member States, with each Member State designating one delegate.
- Hold regular plenary sessions
- Convene interim

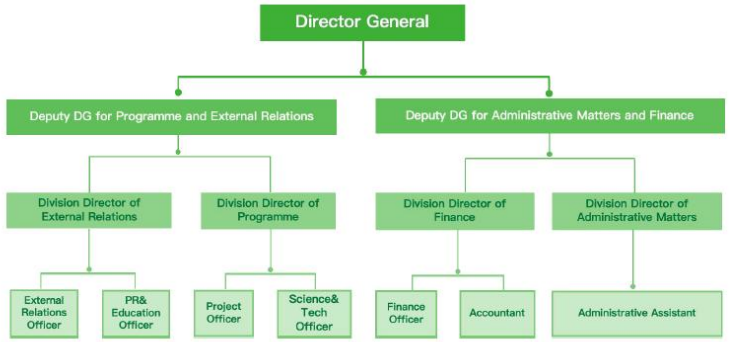
Scientific and Technical Subgroup

- Advisory body of the IMC.
- Members of the Subgroup shall be recommended by Member States and selected by the Council.

The Secretariat

- Located in Shenzhen, China Executing body of the IMC
- Responsible for daily operations, under the authority and guidance of the Council.

03 | Structure & Operations



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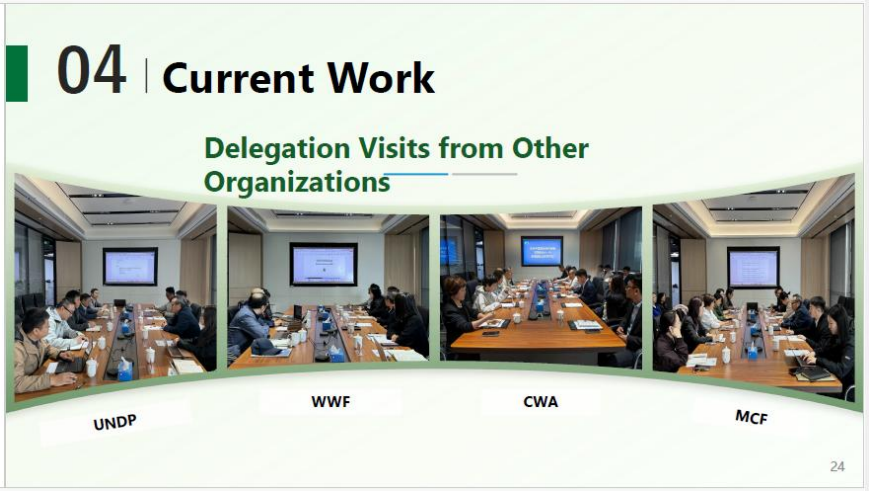
03 | IMC Secretariat


03 | IMC Secretariat
Futian National Nature Reserve
IMC Secretariat (Area: 3,000㎡)
China Mangrove Museum (35,000 ㎡)


04 Current Work


04 | Current Work
Delegation Visits from Other Organizations
UNDP
WWF
CWA
MCF
24

04 | Current Work

Visit by Zimbabwean Minister

04 | Current Work

First Council Meeting

01

- Composed of Member States, each designating one representative
- Plenary meetings are held on a regular basis
- The first council meeting is scheduled to be held in Shenzhen this November

02

Document Preparation

- Charter, Rules of Procedure, and Secretariat Working Regulations have been drafted
- Strategic Plan, Scientific and Technical Working Groups, Project Management Guidelines in draft

03

Nominations of Council Member and FP

- 11 countries have nominated their council members and focal points
- China's nominations for council member, and FP are in progress

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04 | 2025 Annual Work Plan

Institutional Development	Office System Development	Global Outreach Initiatives	International Staff Recruitment
The IMC Secretariat's institutional framework has been drafted.	Establishing infrastructure to ensure operational efficiency and data security	Plan to promote IMC at the COP15, IUCN World Conservation Congress, and RRC-EA.	In contact and preparing relevant procedures for the employment of staff from Cambodia and Madagascar to work in China.

International Workshops	International Mangrove Wetland Lecture	Member States Development	Website Development
3 workshops in June, August, and November 2025	Launched the International Mangrove Wetland Lecture Series via Zoom, open to global audience.	Australia、UAE、Zimbabwe、Zambia	Official website under development; domain (www.imc.int) registered

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04 | Current Work

Website Development

Domain (www.imc.int) registered, official website under development

04 | Future Cooperation

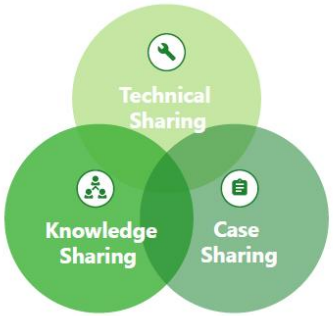
Capacity Building

01 Technical Sharing

- Share advanced technologies and expertise in wetland management.

02 Knowledge Sharing

- Empower relevant institutions and staff through tailored workshops.



03 Case Sharing

- Provide access to successful global case studies in wetland conservation.
- Offer valuable insights and practical references.

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04 | Future Cooperation

Joint Projects

- Multilateral cooperation that tailored to specific needs.
- E.g. Establishing wetland demonstration sites.

Project Support

- Assist in applying for technical and financial assistance to implement pilot projects aligned with IMC's conservation objectives.

Collaborative

- Conduct cooperative projects.
- Wetland ecosystem services value assessment and climate change adaptation studies.

30

LECTURE 2: THE STATUS, CHALLENGES AND ACTIONS OF MANGROVES IN CHINA

CONTENTS

1 Overview of Mangroves in China

2 Main measures

3 The plan of future work

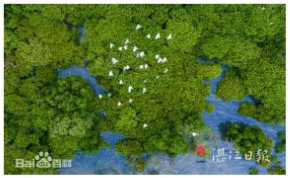
2/25

Part 1. Overview of Mangroves in China

3/25

National priority

The Chinese government attaches great importance mangrove conservation. President Xi Jinping has visited the mangroves several times. He emphasized that *Mangrove is a National Treasure and should be carefully protected as one's eves.*

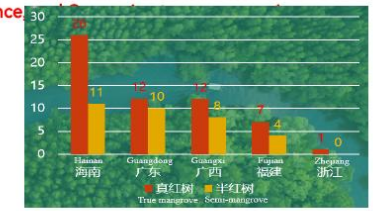


4/25

Mangroves distribution in China

In the mainland of China (excluding Hong Kong, Macau, and Taiwan), mangroves are distributed

across 5 provinces and regions: Hainan province, Guangdong province, Fujian province, Zhejiang province



species

5/25

National Land Inventory

carried out from 2018 to 2024. It recorded 30,300 hectares of mangroves distributed in the mainland of China, with 97% located in Guangdong,

6/25

Trend and driving factors of mangroves area change in China

Compared with 2002, the area increased 8,300 hectares. China has become one of the few countries in the world with a net increase in mangrove area over the past 20 years.

Loss drivers

- Aquaculture
- Urbanization
- Timber harvesting
- Natural degradation

Measures facilitating increase of mangroves:

- Protected areas
- Coastal shelterbelt project
- Blue Bay Remediation Action
- Mangrove Conservation and Restoration Action

7/25

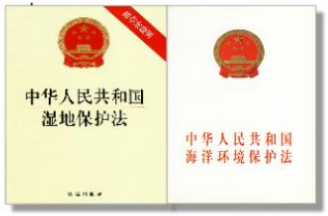
Part 2. Main measures

8/25

1. Laws and Regulations

National level:

- Wetland Conservation Law
- Marine Environment Conser vation



Local Level:

- Mangroves Conservation Regulation (Hainan)
- Mangroves Conservation Regulation (Guangxi)
- Wetland Conservation Regulation (Guangdong)
- Wetland Conservation Regulation (Fujian)
- Marine Area Utilization Management Regulation (Zhejiang)

2. Protected areas

19,400 ha, 64% of mangroves are protected areas such as nature reserve, wetland park, and marine park (10 nature reserves at national level, and 7 are Ramsar Sites)

3. Action Plan

Long-term Goals

- Strictly protect existing mangroves and conduct ecological restoration scientifically;
- Expand the area of mangrove forests and improve biodiversity;
- Overall improvement of mangrove ecosystem quality and comprehensive enhance the supply capacity of ecological products.

Specific Objectives

By 2025, to replant 9,050 hectares of mangroves and to restore 9,750 hectares of existing mangrove forests

7 key actions with 19 tasks

Action 1: Overall conservation of mangrov

- Prioritely protect mangrove ecosystems;
- Strictly control land use conversion.

Action 2: Management of protected areas

- Optimize the boundary of existing, and establish new protected areas;
- Stop aquaculture activities in protected areas;
- Improve capacity building of protected areas.

Action 3: Strengthen planning for mangrove restoration

- Overall plan for mangrove conservation and restoration;
- Put conservation and restoration tasks in place.

Tasks for provinces by 2025

Province	Replanting area (ha)	(%)	Province	Restoration area (ha)	(%)
Zhejiang	200	2.21	Zhejiang	0	0.00
Fujian	350	3.87	Fujian	550	5.64
Guangdong	5500	60.77	Guangdong	2500	25.64
Guangxi	1000	11.05	Guangxi	3500	35.90
Hainan	2000	22.10	Hainan	3200	32.82
Total	**9050**	**100.00**	**Total**	**9750**	**100.0**

13/25

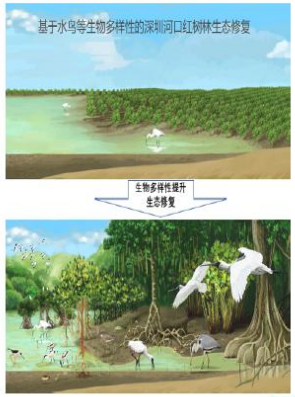
Action 4: Ecological restoration of mangroves

- Replant mangroves with scientific methods;
- Restore degraded mangroves;
- Protect rare and endangered mangrove species;
- Enhance post-planting management;
- Control harmful organisms (Strive to achieve a *S. alterniflora* removal rate of over 90% by 2025)
- Ensure supply of mangrove seedlings.

14/25

Action 5: Improvement of scientific supports for mangroves

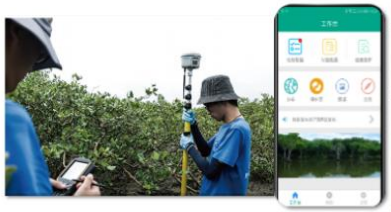
- Carry out scientific and technological breakthrough projects;
- Improve research facilities and professional standards.



15/25

Action 6: Monitoring and assessment

- Improve monitoring capabilities;
- Track and assess the whole mangrove restoration process.



16/25

Action 7: Improvement of legislation

- Promote legislation for mangrove protection and restoratior
- Improve local regimes for mangrove protection and restorati

17/25

Guarantee Measures

- Strengthen organizational leadership
- Financial and policy supports
- Encourage social capital into conservation and restoration
- Enhance CEPA and international cooperation

18/25

Mid-term Assessment

By 2023, 52% of replantation and 49% of restoration have been completed.

自 然 资 源 部 办 公 厅
国 家 林 业 和 草 原 局 办 公 室

自然资办函〔2023〕548号

自然资源部办公厅 国家林业和草原局办公室
关于开展《红树林保护修复专项行动计划
（2020—2025 年）》中期评估工作的通知

浙江省、福建省、广东省、广西壮族自治区、海南省自然资源主管部门、林业和草原主管部门，广西壮族自治区海洋局：

自 2020 年 8 月自然资源部、国家林草局联合印发《红树林保

Replantation

Province	Target(ha)	Completion(ha)	Completion rate
Zhejiang	200	147.68	73.84%
Fujian	350	907.52	259.29%
Guangdong	5500	1821.16	33.11%
Guangxi	1000	457.81	45.78%
Hainan	2000	1322.07	66.10%
Total	**9050**	**4656.24**	**51.45%**

Restoration

Province	Target(ha)	Completion(ha)	Completion rate
Zhejiang	——	44.28	——
Fujian	550	920.77	167.41%
Guangdong	2500	1834.47	73.38%
Guangxi	3500	1455.95	41.60%
Hainan	3200	496.642	15.52%
Total	**9750**	**4752.112**	**48.74%**

19/25

4. IMC

- President Xi Jinping proposed to build International Mangrove Center in Shenzhen at COP14 in 2022.
- The COP14 **Resolution XIV.19** welcomes the focus of the International Mangrove Center as the conservation, restoration, and wise use of mangroves and coastal blue carbon ecosystems;
- **Decision SC62-22**: The Standing Committee endorsed the International Mangrove Center as a new Ramsar Regional Initiative within the framework of the Convention

President Xi Jinping on COP14

Sketch of the Chinese Mangrove Museum (Center)

20/25

Part 3. The plan of future work

21/25

Promote IMC to a high level

Provide services such as knowledge sharing, technological cooperation, training and exchange, demonstration projects, etc

22/25

中华人民共和国自然资源部司局函

关于征求《自然资源部 国家林业和草原局关于进一步加强红树林保护修复的通知（征求意见稿）》意见的函

Issue policy documents

Master plan or action plan or documents, involving various aspects such as investigation, replanting, restoration, protection, utilization, supervision, etc

23/25

Implement key projects

Manage and protect newly constructed mangrove project

Improve the quality of existing mangrove project

Dispose the non-native mangrove plants project

24/25


Let's Take Actions Together to Protect
the Global Mangroves

LECTURE 3: THE IMPLEMENTATION OF THE CONVENTION ON WETLANDS AND INTERNATIONAL COOPERATION ON MANGROVE CONSERVATION

Ramsar Convention & China

Dept. International Cooperation
National Forestry and Grassland Administration
(National Park Administration)

Outline

I. The Ramsar Convention
II. Ramsar implementation in China
III. International Cooperation on Mangrove & the IMC

I. The Ramsar Convention

1. The origin and evolution

Luc Hoffmann (1923-2016)
Vice President, WWF (1961-1988)
Vice President, IUCN (1960-1969)

G. V. T. Matthews (1923-2013)
Director of IWRB

Eskander Firouz (1926–2020)
Director of Iran's Game and Fish Department

Those who shall be remembered forever

I. The Ramsar Convention

1. The origin and evolution

Road to the Convention

- The Marshes Conference, Camargue, France, Nov. 12-16, 1962
- St. Andrews, UK, 1963
- Noordwijk, Netherlands, 1966
- Morges, Swiss, 1967
- Vienna, Austria, 1969
- Moscow, USSR, 1969
- Espoo, Finland, 1970
- Ramsar, Iran, Feb. 1972

I. The Ramsar Convention

2. The Convention

Ramsar
CONVENTION ON WETLANDS
CONVENTION SUR LES ZONES HUMIDES
CONVENCIÓN SOBRE LOS HUMEDALES
(Ramsar, Iran, 1971)

Convention on Wetlands of International Importance especially as Waterfowl Habitat

Mission

The conservation and wise use of all wetlands through local and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world.

I. The Ramsar Convention


Convention on Wetlands of International Importance especially as Waterfowl Habitat

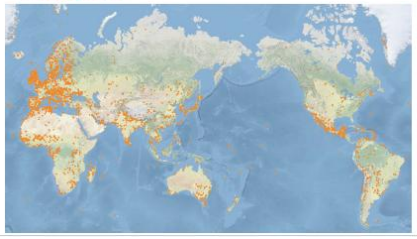
Convention on Wetlands of International Importance especially as Waterfowl Habitat

UNESCO

3. Actions taken by contracting parties

Three Pillars of action

- Wise use of all wetlands
- International Cooperation
- Wetlands of Int'l Importance, designation and management

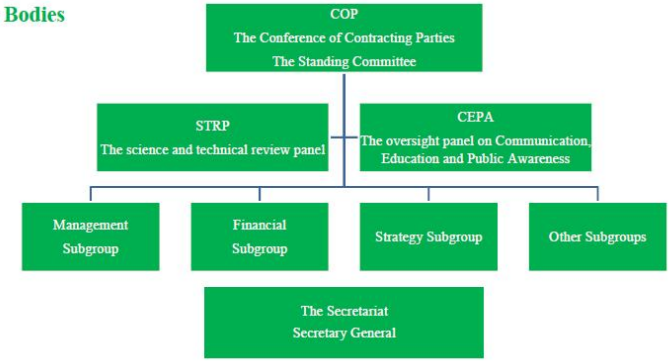


I. The Ramsar Convention

4. RRI-EAAFP

I. The Ramsar Convention

5. The Bodies



II. Ramsar implementation in China


中华人民共和国国务院

国函〔1992〕1号

国务院关于决定加入《关于特别是作为水禽栖息地的国际重要湿地公约》的批复

林业部、外交部：

国务院决定，我国加入《关于特别是作为水禽栖息地的国际重要湿地公约》，加入该公约的通知手续由外交部办理，执行该公约的具体事宜，由林业部负责组织、协调，有关交纳会费问题，按照国家有关规定办理。

一九九二年一月二日

主题词：外事 公约 批复

2. Accession and institutional setup

- January 3rd 1992, China's instrument of accession to UNESCO, depository of the Convention
- July 31 1992, China's entry into force (the 67th contracting party)
- 2005, Ramsar Management Authority established in China
- 2007, National Ramsar Committee formed to coordinate implementation efforts
- 2018, Department of Wetland Management set up in National Forestry & Grassland Administration

II. Ramsar implementation in China

4. Legal framework

- *The Wetlands Protection Law* introduced 1 June 2022

China "adopts the principle of protection in priority, strict management, systematic control, science-based restoration and wise use in wetland protection, so as to play multiple ecological functions of wetland ecosystem in conserving water, regulating climate, improving environment and conserving biodiversity"

- 28 of the 31 provinces on mainland China have released provincial regulations on wetlands


中华人民共和国
湿地保护法


全国湿地保护工程实施规划
（2005-2015年）

中国湿地保护规划
（2022—2030年）

二〇二二年五月

II. Ramsar implementation in China

5. National programs and financial input

- National Programs launched, including wetland conservation & restoration and mangrove conservation
- Central investment for infrastructure construction and restoration at RMB 600m/y
- Central investment at RMB 2b/y for
  1. subsidies for wetland conservation & restoration
  2. PES
  3. subsidies for converting farmland to wetland

II. Ramsar implementation in China

5. National programs and financial input

National Wetland Conservation Plan (2022-2030) identified 6 Key tasks

1. Total wetland area under control
2. Classified management
3. Conservation and restoration programs
4. Wetland monitoring
5. Research & technical support
6. International cooperation

II. Ramsar implementation in China

6. Wetland inventory and monitoring

3 national inventories (1995-2003, 2009-2013, 2017-2021)
Monitoring of wetlands of international importance

ECOLOGICAL CONDITION OF CHINA'S WETLANDS OF INTERNATIONAL IMPORTANCE (RAMSAR SITES)

Ramsar Convention on Wetlands Management Office of People's Republic of China

December 2018

II. Ramsar implementation in China

7. CEPA

Full participation of target groups

Conservation network in Yangtze River, Yellow River and coastal areas

World Wetland Day

Natural education, science popularization

Educational models for primary people

Training courses

II. Ramsar implementation in China

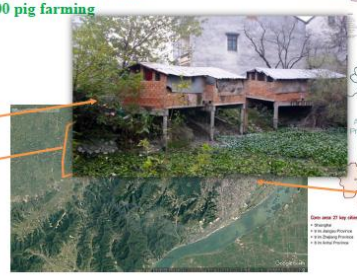
7. CEPA

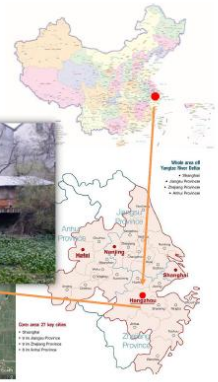
II. Ramsar implementation in China

8. Xixi wetland: what it means for Green Development

Addressing wetland conservation & wise use amid rapid urbanization within 3 decades

- Hangzhou in the Yangtze River Delta, China's most developed region
- Xixi, urban fringe in eastern coast, 70% covered by water bodies
- Over 50,000 inhabitants, 12 villages, 250,000 pig farming





II. Ramsar implementation in China

8. Xixi wetland: what it means for Green Development

Xixi before 2005

- Demolition of 1 million m² of houses, 80% of the park
- 10 million CNY investment for conservation and restoration

II. Ramsar implementation in China

8. Case of Xixi: conservation & wise use of urban wetlands

Xixi: Past and now

II. Ramsar implementation in China

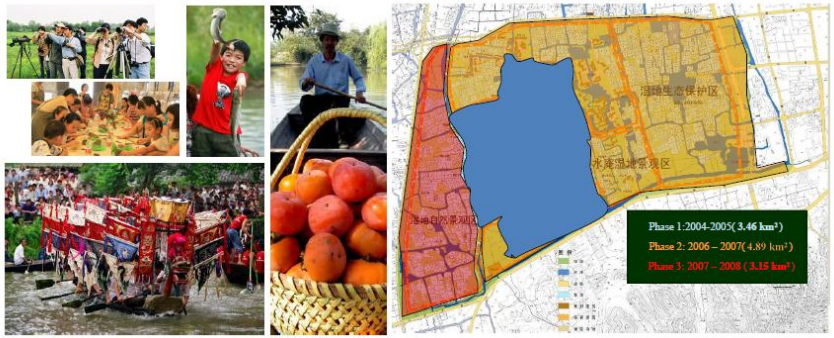
8. Case of Xixi: conservation & wise use of urban wetlands

- First National Wetland Park in China, established in 2005
- A Ramsar Site designated in 2009
- Top 10 charming wetlands recognized by CCTV in 2013

A fantastic metropolitan wetland park

II. Ramsar implementation in China

8. Case of Xixi: conservation & wise use of urban wetlands



II. Ramsar implementation in China

8. Case of Xixi: conservation & wise use of urban wetlands

Population: 12.52 million
GDP: 2 trillion CNY (287 billion US$)
GDP per capita: 23,000 USD

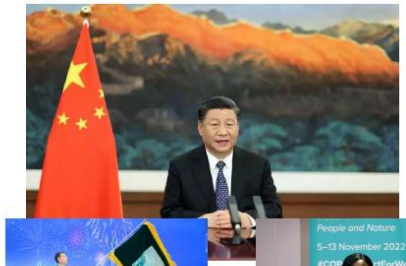
Much more than building a park

- Urban eco-planning
- POD: Park oriented development
- Real estate promoted city development

- 4~5 million of visitors annually
- Park incomes reached 3 bn CNY since 2005
- More than 200 local villager employees in the park, 40 % of total staff
- Villager's real estate cost 10 million CNY (1.5 m USD) per family

II. Ramsar implementation in China

9. International Cooperation



COP 14

- Nov. 5-13, 2022, hybrid mode in Wuhan & Geneva
- Chinese President Xi delivers the opening
- Wetlands Actions for People and Nature
- 142 contracting parties, international organizations, 950 plus participants
- Ramsar Post-2025 Strategic Plan
- Wuhan Declaration
- Establishing International Mangrove Centre (IMC) in Shenzhen, China

COP14 2022

II. Ramsar implementation in China

International Mangrove Center

- Nov. 6, 2024, IMC Establishment Agreement signed in Shenzhen, China
- 18 founding members: Burkina Faso, Cambodia, China, Comoros, Cuba, Gabon, Guinea, Laos, Lesotho, Liberia, Libya, Madagascar, Mozambique, Nicaragua, Pakistan, Panama, Samoa, Sierra Leone

International Mangrove Center

III. International Cooperation on Mangrove & the IMC

1. Global mangrove ecosystems

Mangrove ecosystems are exceptional in their ability to provide essential ecosystem services to people, **including coastal disaster risk reduction, carbon sequestration and long-term storage**, and ecological support for **fisheries and biodiversity**.

- Store almost **11 billion** tons of carbon, which is almost three times the amount of carbon stored by tropical forests of the same size.
- Protect **15.4 million** people and **USD 65 billion** worth of property per year from coastal disasters. In 2050, this could rise to 15.5 million and USD 118 billion because of population growth and rise in property values.
- Support **126 million** fishing days per year, providing a key source of food for human populations living near coasts and beyond, along with valuable employment provided by millions of fisheries-related jobs.

III. International Cooperation on Mangrove & the IMC

3. Global efforts in mangrove conservation

The Regional Initiative for the Integral Management and Wise Use of Mangroves and Coral Reefs/Ramsar Convention (2009)

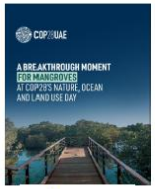
Initiated by Ramsar to develop a Regional Strategy and Action Plan for the conservation, management, and wise use of mangroves and coral reefs in America, members countries include Brazil, Costa Rica, Mexico, Venezuela, etc.

Global Mangrove Alliance (2018)

GMA is coordinated by CI, IUCN, TNC, WI, & WWF. Its target is to increase the global area of mangrove habitat 20% over current extent by the year 2030.

Mangrove Alliance for Climate (2022)

An initiative by the UAE in partnership with Indonesia at the UNFCCC COP 27. The members commit to plant, rehabilitate, and restore mangroves within their country; as well as supporting others to do the same.



MANGROVE ALLIANCE FOR CLIMATE

III. International Cooperation on Mangrove & the IMC

4. Mangrove conservation & restoration in China

- Special Action Plan for Mangrove Conservation and Restoration (2020-2025)
- Regulations on Mangrove Conservation by Guangxi and Hainan provinces
- Mangrove Ecological Restoration Guidelines
- 10 national mangrove nature reserves and 7 mangrove Ramsar sites designated in mainland China

III. International Cooperation on Mangrove & the IMC

4. Mangrove conservation & restoration in China

The Action Plan sets targets of 9,050 ha restored and 9,750 ha enhanced in ecological services by 2025 through establishing mangrove protected areas and restoration of ecological functions.

III. International Cooperation on Mangrove & the IMC

5. Coastal driveway in the city of Shenzhen

- The newest metropolis with the fastest development in China
- City started to develop as a special economy zone since 1979
- GDP 3.5 trillion CNY, 190,000 CNY (27,000 USD) per capita

III. International Cooperation on Mangrove & the IMC

5. Coastal driveway in the city of Shenzhen

- 1984 - Futian-Neilingding Nature Reserve established
- 1993 - Listed as Biosphere Reserve
- 2020 - Listed as Wetland of National Importance
- 2023 - Listed as Wetland of International Imporance

- Important habitat for Black-faced Spoonbills, Spoon-billed Sandpiper and others

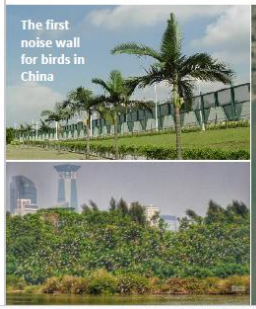
III. International Cooperation on Mangrove & the IMC

5. Coastal driveway in the city of Shenzhen

III. International Cooperation on Mangrove & the IMC

5. Coastal driveway in the city of Shenzhen

- 1994 - A Binha (Coastal/Sea view) Boulevard was planned and made big concern on mangroves
- 1995 - The municipal gov. decided to move the boulevard 260m north to avoid Core zone of the nature reserve
- 20 million CNY was compensated to the nature for conservation and 100 million CNY of extra cost



III. International Cooperation on Mangrove & the IMC

6. International Mangrove Center (IMC)

International Mangrove Center

A **RRI** approved at SC 62, Sept. 2023, an **independent, non-profit, inter-governmental international organization**

Mission: promote international cooperation and joint actions in mangrove conservation, restoration, and wise and sustainable use

Principles: Open, Inclusive, Transparent, Action-based

Objectives: Knowledge sharing and joint research, technology transfer and training, public education and awareness, capacity building and pilot projects

Members: Parties and Non-party countries to Ramsar

Location: **Shenzhen**, China

Thank You for Your

LECTURE 4: INTRODUCTION TO CHINA AND THE CHINESE CULTURE

Introduction to China and its Culture

ZHENG Xinmin

National Academy of Forestry and Grassland Administration

Jun. 2025

Main contents

Part One Profile of China

Part Two Population and Culture

2

Part One Profile of China

I. Geography
II. History
III. Political system
IV. Economy
V. Diplomacy

3

1. Location and territory

East Asia and west to the Pacific, with a land area of 9.6 million km^2 , the third largest after Russia and Canada.

5

3. Land and water resources

(1) Land types There are different land types in China including cultivated land, forest land, grassland, deserts, wetland and so on. Cultivated land is principally in east China, grassland in north and west China and forest land in northeastern and southwestern China, wetland in different areas.






(2) Terrain Mountains accounts for 33% of China's territory, plateaus for 26%, basins for 19%, hills for 10% , and plains for 12% . China also has abundant island resources.

8

II. China's history

China is one of the ancient civilizations in the world, and the only country among the four ancient civilizations (ancient Egypt, ancient India, and ancient Babylon) with uninterrupted civilization. According to the latest achievements of the "Exploration of Civilization" project, the recorded history of China is over 5800 years. In the long process of historical evolution, the Chinese people have created brilliant historical and cultural heritage.

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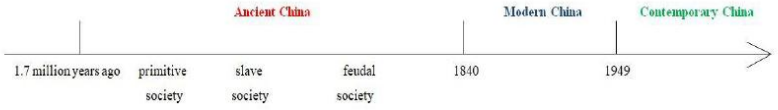
(2) Historical periods



There are three historical periods in China's history: ancient times, modern times, and contemporary times.

20

Ancient China

China's ancient history and dynasties oriented from 1.7 million years ago, ended in 1840AD, before the First Opium War.

The ancient history includes: Primitive society, Slavery society, Feudal society.

21

Modern China

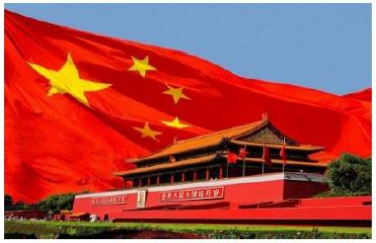
From 1840 （the First Opium War）- 1949（the founding of PRC), the history of the semi-colonial and semi-feudal society.

The first Opium War 1840

22

Contemporary China

From 1949（the founding of PRC) till now, the socialist revolution and construction period

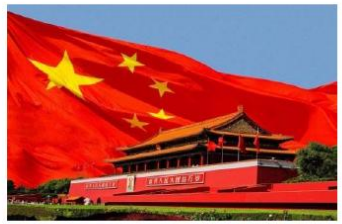


Founding of People's Republic of China 1949

23

IV. China's political system

- The basic political structure: under the leadership of the Communist Party of China, the systems of People's Congress, Multi-party Cooperation and Political Consultation, and Regional Autonomy for Ethnic Minorities are adopted.



24

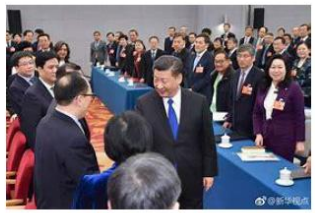
1. People's congress system

- The people's congress is an important part of the system of socialism with Chinese characteristics and the fundamental political system.

25

2.Multi-party Cooperation and Political Consultation

- The CPC is the only ruling party in China and the rest 8 democratic parties, led by the CPC, participate in the state affairs.



26

4. China's administrative system

China's administrative units are currently based on a three-tier system, dividing the nation into provinces, counties and townships:

- The country is divided into provinces, autonomous regions and municipalities directly under the Central Government;
- A province or an autonomous region is subdivided into autonomous prefectures, counties, autonomous counties and cities;
- A county or an autonomous county is subdivided into townships, ethnic townships and towns.

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- Municipalities directly under the Central Government and large cities are subdivided into districts and counties;
- Autonomous prefectures are subdivided into counties, autonomous counties and cities.
- Autonomous regions, autonomous prefectures and autonomous counties are all ethnic autonomous areas.
- The Constitution specifically empowers the state to establish special administrative regions when necessary.
- A special administrative region is a local administrative area directly under the Central Government.

29

V. China's economy

1.Reform and opening up

Deng Xiaoping
(1904-1997)

The CPC has steered China to such massive growth and development by introducing its major economic reforms, known as the reform and opening-up policy, in 1978.

During the past 40 years, China has experienced tremendous development in all major sectors including manufacturing, international trade, transport infrastructure and smart city solutions. These changes have pivotal importance that has not only impacted the lives of Chinese citizens but also proved beneficial for foreigners.

30

Shenzhen before and after the policy

31

China's poverty alleviation

- China has since lifted more than 700 million people out of poverty, which is over 70 percent of the total global poverty reduction during the time. Thus it shook off abject poverty one decade before the deadline set by the UN by 2030.

32

VI. China's diplomacy

1. Basic tenets

- Maintaining world peace and promoting common development are the purposes of China's foreign policy
- The five principles of peaceful coexistence are the basic norms of China's foreign relations.
- Independence is the basic position of China's foreign policy.
- Strengthening solidarity and cooperation with third world countries is the basic foothold of China's foreign policy.

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2. Major country diplomacy with Chinese characteristics

A Community with Shared Future for Humanity

- To build a community with a shared future for humanity calls for concrete actions. China has advocated that the international community promote a common approach to partnership, the security landscape, economic development, cultural exchanges and eco-environmental conservation.

34

The Belt and Road Initiative

- The initiative was launched by Chinese President Xi Jinping in 2013.
- In September 2013, during an official visit to Kazakhstan, Xi announced the Silk Road Economic Belt, a plan to develop overland infrastructure to connect the region.
- BRI infrastructure projects connect China with different parts of the world.

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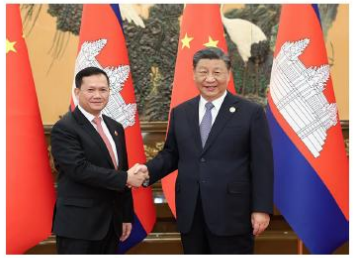
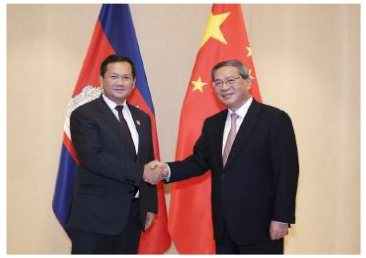
3. Diplomatic relations

China and Cambodia



China's President Xi Jinping Met With Cambodia's Prime Minister Hun Manet



China's Premier Li Qiang Met With Cambodia's Prime Minister Hun Manet

China and Madagascar

China's President Xi Jinping Met With Madagascar's President Andry Nirina Rajoelina

China and Madagascar Cooperate To Establish Confucius Institutes.

Part Two Population and Culture

I. Population & Ethnic Groups
II. Chinese Culture

38

I. China's population and Ethnic group

Chinese culture is inclusive and develops in a long history. In the process of historical development, not only have numerous local schools of thought emerged, but also foreign cultures have been constantly introduced. Different schools of thought and cultures have absorbed and integrated into each other in contradictions and conflicts, gradually establishing a basic pattern of Confucianism as the main body, with Confucianism, Buddhism, and Taoism each holding its own unique banner, while also working together to complement each other and apply it to society.

39

2. Ethnic Groups

Ethnic groups China is a unified country with 56 ethnic groups with the han people accounting for 91.11% of the total population

Chinese culture is inclusive and develops in a long history. In the process of historical development, not only have numerous local schools of thought emerged, but also foreign cultures have been constantly introduced. Different schools of thought and cultures have absorbed and integrated into each other in contradictions and conflicts, gradually establishing a basic pattern of Confucianism as the main body, with Confucianism, Buddhism, and Taoism each holding its own unique banner, while also working together to complement each other and apply it to society.

Confucius

benevolence, righteousness, courtesy and trustworthiness

Laotzu

non-intervention, follow the nature

Buddha

compassion, karma

49

Confucianism emphasizes benevolence and filial piety, requiring humans to hold awe for all things in nature and to maintain the harmonious order of the universe. Taoism focuses on pursuing the realm of natural non-action, integrating with nature, seeking harmony and unity between nature and human, and advocating that human should conform to the way of nature, abandon impatience and utilitarianism, and pursue inner tranquility and self-transcendence. Buddhism emphasizes letting go of desires, pursuing inner peace and transcendence, advocating compassion, paying attention to the suffering of all beings, and promoting coexistence with nature to achieve harmonious coexistence between human and nature.

50

2.Specific forms of Chinese Culture

2.1 Opera and Quyi arts

Chinese opera is one of the three ancient dramas in the world (including Chinese opera, Greek tragicomedy, and Indian Sanskrit opera), with over 300 genres including Peking Opera, Kunqu Opera, Yue Opera, and Yu Opera. Peking Opera is the most influential. Peking Opera, also known as Peking Opera or National Opera, is divided into four types of characters: male roles, female roles, painted roles and clowns--on stage. It has four skills: singing, speaking, acting and acrobatic fighting.

51

赤壁 The Red Cliffs

52

Quyi arts

Quyi is a general term for various "talking and singing arts". It is a unique art form that has evolved over a long period of development from folk oral literature and singing arts. According to incomplete statistics, there are about 400 different types of quyi performed by various ethnic groups in China.

Quyi, as a performing art, uses "oral talking and singing" to narrate stories, portray characters, express thoughts and emotions, and reflect social life. Just as the essential characteristic of opera art is "performing stories through singing and dancing," the fundamental feature of quyi art can be described as "narrating stories through oral talking and singing."

53

苏州评弹Suzhou Pingdan

54

2.2 Music and dance

Chinese music specifically refers to Chinese instrumental music and Chinese vocal music, with a history that can be traced back to the Yellow Emperor era. From Confucius' transmission of the Six Arts to modern Western music, Chinese music has continued to enrich and develop in the process of absorbing foreign musical elements. China is known as the "land of rites and music," and ancient music played a significant role and held an important position in personality cultivation, cultural life, and national etiquette.

战国时期曾侯乙编钟
Zeng Houyi Chime Bells

55

Music

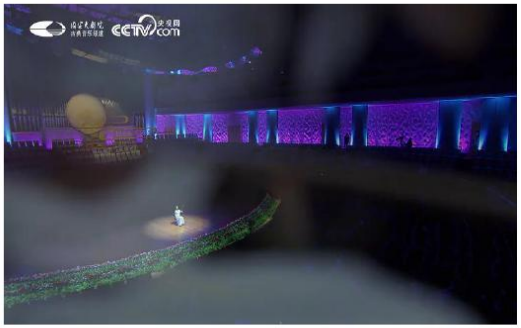
Guzheng

Pipa

Erhu

56

二泉映月 Moon Reflected in Second Spring



57

Dance

It can be said that China has had a history of dance for as many years as it has had civilization. Chinese traditional dance is rich in variety and form, containing abundant cultural connotations and ethnic characteristics. Classical dance is one of the main forms of Chinese dance, which has formed a unique artistic style through thousands of years of development and inheritance. It mainly includes Han and Tang dances, court dances, and more. Ethnic and folk dances refer to the dances of various ethnic groups in China in aspects such as production labor, living customs, religious beliefs, etc., fully demonstrating the unique customs and cultural traditions of various ethnic groups in China.

58

《霓裳羽衣舞》The Dance of Rainbow Skirt and Feathered Robe

59

Chinese calligraphy

Calligraphy is a unique traditional art in China, mainly composed of writing Chinese characters with a brush, as well as pen calligraphy and finger writing. There are five main styles of Chinese calligraphy: seal script, clerical script, regular script, running script, and cursive script.

60

Calligraphy Practice

61

Poetry and rhymes, as well as classics, histories, philosophical works, and collected works,

Poetry and rhymes are the treasures of ancient Chinese literature. With refined language, profound artistic conception, and rich emotions, they express the unique perceptions of ancient literati on themes such as life, nature, love, friendship, home, and country. Poetry, songs, and rhymes emphasize rhythm, parallelism, and the creation of artistic conception, embodying the essence of ancient Chinese literary art."

From the simplicity and freshness of the "Book of Songs" to the prosperity and splendor of Tang poetry, and further to the graceful delicacy of Song lyrics, poetry and songs have carried the development process of ancient Chinese literature and reflected the social styles and humanistic spirits of different historical periods.

Li Bai, 701—762

62

The collection of classics, histories, philosophical works, and collected works constitutes the core of ancient Chinese academic culture. The classics section includes Confucian classics such as the "Book of Songs", "Book of History", "Book of Rites", "I Ching", and "Spring and Autumn Annals", which are important carriers of mainstream thought and moral norms in ancient Chinese society. The histories section includes various historical works such as "Records of the Grand Historian", "History of the Han Dynasty", and "History of the Later Han Dynasty", which record the social development, changes, and historical events of ancient China, serving as important materials for studying ancient Chinese history. The philosophical works section covers the writings of various schools of thought such as "The Analects of Confucius", "Mencius", "Laozi", "Zhuangzi", etc., representing different ideological schools and academic viewpoints in ancient China.

Sima Qian, 145B.C.--?

63

定风波(Calming Wind and Waves)

64

2.5Architecture

- The total number of world heritage sites amounts to 1,122, distributed in 167 countries around the world, with 39 dual world cultural and natural heritage sites, 213 world natural heritage sites and 869 world cultural heritage sites. China has 57 world cultural and natural heritage sites on the World Heritage List, including 39 world cultural heritage sites, 4 dual world cultural and natural heritage sites and 14 world natural heritage sites.

65

III. Chinese martial arts

Chinese martial arts is a rich and full cultural carrier, reflecting Chinese wisdom in every move, embodying Chinese spirit in every fist and every movement, and concealing Chinese civilization in every skill and theory. Chinese martial arts emphasizes the balance of strength and softness, with both internal and external cultivation. It has a robust and beautiful appearance, as well as an elegant and profound connotation.

68

Video: Three Section Cudgel

69

IV.Festivals and customs

4.1 Etiquettes

Chinese traditional culture is renowned for its long history, profound connotations, and diverse artistic forms. One of its core characteristics is the high emphasis on ceremonies and etiquette. Ceremonies and etiquette permeate every aspect of Chinese traditional culture, from family to society, from religion to politics, omnipresent. They are not only seen as a code of conduct but also carry moral values, social order, and the maintenance of interpersonal relationships. Through the study and inheritance of ceremonies and etiquette, we can gain a deep understanding of the essence of Chinese traditional culture and experience the respect and care between people.

70

In the excellent traditional Chinese culture, rituals and etiquette play an important role. Ritual is a sacred activity that expresses respect for significant events and traditional customs through standardized procedures and unique symbols. Etiquette emphasizes the norms and respect of personal behavior, reflecting the unique expression of culture.

In traditional Chinese culture, etiquette is regarded as a necessary social way and behavioral norm. It involves interpersonal communication, social interaction, and rituals in various fields. Etiquette occupies an important position in traditional Chinese culture and runs through all aspects of people's lives.

71

Traditional Chinese culture, with rituals and etiquette as its core, is a unique set of social behavioral norms and normative systems. It originated in ancient China and has undergone thousands of years of inheritance and development. Ritual holds a very important position and profound significance in traditional Chinese culture. From major turning points in personal life such as weddings, funerals, and celebrations to major national events such as politics and military, rituals occupy a crucial position. Ritual is not only a carrier of conveying appearance and emotions, but also an important means of conveying values, moral norms, and social order.

72

Ancient etiquette includes a wide range of contents and forms, such as political system, court code, worship of heaven and earth, praying for floods and droughts, school imperial examinations, military campaigns, administrative division, building and tomb construction, as well as clothing, food, housing, transportation, weddings, funerals, weddings, and speech, all of which are related to etiquette. It is almost a vast concept that includes all national political, economic, military, and cultural laws and regulations, as well as personal ethical and moral cultivation and behavioral norms. Until modern times, the scope of etiquette gradually narrowed down, and generally only had the meaning of etiquette and ritual.

73

Tiananmen Square Flag Raising Ceremony

74

4.2 Important festivals

Chinese traditional festivals are an important part of the long history and culture of the Chinese nation, with diverse forms and rich content. The formation of traditional festivals is a process of long-term accumulation and cohesion of the historical and cultural heritage of a nation or country.

75

The origin and inheritance development of ancient traditional festivals is a cultural process that gradually forms and improves human society, and is a product of the evolution and development of human civilization. According to the research results of modern anthropology and archaeology, the two most primitive beliefs of humans are: the belief in heaven and earth, and the belief in ancestors.

The ancient traditional festivals of the Chinese nation cover humanistic and natural cultural content such as primitive beliefs, sacrificial culture, astronomy and calendar, and the principles of change and numerology, containing profound and rich cultural connotations. The traditional Chinese festivals that have developed from the ancient ancestors not only clearly record the rich and colorful social and cultural content of the Chinese nation's ancestors, but also accumulate profound historical and cultural connotations.

76

Spring Festival

also known as the Lunar New Year or the Chinese New Year. The Spring Festival has a long history and evolved from the ancient era of praying for the beginning of the year and offering sacrifices. In traditional agricultural societies, the beginning of the Spring Festival is of great significance. Starting with a hundred festivals, the Spring Festival is the most solemn traditional festival of the Chinese nation. It not only embodies the ideological beliefs, ideal wishes, life entertainment, and cultural psychology of the Chinese nation, but also serves as a display of blessings, food, and entertainment activities.

77

Yuanxiao Festival

also known as the Lantern Festivalalls on the 15th day of the first lunar month every year and is one of the traditional festivals in China. The first month is the first month of the lunar calendar. The 15th day of the first month is the first full moon night of the year, so the 15th day of the first month is called "Yuanxiao (Filled round balls made of glutinous rice-flour for Lantern Festival) Festival". Since ancient times, the custom of Yuanxiaoas been dominated by the warm and festive custom of watching lanterns.

78

Qingming Festival

also known as Qingqing Festival, Xingqing Festival, March Festival, Ancestral Worship Festival, etc., is celebrated at the turn of mid spring and late spring. The Qingming Festival originated from the ancestral beliefs and spring festival customs of ancient times, and has both natural and cultural connotations. It is not only a natural solar term, but also a traditional festival.

79

Loong Boat Festival

The ancients have always advocated the path of righteousness and righteousness. The Dragon Boat Festival, also known as Zhongzheng, refers to the noon hour on this day, which is the highest point in the middle. The Loong Boat Festival originated from the worship of celestial phenomena and evolved from dragon worship in ancient times. The Dragon Boat Festival is an auspicious day of "flying dragons in the sky". People hold some celebration activities at the Dragon Boat Festival, especially the activity elements corresponding to the dragon, such as offering sacrifices to the dragon and ancestors, picking up the Loong Boat, etc., or do some activities to pray for good fortune and ward off evil spirits on this auspicious day.

80

Mid-Autumn Festival

also known as the Reunion Festival, originates from the worship of celestial phenomena and evolved from the ancient autumn moon sacrifice. Since ancient times, the Mid-Autumn Festival has been associated with customs such as moon worship, moon gazing, eating mooncakes, playing with lanterns, admiring osmanthus flowers, and drinking osmanthus wine, which have persisted and spread for a long time. Eating mooncakes has become an essential custom for celebrating the Mid-Autumn Festival across China. On this day, people eat mooncakes to symbolize "reunion".

81

New Year's Eve

marks the final night of the year, signifying the end of the old year and the beginning of a new one. It is a day for removing the old and welcoming the new, for family reunion, and for sacrificing to ancestors. Together with the Qingming Festival, the Zhongyuan Festival (July 15th), and the Double Ninth Festival, New Year's Eve is one of the major traditional Chinese festivals for ancestral worship.

82

V. Food culture

5.1 Chinese food

Chinese cuisine is famous worldwide and is one of China's business cards. Color, aroma, taste, and shape are the four major standards of Chinese cuisine. Traditional Chinese cuisine uses chopsticks as a tool for eating. For thousands of years, people have continuously summarized and formed the eight major cuisines of Chinese cuisine, namely the Shandong, Sichuan, Guangdong, Fujian, Jiangsu, Zhejiang, Hunan, and Anhui schools.

5.2 Chinese tea

China is the homeland of tea and the birthplace of tea culture. Chinese tea culture has a long and profound history, with a discovery and utilization spanning over 4,700 years. It has remained vibrant and widespread globally. Chinese tea culture encompasses not only the material cultural aspect but also a profound spiritual dimension. The "Tea Classic" by Lu Yu, the Tea Sage of the Tang Dynasty, sounded the clarion call of Chinese tea culture in history. Since then, the spirit of tea has permeated the imperial court and society, deeply influencing Chinese poetry, painting, calligraphy, religion, and medicine. Over thousands of years, China has accumulated not only a substantial material culture related to tea planting and production but also a rich spiritual culture associated with tea, which is the unique tea culture of China.

Tea has medicinal effects in promoting health and treating illnesses, and it also offers aesthetic pleasure that can cultivate one's sentiments. Enjoying tea and entertaining guests are elegant forms of entertainment and social activities for Chinese people. Visiting teahouses and attending tea parties are social group activities related to tea art for Chinese people.

China's tea varieties are also diverse, classified into green tea, black tea, oolong tea, white tea, yellow tea, dark tea, and so on.

VI. Technological innovations

In addition to historical relics, ancient China also had countless technological inventions. There were the Four Great Inventions in ancient China, namely paper, Movable type, gunpowder and compass, which greatly promoted the development of politics, economy and culture in ancient China. They spread to the West through various channels, and exerted great influence on the development of world civilization.

Paper was invented by Cai Lun in 105 AD (during the Eastern Han Dynasty). It was made from bark, hemp, rags, and old fishing nets, which is convenient for people to write and promoted cultural dissemination.

Paper

87

Printing in ancient China can be traced back to the 6th century AD. Engraving printing was invented in the Tang Dynasty. Bi Sheng invented movable type printing, marking the birth of movable type printing. He was the world's first inventor, about 400 years ahead of Western lead movable type printing.

Movable type printing

88

The invention and use of gunpowder can be traced back to 2000 years ago. In the Spring and Autumn period, China had already used gunpowder for civilian and people's livelihood applications. China's gunpowder has advanced the process of world history. Gunpowder shook the feudal rule of Western Europe and was one of the important impetus to the European Renaissance and Religious Reform.

Gunpowder

89

The invention of the compass can be traced back to the Warring States period (2500 years ago), greatly promoting the development of navigation and writing a glorious page in the history of world navigation.

Compass

90

Traditional Chinese Medicine

Traditional Chinese Medicine (TCM). TCM emphasizes "observation, listening, inquiry, and palpation," viewing the human body as a unity of qi (vital energy), form, and spirit. It is also a great invention in Chinese tradition and has made significant contributions to humanity throughout history. In addition to TCM, there are also ethnic medical systems in China such as Tibetan medicine, Zhuang medicine, Miao medicine, Mongolian medicine, Uyghur medicine, Korean medicine, and Dai medicine.

91

TCM is a discipline that studies human physiology, pathology, pharmacology, and their relationship with the natural environment from a dynamic and holistic perspective, guided by the theories of yin-yang and the five elements. With yin-yang and the five elements as its theoretical foundation, TCM views the human body as a unity of qi (vital energy), form, and spirit. Through the methods of observation, listening, inquiry, and palpation, combined with the four diagnostic methods, TCM explores the cause, nature, and location of diseases, analyzes the pathogenesis and changes in the internal organs, meridians and collaterals, qi, blood, and body fluids, judges the growth and decline of pathogenic and healthy factors, and then determines the disease name and summarizes the syndrome type. Based on the principle of syndrome differentiation and treatment, TCM formulates treatment methods such as "inducing sweating, inducing vomiting, purgation, harmonization, warming, clearing, tonifying, and eliminating," and uses various therapeutic means such as Chinese herbal medicine, moxibustion, acupuncture, massage, cupping, qigong (breathing exercises), and dietary therapy to restore the body's yin-yang balance and promote recovery.

92

On November 16, 2010, the application for Chinese acupuncture to be included in the World Intangible Cultural Heritage succeeded.

93

1.Huangdi Neijing (the Yellow Emperor's Inner Canon)

Huangdi Neijing is the earliest and most influential medical book in China, revered by later generations as the "Ancestor of Medicine.". It emphasizes the principle of prevention, advocating for treating diseases before they occur rather than after they have manifested.

94

2. Hua Tuo

Hua Tuo was a renowned physician at the end of the Han dynasty. He was proficient in internal medicine, surgery, gynecology, pediatrics, and acupuncture. Hua Tuo was the first to use general anesthesia in surgical procedures, earning him the titles of "Saint of Surgery" and "Father of Surgery" from later generations. Hua Tuo also developed a set of therapeutic exercises, which mimics the movements of the monkey, deer, bear, tiger, and bird, designed to promote health and vitality in the elderly and infirm.

95

3. Zhang Zhongjing

Zhang Zhongjing was a great clinical physician at the end of the Han Dynasty. He authored the medical masterpiece "Treatise on Cold Damage and Miscellaneous Diseases" (Shang Han Za Bing Lun). Zhang Zhongjing classified diseases into six categories, known as the "Six Channels" (Liu Jing). Based on factors such as the body's resistance to disease and the progression and severity of the illness, he summarized the characteristics of symptoms and the locations of pathological changes.

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Thank you for your attention!

97

LECTURE 5: WETLAND CONSERVATION PLAN IN SHENZHEN CITY

Resource Situation 资源现状

The total wetland area in Shenzhen is 347.88 square kilometers,of which the area of coastalwetlands accounts for 76.62%.
深圳2021年湿地总面积347.88平方公里，滨海湿地占76.62%

Wetland type	area (square kilometer)	patch number	Average plaque Area (ha)
coastalwetlands 近海与海岸湿地	267.75	1893	14.14
rivers 河流湿地	16.35	3721	0.44
Swamp wetlands 沼泽湿地	0.64	146	0.44
constructed wetlands 人工湿地	63.14	3297	1.91

3

Resource Situation 资源现状

With typical wetland ecosystems of the South Asian tropics, including mangroves, coastal mudflat, coral reefs, estuaries, bays.
深圳拥有红树林、滨海滩涂、珊瑚礁、河口、海湾等南亚热带典型湿地生态系统

4

Problems and Challenges 问题与挑战

The maintenance of total wetland area faces challenges.
湿地规模总量维持面临挑战

Connectivity and biodiversity need improvement, with ecological functions not being fully realized.
连通性、生物多样性待提升，生态功能未充分发挥

The legal and regulatory systems are incomplete, and governance capabilities and levels need to be improved.
法规制度不健全，治理水平和能力有待提升

2009-2021年减少31平方公里

6

Functional positioning of the plan 规划定位

This plan, positioned as a specialized component within the territorial spatial planning system, serves as an action initiative that guides and coordinates wetland conservation and management across the city. This plan has been formally issued by the competent authorities on March 31, 2025.

这项规划是国土空间规划体系下的专项规划，是统筹指导全市湿地保护管理的行动纲领，已于3月31日印发

深圳市规划和自然资源局
深圳市海洋发展局 文件

深规划资源〔2025〕282号

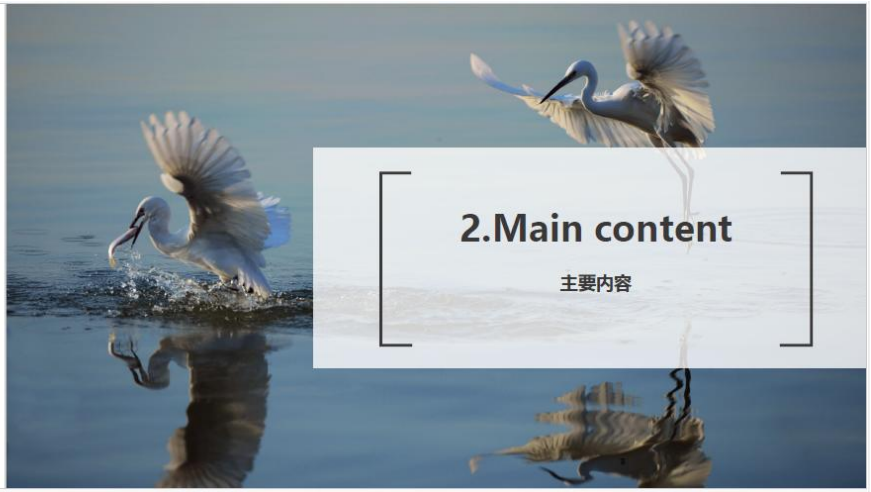
市规划和自然资源局 市海洋发展局
关于印发《深圳市湿地保护规划
（2025—2035年）》的通知

各区人民政府，市各有关单位：

为贯彻落实《中华人民共和国湿地保护法》《广东省湿地保护条例》，推进深圳湿地保护高质量发展，结合深圳实际，市规划和自然资源局会同市海洋发展局组织编制了《深圳市湿地保护

—1—

7



2.Main content

主要内容

Planning objectives 规划目标

By 2030，the city will have been recognized as a Wetland City(Ramsar accredited).
到2030年建成国际湿地城市

By 2035，become aninternational first-class coastal wetland city.
到2035年建成国际一流的滨海湿地城市

Strategic Measures 策略举措

Improve the wetland conservation management system and mechanisms.
立法先行，完善保护顶层设计

Accelerate the legislation on wetland protection Establish and improve the conservation manageme system including total quantity control, graded managment, survey and evaluation, etc.

加快湿地保护立法，健全总量管控等管理制度体系

Establish mechanisms for interdepartmental collaboration, expert consultation and decision-making, and collaborative protection in the bay area.

完善管理体制，建立部门协作、专家咨询决策、湾区协同等机制

Develop technical specifications for the full chain of "investigation and monitoring -planning -integrated infrastructure stewardship- evaluation and examination.
完善“调查监测—规划计划—建设管养—评估考核”全链条技术规范，推进管理规范化

Explore the involvement of social welfare organizations and communities in wetland governance. wetlands managed by social welfare organizations≥ 5，wetlands co-managed with communities≥ 10.

探索湿地公益治理和社区治理，建设社会公益治理的湿地、社区共建湿地

10

Strategic Measures 策略举措

Establish a wetland classification protection system with protected areas as the main body and Other Effective Area-based Conservation Measures(OECMs) as supplements. By 2035, no less than 10 Wetland conservation community will be established. The city-wide wetland conservation rate shall not be lower than 55%.
建立以自然保护地为主体，其他有效保护措施为补充的分类保护体系，到2035年设立不少于10个湿地保护小区

13

Strategic Measures 策略举措

High quality and high-level construct and operate the international mangrove center, promote international cooperation and joint actions.Based on the International Mangrove Center, implement cooperation on mangrove and coastal wetland protection and restoration projects, as well as on the protection of migratory bird flyways.高质量高水平建设和运行国际红树林中心，推动国际合作和联合行动。依托国际红树林中心，实施红树林及滨海湿地保护修复、候鸟迁飞通道保护合作。

14

Strategic Measures 策略举措

Construct more than 30 diverse and wild Small and Micro Wetlands. Develop a waterfront recreation system and a science popularization and education network. Develop "wetland + tourism/culture/science & innovation" integration spacesand inject new vitality into urban development.建设多元复合、野趣十足的高品质小微湿地，构建活力滨水游憩体系。以“湿地+”激活科创、文化、旅游等绿色产业，为城市发展注入新活力

19

Tasks and Projects 实施行动

Two key tasks
2项重点任务

- High-Standard application of an International Wetland City (Ramsar accredited)
- High quality and high-level construction of the International Mangrove Center

Three categories and six key projects
3类6项重点工程

- Key projects for wetland protection and restoration
- Key projects for rational utilization
- Key projects for wetland scientific research and monitoring

Recent Action Projects
28个近期行动项目

Application of Wetland City (Ramsar accredited)	Construction of the international mangrove center	Protection and restoration of mangrove wetlands	Protection and restoration of coastal wetlands
2个	4个	7个	4个

Protection and restoration of inland wetlands	Restoration and enhancement of Small and Micro Wetland	Construction of recreation and nature education network	Wetland scientific research monitoring
3个	1个	4个	3个

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LECTURE 6: MANGROVE CONSERVATION AND CLIMATE CHANGE

IMC Mangrove Training Workshop (Shenzhen； 3 November, 2024)

Lecture 6: Mangroves, Blue Carbon and Climate Change Mitigation

Guanghui Lin[1,2]

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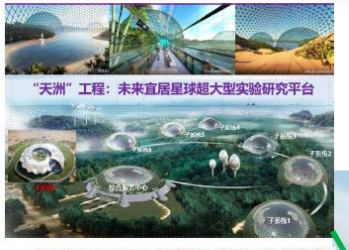
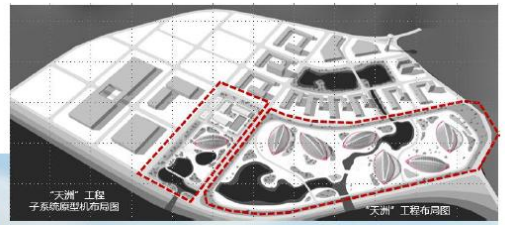
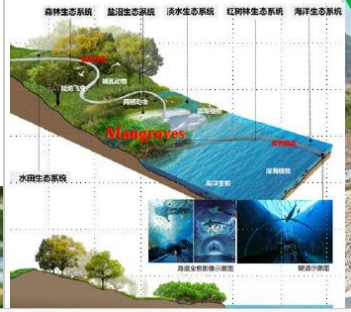
[2]Hainan International Blue Carbon Research Center, Haikou, China
lingh@tsinghua.edu.cn; 13911768246 (wechat)

Site for Tianzhou Project (Jianjiang, LuoYuan, Fujian)



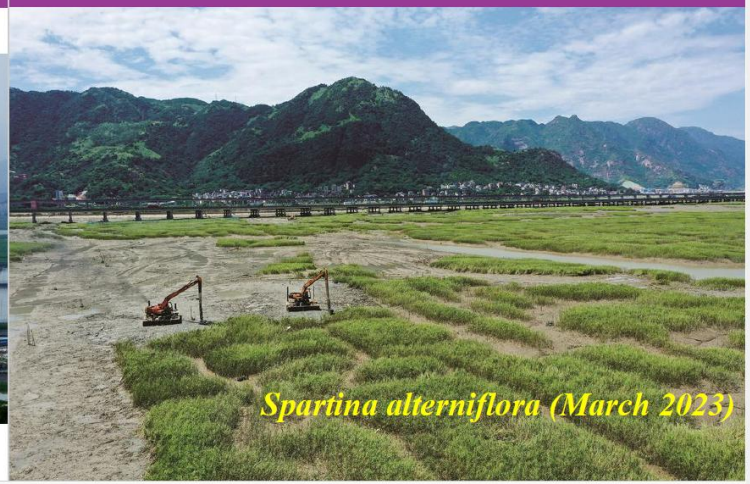




Mangroves in LuoYuan Bay, Fujian (1980's)

3

LuoYuan Bay, Fujian: Invasion of US cordgrass



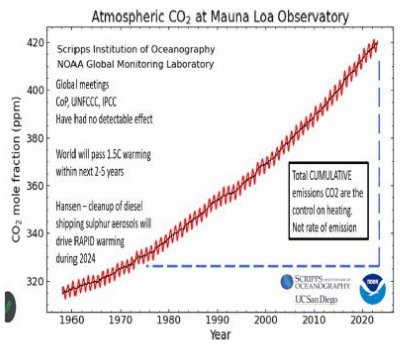
What are the restored mangroves and new sea wall for?

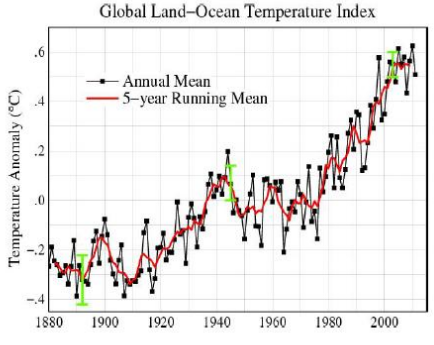
Outline

- Climate change as one of biggest threats to humankinds
- Blue carbon as key ecosystem service of mangrove wetlands
- Case studies of mangrove blue carbon
- Blue carbon trading and methodologies

6

Climate Change: One of Greatest Challenges in 21st Century

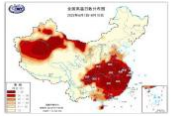




Human induced increase of atmospheric CO2 caused global warming and extreme climate events

Serious consequences of global change

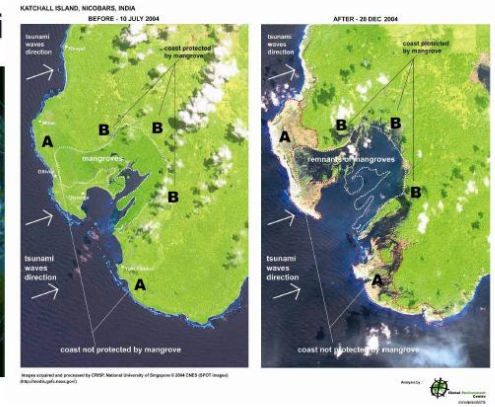
- global warming
- sea level rise
- heat wave, heavy rains, drought, etc.



Damage to the mangrove forests in Dongzhaigang of Hainan caused by super typhoon "Yagi"

Mangroves reduced Tsunami damages!

Indian Ocean Tsunami



Danielsen et al. 2005, Science 310: 643

Mangrove forests can protect the coasts!

The 2004 tsunami broken a long boat jetty in to pieces, while mangroves intact without damage in Parangipettai, south east India

Disasters raise attentions!

Source: The Star newspaper, Malaysia

Focus 31

Save mangroves to fight tsunamis

GLOBAL TRENDS
By Martin Khor

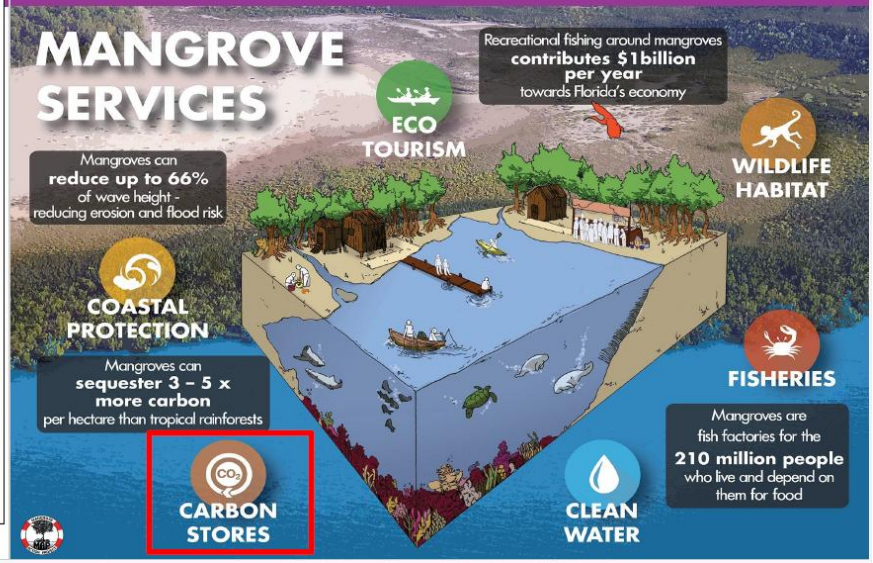
Nation 21

Mangroves can protect coasts

Tsunami Aftermath

Natural barriers against tsunamis

Key ecosystem services of global mangroves



Outline

- Climate change as one of biggest threats to humankinds
- Blue carbon as key ecosystem service of mangrove wetlands
- Case studies of mangrove blue carbon
- Blue carbon trading and methodologies

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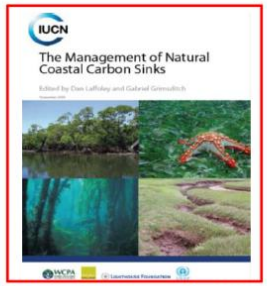
What is blue carbon?

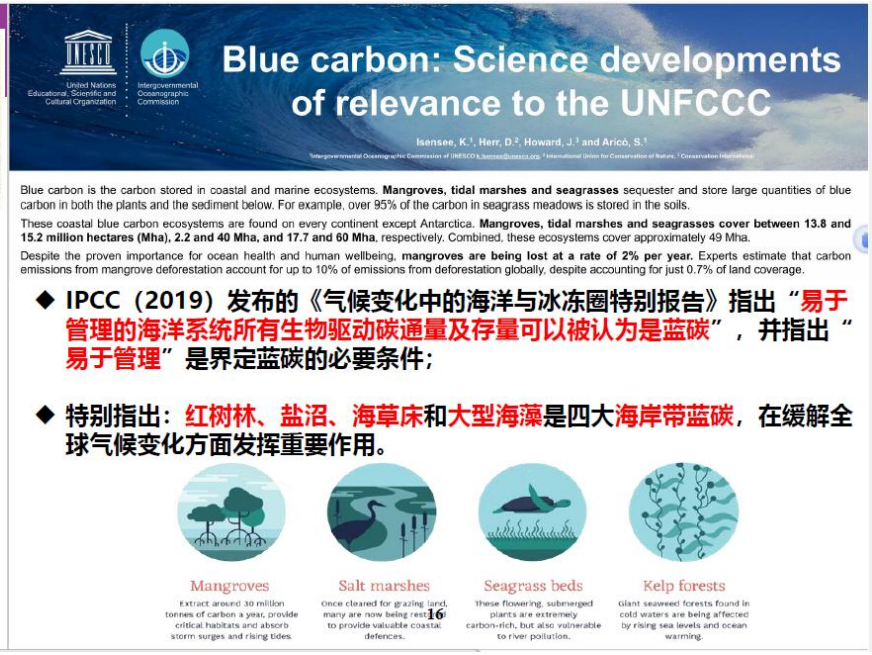
Blue Carbon: organic carbon that is captured and stored by the oceans and coastal ecosystems, particularly by seagrass meadows, tidal marshes, mangroves & kelps



2009年联合国环境署、粮农组织和教科文组织政府间海洋学委会共同发布《蓝碳》、《滨海自然碳汇管理》等报告

蓝碳生态系统
（滨海蓝碳生态系统）

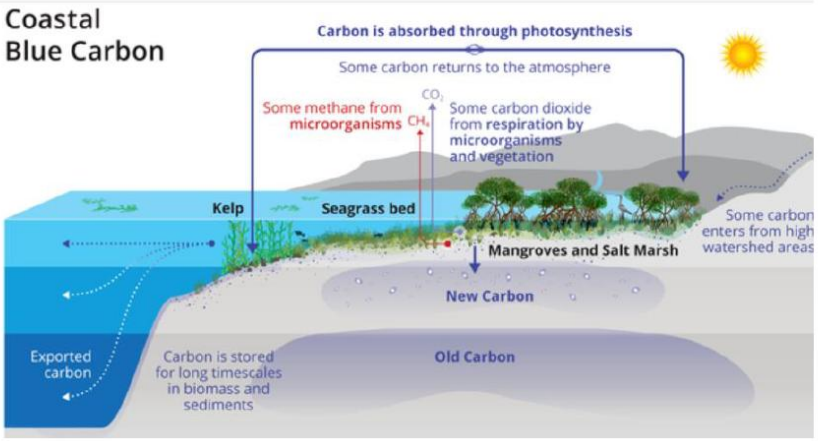
BC Ecosystems
(BCEs)
or
Coastal BC Ecosystems
(CBCEs)



- IPCC（2019）发布的《气候变化中的海洋与冰冻圈特别报告》指出“易于管理的海洋系统所有生物驱动碳通量及存量可以被认为是蓝碳”，并指出“易于管理”是界定蓝碳的必要条件；
- 特别指出：红树林、盐沼、海草床和大型海藻是四大海岸带蓝碳，在缓解全球气候变化方面发挥重要作用。

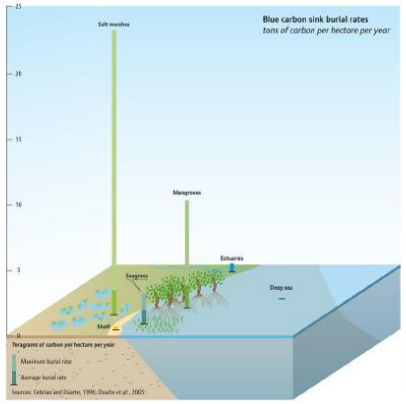
Mechanisms for blue carbon in four BCEs

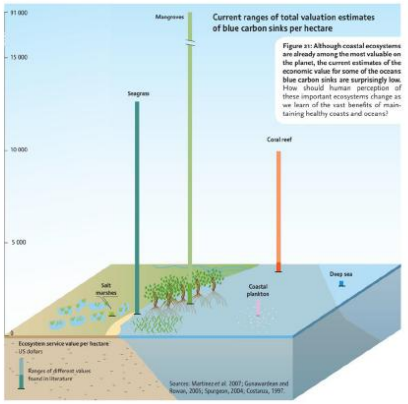
四大海岸带蓝碳生态系统的碳交换过程与碳汇机制



IPCC（2019）发布的《气候变化中的海洋与冰冻圈特别报告》

Comparison of carbon burial rates among three coastal blue carbon ecosystems





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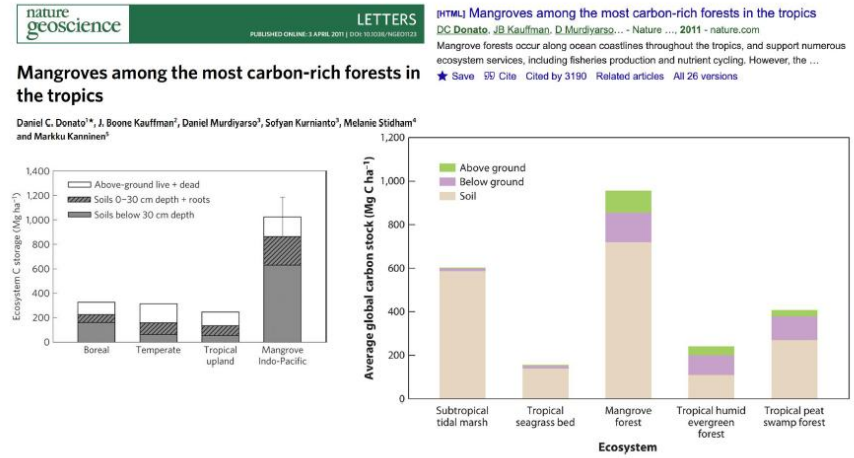
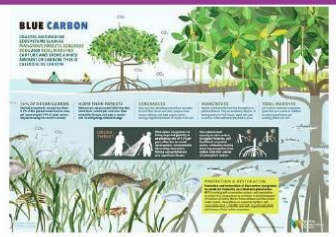
Mangrove forest is one of the best blue carbon ecosystems



[HTML] Mangroves among the most carbon-rich forests in the tropics
DC Donato, JB Kauffman, D Murdiyarso… - Nature …, 2011 - nature.com
Mangrove forests occur along ocean coastlines throughout the tropics, and support numerous ecosystem services, including fisheries production and nutrient cycling. However, the …
★ Save 99 Cite Cited by 3190 Related articles All 26 versions

Blue Carbon as NbS for Mitigating Climate Change



照片来源：Emily Pidgeon

Monday, May 14 - W3

Workshop 3 (W3)

Coastal Blue Carbon: Mitigation opportunities and vulnerability to change

Co-Convenors:
Ik Kyo Chung (PNU, Korea)
Gabriel Grimsditch (UNEP)
Jerker Tamelander (UNEP)

2024： New era of blue carbon research

BioScience, 2024, 74, 253–268
https://doi.org/10.1093/biosci/biae007
Advance access publication date: 18 March 2024
Forum

所有受潮汐影响的湿地都是蓝碳生态系统

All tidal wetlands are blue carbon ecosystems

Maria Fernanda Adame, Jeff Kelleway, Ken W. Krauss, Catherine E. Lovelock, Janine B. Adams, Stacey M. Trevathan-Tackett, Greg Noe, Luke Jeffrey, Mike Ronan, Maria Zann, Paul E. Carnell, Naima Iram, Damien T. Maher, Daniel Murdiyarso, Sigit Sasmito, Da B. Tran, Paul Dargusch, J. Boone Kauffman and Laura Brophy

本期好文推送为您精选了发表在BioScience上的一篇文章。澳大利亚昆士兰格里菲斯大学河流研究所的Maria Fernanda Adame及其团队指出，蓝碳项目在全球范围内呈指数级增长，但对碳信用的需求远远超过了供给。目前大多数蓝碳项目都在红树林中进行，然而，许多潮汐湿地具有的特征与蓝碳定义高度一致，尚待充分利用和有效管理。因此，作者建议所有直接或间接受潮

DOI: 10.1111/gcb.17261

和恢复潮汐湿地，可以减少碳排放。

OPINION

Blue Carbon (BC)

Blue Carbon (BC)

Blue Carbon (BC)

Global Change Biology WILEY

It's time to broaden what we consider a 'blue carbon ecosystem'

是时候拓展所谓的“蓝碳生态系统” 了!

Kelly James[1] | Peter I. Macreadie[2] | Heidi L. Burdett[3,4] | Ian Davies[5] | Nicholas A. Kamenos[3,4]

本期好文推送为您精选了发表在Global Change Biology上的一篇文章，作者提供了一个通用框架，可以评估一个特定的生态系统在特定情况下作为蓝色碳汇的可能性。总体而言，本文旨在鼓励在国家统计局战略中考虑非经典的蓝碳生态系统，从而实现更完整的蓝碳核算。希望能够为您提供新的思路和参考，欢迎阅读和转发。

I am here

International Blue Carbon Scientific Working Group (IBCSWG) held its 15th annual meeting in Singapore on October 3-6, 2023

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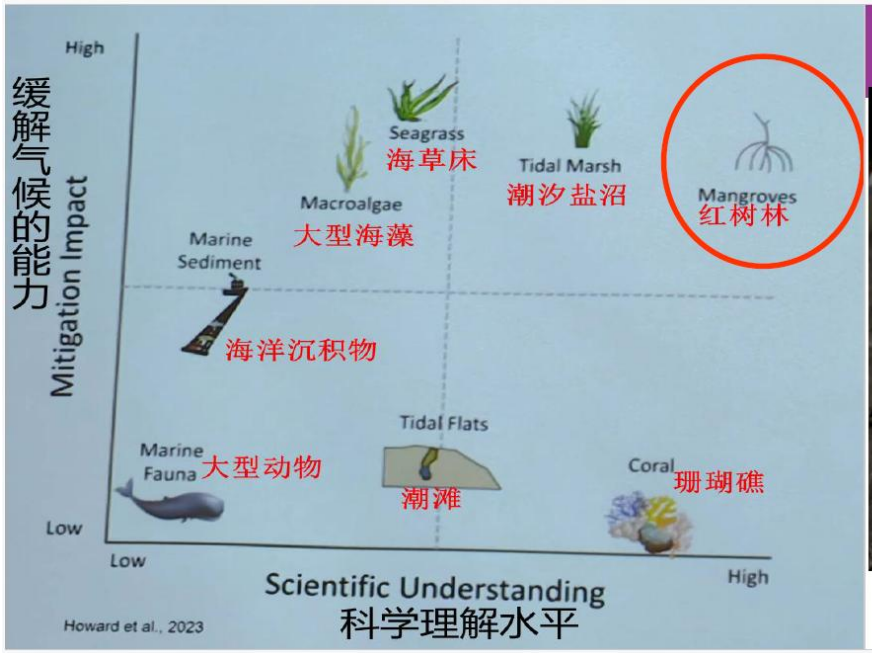
High
缓解气候的能力
Mitigation Impact
Seagrass
海草床
Macroalgae
大型海藻
Tidal Marsh
潮汐盐沼
Mangroves
红树林
Marine Sediment
海洋沉积物
Tidal Flats
潮滩
Marine Fauna
大型动物
Coral
珊瑚礁
Low
Low
High
Scientific Understanding
科学理解水平
Howard et al., 2023


Example： Indus Delta Blue Carbon Project
INDUS DELTA CAPITAL
silvestrum
CLIMATE ASSOCIATES
blue ventures
beyond conservation

Indus Delta BC Project

- Restoration of 224,997 ha of mangroves
  75,000 ha already planted
- 60 year long project: 2015 - 2075
- Approximately 1 BILLION mangroves planted over 12 years
- Estimated 140 million t CO_2e removals over 60 years
- Applied Landsat, SRTM, field survey and calibration.

Outline

- Climate change as one of biggest threats to humankinds
- Blue carbon as key ecosystem service of mangrove wetlands
- Case studies of mangrove blue carbon
- Blue carbon trading and methodologies

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The Innovation

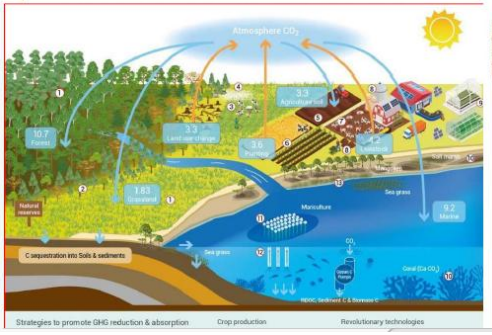
Review

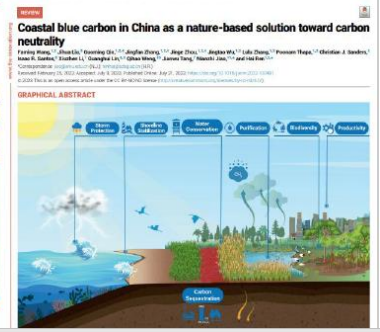
Technologies and perspectives for achieving carbon neutrality

Fang Wang,[1,2,53,*] Jean Damascene Harindintwali,[1,2] Zhizhang Yuan,[2,3,53] Min Wang,[2,4,53] Faming Wang,[2,19,20] Sheng Li,[2,5,53] Zhigang Yin,[2,18] Lei Huang,[5,7,53] Yuhao Fu,[1,2] Lei Li,[2,21] Scott X. Chang,[22] Linjuan Zhang,[2,23] Jörg Rinklebe,[24] Zuoqiang Yuan,[2,25] Qinggong Zhu,[2,26] Leilei Xiang,[1,2] Daniel CW. Tsang,[27] Liang Xu,[2,28] Xin Jiang,[1,2] Jihua Liu,[29] Ning Wei,[2,30] Matthias Kästner,[31] Yang Zou,[2,23] Yong Sik Ok,[32] Jianlin Shen,[2,4] Dailiang Peng,[4,6,7] Wei Zhang,[2,33] Damia Barcelo,[34] Yongjin Zhou,[2,35] Zhaohai Bai,[2,36] Boqiang Li,[2,37] Bin Zhang,[2,38] Ke Wei,[2,39] Hujun Cao,[2,40] Zhiliang Tan,[2,4] Liu-bin Zhao,[41] Xiao He,[2,42] Jinxing Zheng,[2,43] Nanthi Bolan,[44] Xiaohong Liu,[2,33] Changping Huang,[2,7] Sabine Dietmann,[45] Ming Luo,[2,46] Nannan Sun,[2,47] Jirui Gong,[48] Yulie Gong,[2,49] Ferdi Brahushi,[50] Tangtang Zhang,[51] Cunde Xiao,[48] Xianfeng Li,[2,5,*] Wenfu Chen,[52] Nianzhi Jiao,[8,9,10,*] Johannes Lehmann,[11,12] Yong-Guan Zhu,[2,13,14,*] Hongguang Jin,[2,5,*] Andreas Schaeffer,[15] James M. Tiedje,[16,*] and Jing M. Chen[17,**]

*Correspondence: wangfang@issas.ac.cn (F.W.); lixianfeng@dicp.ac.cn (X.L.); jiao@xmu.edu.cn (N.J.); ygzhu@iue.ac.cn (Y.-G.Z.); hgjin@iet.cn (H.J.); tiedjej@msu.edu (J.M.T.); jing.chen@utoronto.ca (J.M.C.)

Received: September 20, 2021; Accepted: October 27, 2021; Published Online: ■■ ■■, ■■; https://doi.org/10.1016/j.xinn.2021.100180



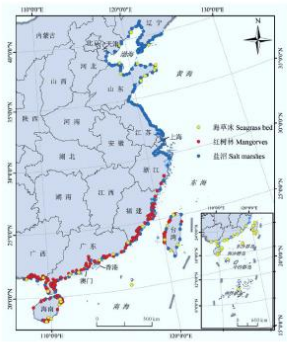

REVIEW

Coastal blue carbon in China as a nature-based solution toward carbon neutrality

GRAPHICAL ABSTRACT

Mangrove forests as the most important coastal wetlands of SE China

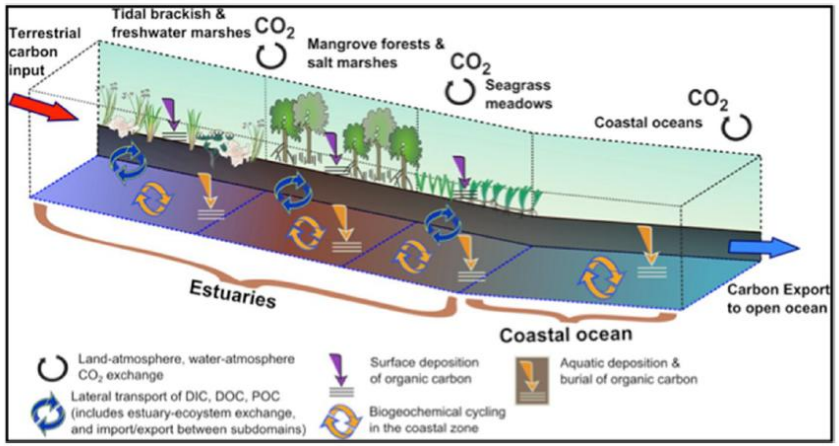
■ Coastal wetlands in China



Chen et al., 2021

The total area of BCEs in China is about 5,000 km², including mangroves, tidal saltmarshes, and seagrass beds. They are habitats for rare and endangered species, maintaining extremely high biodiversity and a wide range of ecosystem services.

CO_2 exchanges of coastal wetlands are open and complex



Barr, Lin et al. 2014

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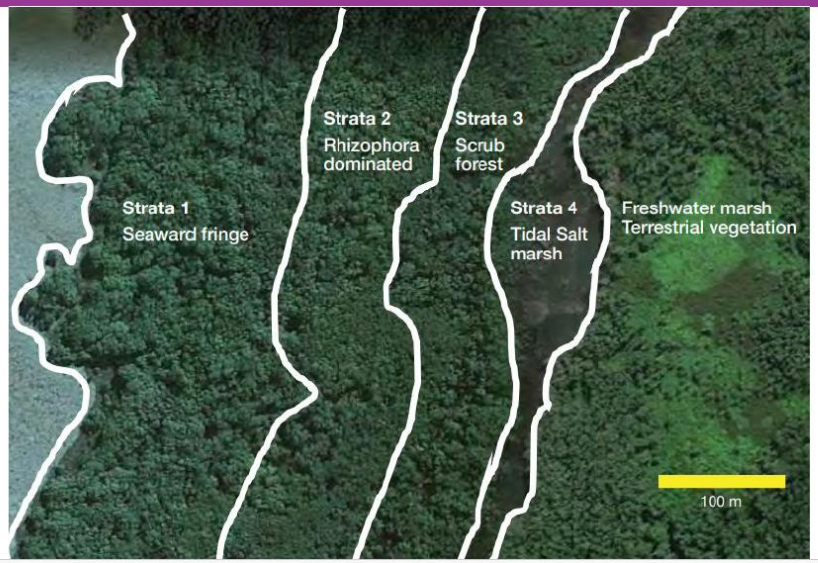
ow to select sites and measure carbon stocks?



ow to select sites and measure carbon stocks?

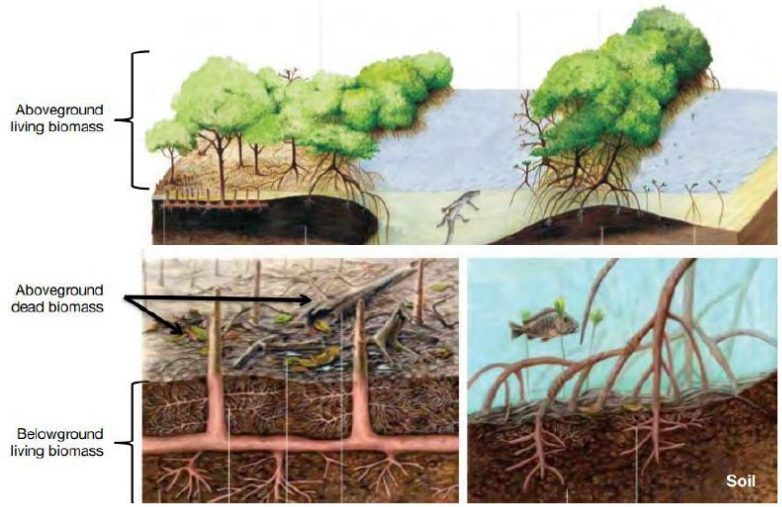
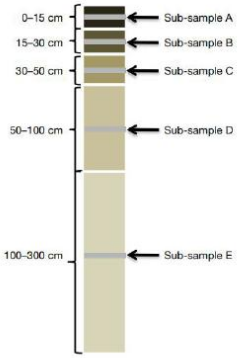


Figure 4.1 Classification of mangroves. (A) Oceanic fringing mangroves (© Enrico Marone, CI), (B) Riverine or estuarine mangroves (© Ginny Farmer, CI), (C) Basin mangroves (© Colin Foster, CI), and (D) Dwarf or scrub mangroves (© Catherine Lovelock, UQ).

How to select sites and measure carbon stocks?



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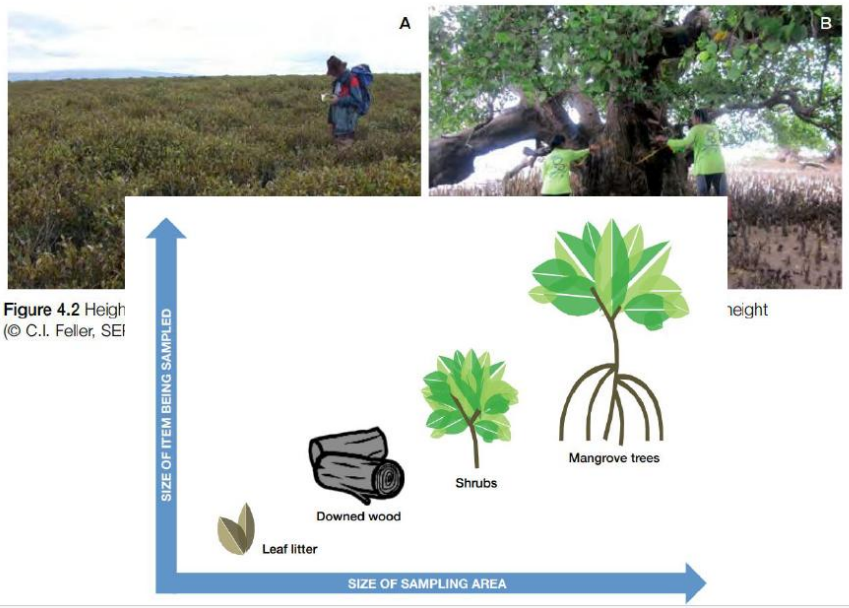

Figure 4.2 Heigh
(© C.I. Feller, SEI

eight

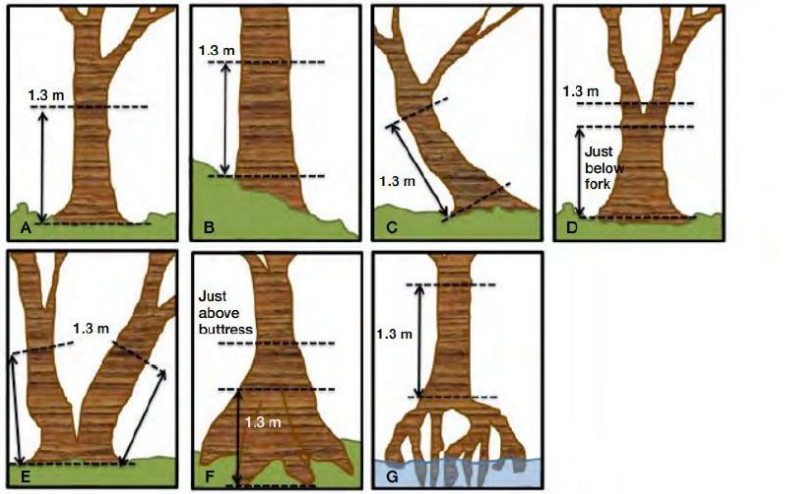

Figure 4.4 Estimating diameter at breast height for irregular mangrove trees (modified from Pearson, *et al.* 2005)

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Figure 4.10 Pneumatophores. (A) Measuring pneumatophore height, (B) Pneumatophores can be measured n or next to microplots. These microplots can be the same plots used to sample litter (described below). (© Boone Kauffman, OSU)

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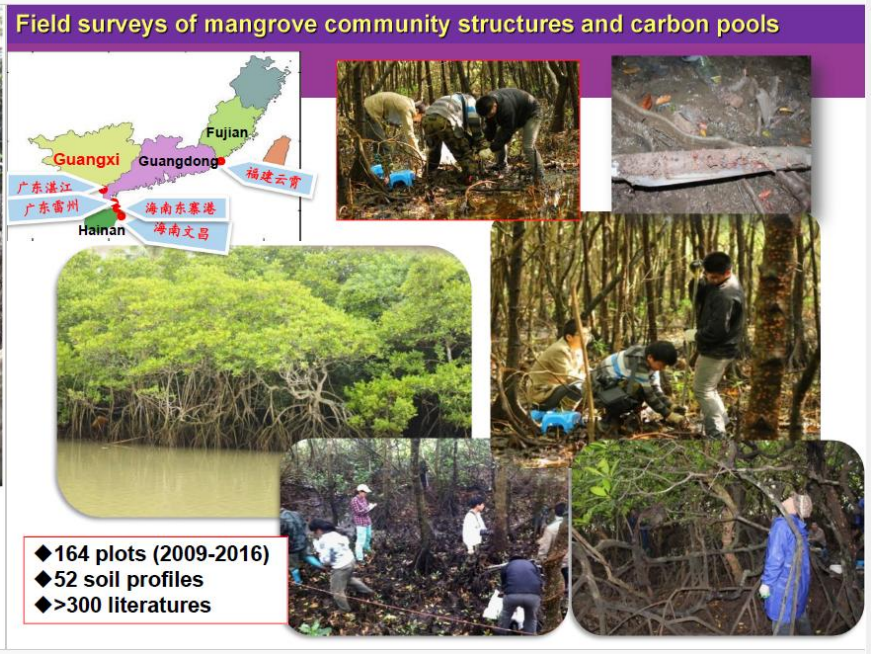
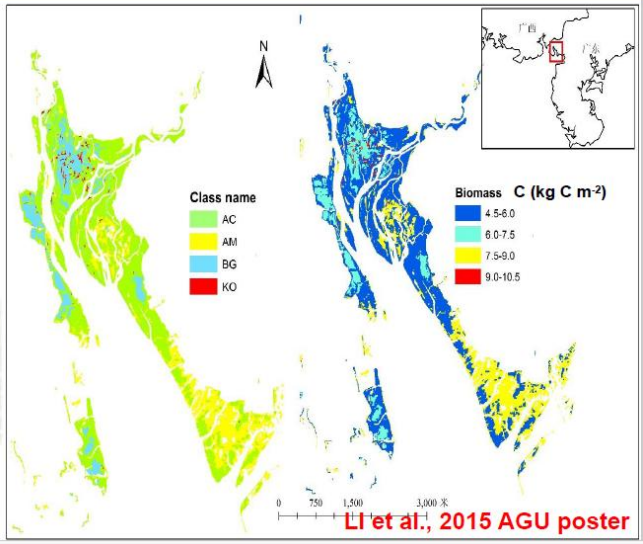


Classification of mangrove vegetation distribution and estimation of biomass C by remote sensing

High resolution RS

LiDAR on drone



LI et al., 2015 AGU poster

Quantification of Blue C for whole Hainan Island

RESEARCH ARTICLE

Global Ecology and Biogeography WILEY

Spatial patterns and driving factors of carbon stocks in mangrove forests on Hainan Island, China

Yuchen Meng[1,2,3] | Ruikun Gou[1,2] | Jiankun Bai[1,4] | David Moreno-Mateos[5,6,7] | Charles C. Davis[5] | Luoma Wan[8] | Shanshan Song[1] | Hongsheng Zhang[9] | Xiaoshan Zhu[3] | Guanghui Lin[1,3]

[1]Department of Earth System Science, Ministry of Education Key Laboratory for Earth System Modeling, Institute for Global Change Studies, Tsinghua University, Beijing, China
[2]Department of Environmental Systems Science, Swiss Federal Institute of Technology in Zurich (ETH Zurich), Zurich, Switzerland
[3]Institute for Ocean Engineering, Shenzhen International Graduate School, Tsinghua University, Shenzhen, China
[4]School of Ecology and Environmental Science, Yunnan University, Kunming, China
[5]Department of Organismic and Evolutionary Biology, Harvard University, Cambridge, Massachusetts, USA
[6]Department of Landscape Architecture, Harvard University, Cambridge, Massachusetts, USA
[7]Basque Center for Climate Change/Ikerbasque Foundation, Leioa, Spain

Abstract

Aim: Mangrove forests are important coastal wetlands for the blue carbon budget and play a significant role in mitigating global climate change. However, spatial patterns of carbon stocks in mangrove forests on an island scale have not been quantified owing to methodological limitations and lack of understanding of controlling factors. We took the entire Hainan Island as a case study and aimed to carry out a comprehensive investigation of the spatial patterns and driving factors of carbon stocks in mangrove forests.

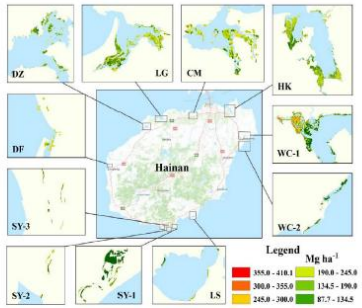
Location: Southern China.

Time period: 2017-2020.

Major taxa studied: Mangrove forest.

Methods: The upscaling method combined with field surveys and Sentinel-2 imagery analysis were used to compare different models for optimization of mangrove ecosystem carbon stock estimations. We also used structural equation modelling (SEM) to evaluate the factors driving the distributional patterns of mangrove carbon stocks on an island scale.

海南不同区域红树林碳密度（吨/公顷）



蓝碳总储量：70.3万吨 (海口占43%，文昌占24%）；碳密度：192吨/公顷(地上部占23%，地下部占77%）

Meng, Lin et al. 2022. *Global Ecology and Biogeography*

Received: 12 June 2020 | Accepted: 3 January 2021
DOI: 10.1111/1365-2435.13753

RESEARCH ARTICLE

Functional Ecology

Mangrove diversity enhances plant biomass production and carbon storage in Hainan island, China

Jiankun Bai[1,2] | Yuchen Meng[1,2] | Ruikun Gou[1,2] | Jiacheng Lyu[1,2] | Zheng Dai[2] | Xiaoping Diao[3,4] | Hongsheng Zhang[5] | Yiqi Luo[6] | Xiaoshan Zhu[2] | Guanghui Lin[1,2]

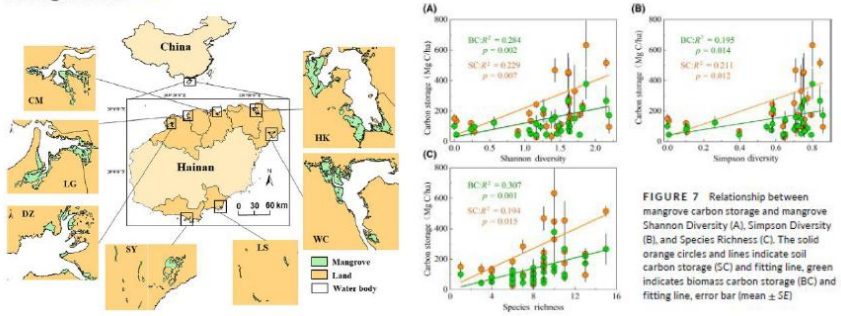
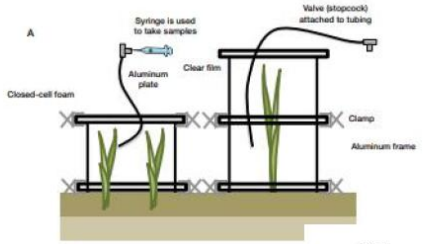


FIGURE 7 Relationship between mangrove carbon storage and mangrove Shannon Diversity (A), Simpson Diversity (B), and Species Richness (C). The solid orange circles and lines indicate soil carbon storage (SC) and fitting line, green indicates biomass carbon storage (BC) and fitting line, error bar (mean ± SE)

Traditional flux chamber methods



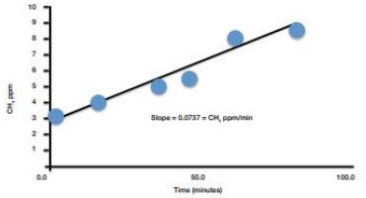
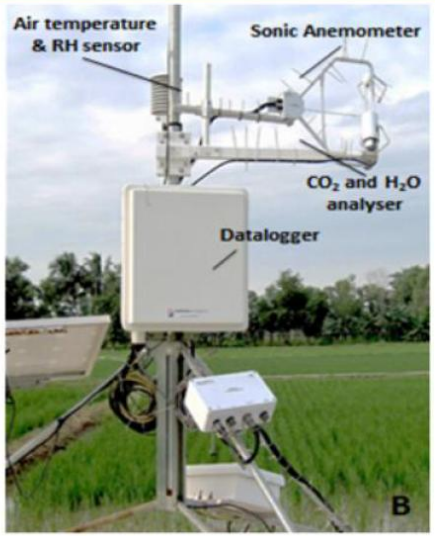


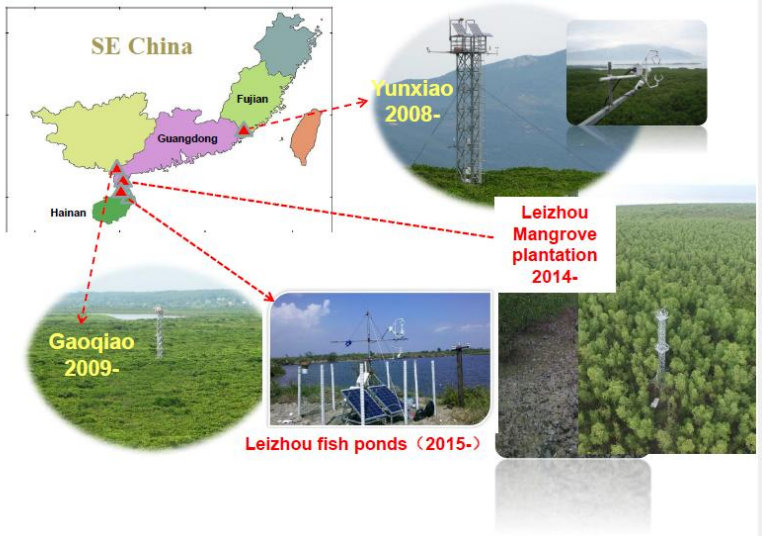
Figure 5.5 Chamber volume must be adjusted to enclose plants of different sta SERC; C, Eric Hazelton, SERC)

Figure 5.6 Proportion of CH_4 gas in the chamber is determined by plotting gas concentration per samples against the time between closing the chamber and collecting the sample. The slope is determined by calculating a best-fit line.

Eddy covariance technology and tower



Monitoring towers for Ecosystem CO_2 exchange of mangrove forests



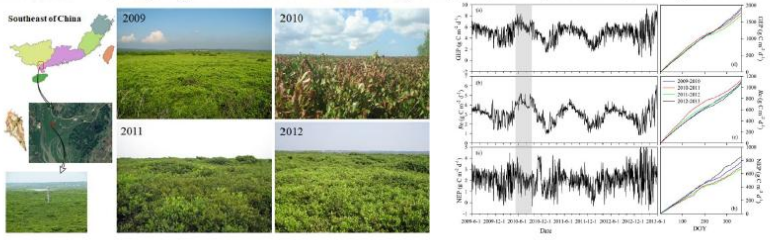
Agricultural and Forest Meteorology 2019

journal homepage: www.elsevier.com/locate/agrformet

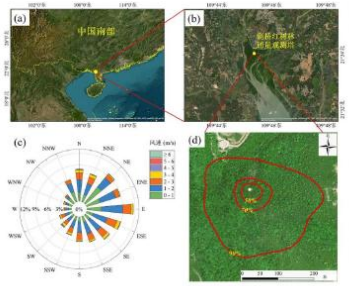
Impact of insect outbreaks on mangrove ecosystem C exchange is short-term !

Insect outbreaks have transient effects on carbon fluxes and vegetative growth but longer-term impacts on reproductive growth in a mangrove forest

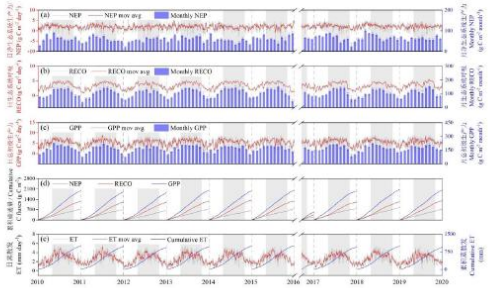
Weizhi Lu[a,b,c,*], Jingfeng Xiao[c], Xiaowei Cui[d,e], Fanghong Xu[f], Guangxuan Lin[f], Guanghui Lin[d,g,*]



Accumulated long-term observation data on mangrove ecosystem CO_2 fluxes



高桥红树林（2010-2019）位于保护区核心区，隔绝人为扰动的影响。



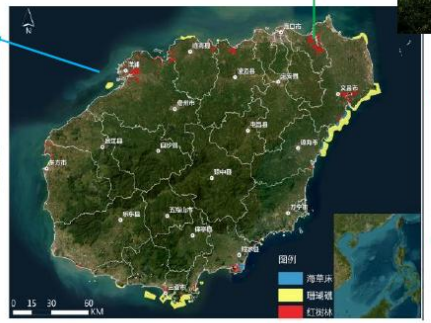
估计十年来的碳收支情况，**NEP (623-833 g C m^{-2} year^{-1})**，**RECO (1198-1349 g C m^{-2} year^{-1})**，**GPP(1841-2060 g C m^{-2} year^{-1})**。

Gou， LIN et al. 2023 AFM

50

New four Eddy flux towers in Hainan's mangroves

- Xinying National Wetland Park in Danzhou
- Comparison between the restored and pristine mangrove forests
- Established in 2022 for CO_2, CH_4 and H_2O fluxes

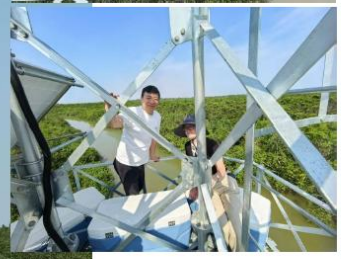


- Dongzhaigang National Mangrove Nature Reserve
- Well protected and most recent restored forests
- Build in 2025

Mangrove Carbon Flux Observation System built by Hainan International Blue Carbon Research Center

Two newes towers in Hainan's mangroves

Well preserved mangroves



Recently restored mangroves

52

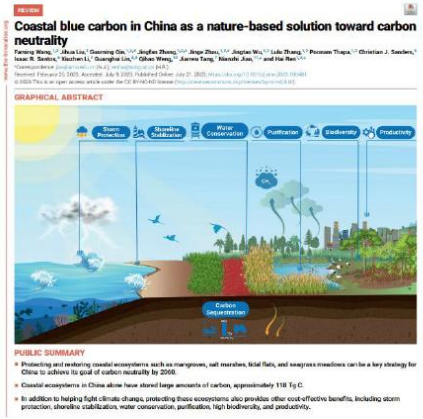
Launch of a new consortium: CBCC

Mission of CBCC:

- ✓ Standardize the methods and Share the data
- ✓ Publish influential papers and Train new scientists
- ✓ Serve the needs of whole country and local communities

53

Chinese coastal blue C toward carbon neutrality

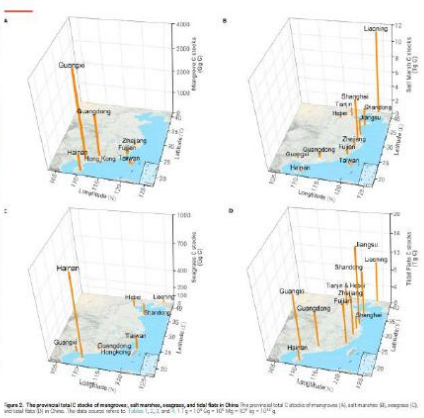


Coastal blue carbon in China as a nature-based solution toward carbon neutrality

GRAPHICAL ABSTRACT

PUBLIC SUMMARY

- Protecting and restoring coastal ecosystems such as mangroves, salt marshes, tidal flats, and seagrass meadows can be a key strategy for China to achieve its goal of carbon neutrality by 2060.
- Coastal ecosystems in China alone have stored large amounts of carbon, approximately 118 Tg C.
- In addition to helping fight climate change, protecting these ecosystems also provides other cost-effective benefits, including storm protection, shoreline stabilization, water conservation, purification, high biodiversity, and productivity.



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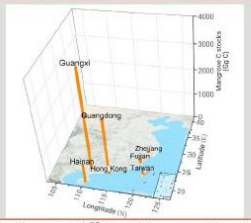
Estimation of blue C stocks and burial rates mangroves of China

Table 1. The distribution, average C stock, C storage, and C burial of mangroves in China

Province	Area (ha)	Soil C stock (Mg C ha^{-1})	Soil C storage (Gg C)	Biomass C stock (Mg C ha^{-1})	Biomass C storage (Gg C)	Total C storage (Gg C)	C burial (Gg C a^{-1})
Zhejiang	106	103.86	11			19	0.21
Fujian	827	103.86	86			149	1.6
Guangdong	9,205	142.13	1,308			1,920	17.86
Guangxi	11,251	255.59	2,876			3,940	21.83
Hainan	3,630	159.10	578			733	7.04
Hong Kong	104	142.13	15			22	0.2
Macao	13	142.13	2			3	0
Taiwan	736	103.86	76			132	1.43
Total	25,872		4,951			6,918	50.17

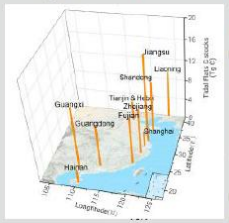


The area data sourced from Mao et al.,[27] the biomass and soil C stock sourced from Fu et al.,[28] C burial data sourced from Wang et al.[55] 1 Tg = 10^3 Gg = 10^6 Mg = 10^9 kg = 10^{12} g.

Carbon stocks and burial rate of tidal flats in China

Table 4. The distribution, average C stock, C storage, and C burial of tidal flats in China

Provinces	Area (ha) Low	Area (ha) High	C stock (Mg C ha^{-1})	Total SOC storage (Tg C) Low	Total SOC storage (Tg C) High	C burial rate (g C m^{-2} $year^{-1}$)	Soil C burial amount (Gg C $year^{-1}$) Low	Soil C burial amount (Gg C $year^{-1}$) High
Liaoning	0.54	133,100	69.9	0.00	9.30	107.45	0.00	143
Tianjin and Hebei	8,305	73,200	53.6	0.45	3.92	146.02	12	107
Shandong	34,208			2.81	10.15	192.95	66	239
Jiangsu	6,277			0.37	17.31	153.84	10	448
Shanghai	10,981			0.81	2.79	91.51	10	35
Zhejiang	21,740			1.48	9.02	153.84	33	204
Fujian	28,285			2.14	9.26	139.38	39	170
Guangdong	34,807			2.61	8.15	74.55	26	81
Guangxi	69,732			14.43	12.38	74.55	52	45
Hainan	5,031			0.63	2.48	136.63	7	27
Taiwan	18,075			1.37	–	139.38	25	–
Hongkong	2			0.00	–	74.55	0	–
Macao	7			0.00	–	74.55	0	–
Total	237,450	1,102,400		27.1	84.8		280	1,499



The area data sourced from Mao et al.[27] and the global tidal flat map,[57,60] the soil C stock sourced from Chen et al.,[59] C burial data sourced from Chen et al.[59] 1 Tg = 10^3 Gg = 10^6 Mg = 10^9 kg = 10^{12} g.

各地无植被滩涂（潮滩、光滩）具有高得多的碳库和碳埋速率！

Ecological connectivity increases Coastal BC

Contents lists available at ScienceDirect

Estuarine, Coastal and Shelf Science

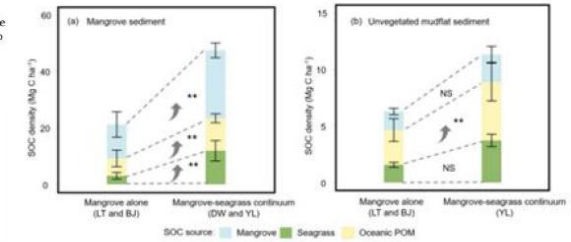
journal homepage: www.elsevier.com/locate/ecss

生态连通性提高了滨海蓝碳！

?

Ecological connectivity between mangroves and seagrasses increases sediment blue carbon storage

Xinao Guo [a,b], Shanshan Song [a,c], Lieyi Che, Ruikun Gou [a], Xiaoping Huang [c], Shuguo, Guanghui Lin [a,b,c,*]



墙报展示：

Ecological Connectivity between Mangroves and Seagrasses Increases Sediment Blue Carbon Storage

Xinao Guo, Shanshan Song, Lieyi Chen, Conghe Zhang, Shengbin Ye, Yali Ding, Ruikun Gou, Xiaoping Huang, Shuguo Lv, Neil Saintilan, Daniel A. Friess, **Guanghui Lin***

Department of Earth System Science, Tsinghua University

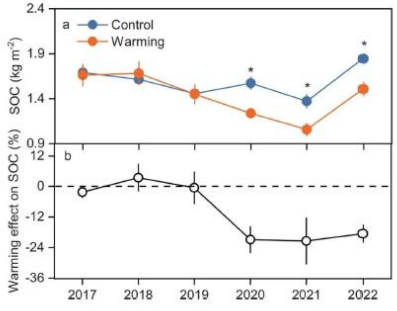
长期实验研究也发现未来气候变化对滨海蓝碳动态影响复杂!

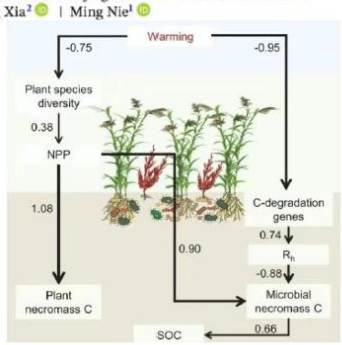
ECOLOGY LETTERS

LETTER Ecology Letters | 复旦大学、华东师范大学和中科院烟台所联合发文揭示气候变化下的湿地土壤碳循环过程

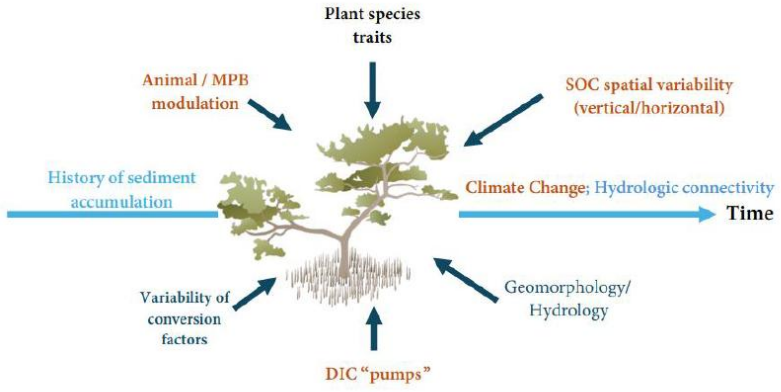
Warming-Induced Plant Species Shifts Lead to Substantial Losses of Wetland Soil Carbon

Baoyu Sun[1,2,3] | Ruifeng Sun[3,4] | Jianjun Xu[1] | Wenjing Gao[1] | Xiaojing Chu[3,4] | Huilan Yuan[1] | Fangxiu Wan[2] | Liming Yan[2] | Guangxuan Han[3,4] | Jianyang Xia[2] | Ming Nie[1]





Driving factors for mangrove blue carbon potentials



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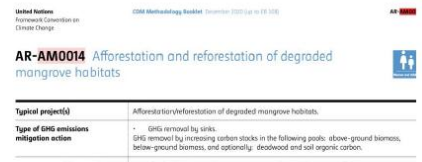
Outline

- Climate change as one of biggest threats to humankinds
- Blue carbon as key ecosystem service of mangrove wetlands
- Case studies of mangrove blue carbon
- Blue carbon trading and methodologies

61

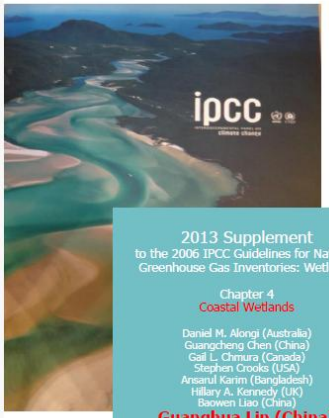
International standards and methodology for BC

联合国批准的红树林CDM碳汇计量方法：
AR0014:退化的红树林生境上造林、恢复方法

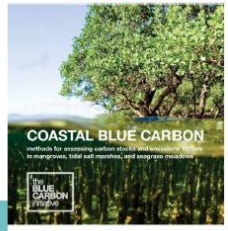


UNFCCC（CDM AM0014）+VCS　　VCS　VM0033　VCS

Methodology development for coastal blue carbon



陈鹭真、卢伟志、林光辉（主译, 2019)



Translated by Lin's group

Trading Blue Carbon using CDM and CCB mechanisms

- 1st BC project in China
- Mangrove afforestation project in Zhanjiang, Guangdong
- CDM (AM-AR0014)
- June 2021, Verra

“广东湛江红树林造林项目”是中国首个符合核证碳标准(VCS)和气候社区生物多样性标准(CCB)的红树林碳汇项目。该项目由自然资源部第三海洋研究所组织并与广东湛江红树林国家级自然保护区管理局合作开发完成。

"Guanadona Zhaniiana Manarove Afforestation Project" is the first manarove blue carbon project in China that meets the Verified Carbon Standard (VCS) and the Climate Community Biodiversity Standard (CCB). This project was organized and completed in collaboration with the Guanadona Zhaniiana Manarove National

Trading of Mangrove Blue Carbon in China

Restored mangrove forests in Sanjiang, Haikou becomes 1st Blue C trade Project in Hainan Province (2022)

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Trading Mangrove Blue Carbon using Chinese methodology

- Mangrove restoration project in Fujian
- 1st BC METHODOLOGY in CHINA

(Developed by Prof. Luzhen Chen et al.)

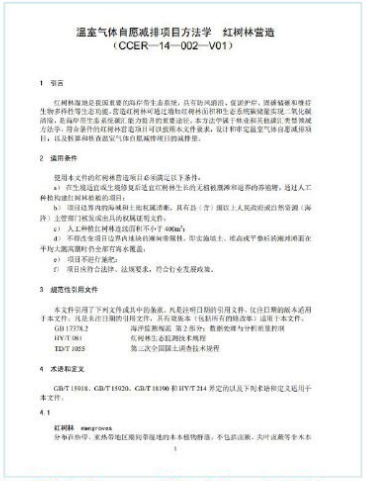
- Traded on 12 Sept, 2021

2021年9月12日，福建省红树林生态修复项目2000吨海洋碳汇在厦门产权交易中心海洋碳汇交易平台顺利成交，这是福建首宗海洋碳汇交易。该宗交易实现了红树林碳汇功能与生物多样性保护的协同增效、红树林保护与周边社区生态建设协同发展的两大目标

On Sept.12, 2021, the 20,000-tCO_2 of the mangrove restoration project in Fujian Province was successfully traded on Xiamen Property Rights Exchange Center. This is the first blue carbon trade in Fujian Province. The transaction achieved the two major goals of synergistic effects of mangrove carbon sink function and biodiversity protection, and the ecological construction of mangrove protection and livelihood of surrounding communities.

China Certified Emission Reductions (CCER)—Mangrove Afforestation Methodology

Methodology developed on CCER framework: Mangroves (October, 2023)


温室气体自愿减排项目方法学　红树林营造
（CCER—14—002—V01）

1 引言

2 适用条件

3 规范性引用文件

4 术语和定义

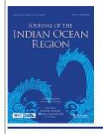
9 方法学编制单位

在本方法学编制工作中，自然资源部第三海洋研究所，以及北京市企业家环保基金会、大自然保护协会北京代表处、北京林业大学、厦门大学、海南省环境科学研究院、国家海洋信息中心、国家海洋环境监测中心等单位作出积极贡献。

The only one of blue carbon ecosystems is officially qualified for CCER!

重视蓝碳与蓝色经济的关联

Blue Carbon and Blue Economy

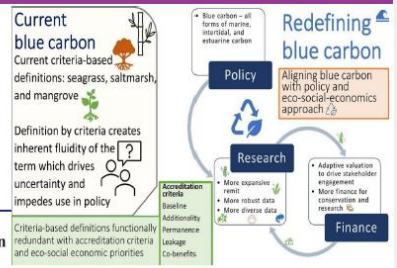


Journal of the Indian Ocean Region

ISSN: 1948-0881 (Print) 1948-108X (Online) Journal homepage: www.tandfonline.com/journals/rior20

A new narrative for the Blue Economy and Blue Carbon

Andrew D. L. Steven, Mathew A. Vanderklift & Narnia Bohler-Muller



Sheehy et al. 2024 STE

ARTICLES

https://doi.org/10.1038/s41558-021-01089-4

nature climate change

Check for updates

OPEN

The blue carbon wealth of nations

Christine Bertram[1], Martin Quaas[2], Thorsten B. H. Reusch[3], Athanasios T. Vafeidis[4], Claudia Wolff[4] and Wilfried Rickels[1]✉

Co-benefits of mangrove conservation and restoration as NbS

- *Blue carbon and biodiversity conservation*
- *Coastal restoration and community sustainability*

High-Quality Blue Carbon

2025 Hainan Blue Carbon Forum (July 17-20, Lingshui)

第二轮通知即将发布，欢迎报名参与交流、合作!

Hainan Blue Carbon Forum（First Circular Notice）

联系邮箱：hibluecarbon@163.com

联系电话：15060385231（郑女士）
17600116727（许先生）

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Take home messages

- ◆Blue carbon in mangrove and other coastal wetlands have significant potentials for mitigate change as NbS approach;
- ◆Mangrove wetlands of China are strong carbon sinks for atmospheric CO_2, which can be used as NbS for CC mitigation in addition to other ecosystem services;
- ◆Reforestation on abandoned fish ponds or degraded habitats of mangroves provide greater blue carbon benefits than afforestation on tidal mud flat, so it is better NOT converting mud flat into blue carbon ecosystems;
- ◆More studies and international collaboration are urgently needed to monitoring carbon flows between mangroves and other coastal ecosystems.

LECTURE 7: BIRD WATCHERS, VALUABLE PARTINERS IN MANGROVE MANAGEMENT AND CONSERVATION

Bird Watchers: Valuable Partners to Mangrove Managers

Haibin Wang
June 20, 2025
Shenzhen, Guangdong, China

Mangroves managed by the Antsatrana community-based organization, leading out to Ambaro Bay.

Mangrove woods, forest at the beach on Nosy Be island in Madagascar, Africa

Krasop Wildlife Sanctuary and Koh Kapik Ramsar site , Cambodia

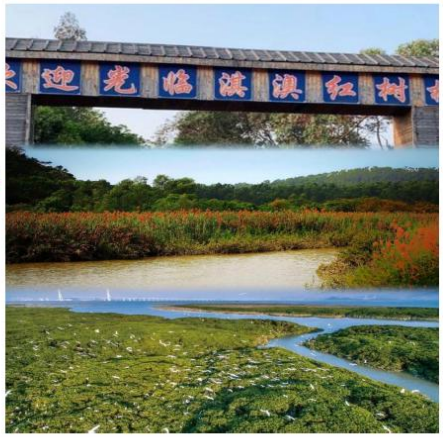
My Brief Experience with Mangrove

Management Plan for the Zhanjiang Mangrove National Nature Reserves, Guangdong, September – October, 2002, a part of the Integrated Mangrove Management and Coastal Protection Program, a joint program by China and the Netherlands governments.

Bird watching around Zhuhai, Guangdong Province, covering Qi'aodao Mangrove Nature Reserve, Yakou Mangrove Wetland Park, Cuiheng National Wetland, September 2019 – Jan. 2024

Zhanjiang Mangrove NNR in 2002

Qi'ao Island Mangrove Nature Reserve, Zhuhai, Guangdong Province, China



Why are Mangroves Important

- Protect shorelines from damaging winds, waves, and floods.
- Improve water quality by filtering pollutants and trapping sediments from the land,
- Reduce coastal erosion.
- Provide habitat for a diverse array of terrestrial organisms, and many species of coastal and offshore fish and shellfish rely exclusively on mangroves as their breeding, spawning, and hatching grounds.
- Local community livelihood, fishing, harvesting of clam, crabs,
- Tourism attraction, including **bird watchers**

To Get to Know bird-watchers in China

Predominantly Retired Males

Well-equipped

Cameras	Canon EOS 5D4, Sony a7m4, Sony a7r5
Zoom lens	Canon 100-400mm, Sigma 150-600mm, Sony 200-600mm, Sony 400-800mm (to be purchased)
Binocular	8X42, 10x50
Telescope	
Monopod	
Tripods	3
Drove	To be purchased
4WD vehicle	
Camping equipment	Tents, mattress, sleeping bags

Economical Capability

- Live on Pension and Savings
- Able and willing to pay travel, boarding costs for bird watching trips
- Keep buying state-of-the-the-art equipments

Numerous and Well-connected

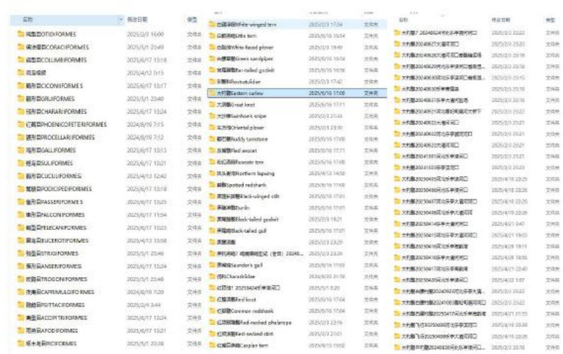
- 1 million bird watchers across the nation
- Bird watching societies at all levels
- Much more wildcat bird watchers connected by networking

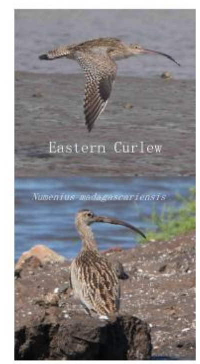
Devoted

- To watch birds full time, over-time
- Often drive hundreds even thousand of kilometers to explore new opportunities to watch birds

In possession of Huge Amount of Bird Information

	A	B	C	D	E	F
392			山鹨?	Upland pipit		需要查相片
393			水鹨	Water pipit	北京奥森	
394			黄腹鹨	Buff-bellied pipit		崖口，三乡，桥头村
395			红喉鹨	Red-throated pipit		崖口，三乡，桥头村
396		燕雀科Fringillidae	燕雀	Brambling		
397			苍头燕雀	Common Chaffinch		
398			锡嘴雀	Hawfinch		
399			黑尾蜡嘴雀	Chinese grosbeak		珠海北理工校园
400			黑头蜡嘴雀	Japanese grosbeak		
401			普通朱雀	Common rosefinch		校园，赤花山
402			北朱雀	Pallas's rosefinch	北京管庄公园	
403			金翅雀	Grey-capped greenfinch		
404			红交嘴雀?	Red crossbill	北京兴隆郊野公园	
405			白翅交嘴雀	White-winged crossbill	北京兴隆郊野公园	
406			黄雀	Eurasian siskin	山东临沂兰山区	山西广灵宛养
407	PASSERIFORMES	鹀科Emberizidae	小鹀	Little bunting		
408			黄喉鹀	Yellow-throated bunting		
409			黄胸鹀	Yellow-breasted bunting	珠海后环	中山三乡
410			田鹀	Rustic bunting	江苏仪征市	三乡
411			灰头鹀	Black-faced bunting		
412			芦鹀	Reed bunting	北京温榆河	
413			白眉鹀	Tristram's Bunting	河北乐亭滦河口	
414			栗耳鹀	Chestnut-eared bunting	内蒙古磴口县奈伦湖国家湿地公园	河北曹妃甸溯河河口
415			苇鹀	Pallas's bunting	内蒙古磴口县奈伦湖国家湿地公园	河北曹妃甸溯河河口
416			黄眉鹀	Yellow-browed Bunting	河北乐亭滦河口	北京国家植物园
417			栗鹀	Chestnut Bunting	大清河盐场鸟类救助站	
418			红颈苇鹀	Ochre-necked reed bunting	乐亭县滦河口	
419			铁爪鹀	Lapland bunting	乐亭县滦河口	
420						





Prolific

A few Exmaples

Common Shelducks
Asian Barred Owlet
Hen Harrier
Common Snipe
Common Tern
Greater Coucal
Verditer Flycatcher

An Eurasian Hobby Feeding on a Sparrow

A Common Snipe and a Green Sandpiper Feeding

Other Vertebrates

Chinese Strip-necked Turtle
Tilapia
Corsac Fox
Oriental Garden Lizard
Greater Bandicoot Rat
Spot-legged Treefrog
Chinese Cobra
Günther's Frog

Tell Me What You Want!

Mangroves are Heaven to Bird Watchers

- Mosaic of Different Micro-habitats
  - Open water body
  - Shallow water
  - Mudflats
  - Sand dunes
  - Farmlands
  - Woodlands
  - Artificial facilities like fish and shrimp ponds, salt pans
- Sea, fresh and brackish waters
- Food supply is daily replete by tidal water

Raw Data Received	Description	Quality
Wow! I saw some ducks.	Vague	Low
I spotted common shelducks	Qualitative	
I saw 1 male common shelducks.		
I saw 15 common shelducks.	Quantitative	
I saw 15 common shelducks, among them 2 adult females, 2 adult males, and 11 chicks.	Age, sex, breeding status	
I saw 15 common shelducks, 10 mallards, 30 red shanks, 6 spoonbills, 1 osprey.	Species diversity	
I saw 15 common shelducks, 10 mallards, 30 red shanks, 6 spoonbills, 1 osprey, on a 6-km transit line.	Density	
We saw 15 common shelducks, 10 mallards, 30 red shanks, 6 spoonbills, 1 osprey. on a 6-km transit line by Pond A, by a team of 2 bird watchers using binocular on foot between 05:30 – 07:30 May 30, 2025.	Methodology	
We saw 15 common shelducks, 10 mallards, 30 red shanks, 6 spoonbills, 1 osprey on a 6-km transit line by Pond A; 31 common shelducks, 20 mallards, 50 redshanks, 6 spoonbills, 1 osprey, 15 tufted pochards, 12 black-tailed godwits, 35 pied avocets on a 6-km transit line by Pond B, by a team of 2 bird watchers each using binocular on foot between 05:30 – 07:30 May 30, 2025.	Spatial variation	
We saw 15 common shelducks, 10 mallards, 30 red shanks, 6 spoonbills, 1 osprey on a 6-km transit line by Pond A by a team of 2 bird watchers each using binocular on foot between 05:30 – 07:30 May 30, 2025, a significant decline compared with the result of an identical survey on Mar 30, 2024 when 31 common shelducks, 20 mallards, 50 redshanks, 6 spoonbills, 1 osprey, 15 tufted pochards, 12 black-tailed godwits, 35 pied avocets were recorded.	Temporal Variation	High

From Raw Data to Parameters with Conservation Application

Qualitative Data	Presence/absence	(1,0,0,1,1,0,1,1,0,1), 6/10=60%	Possibility of occurrence
		Found only in March-May, Sept - Oct	Migrant species
		Found in 30 out of 100 plots (1ha)	Distribution range
	Gender	(M,F,F,F,M,F,F,M,F,F,F)	Sex ration = M:F = 3:7
	Failure/success	(1,1,1,0,0,0,1,0,0,1)	Breeding performance
Quantitative Data			Population size, range, density
			Species diversity
			Age group
			Reproduction Rate
			Mortality
			.....

How to Use the Parameters: to Test Hypothesis

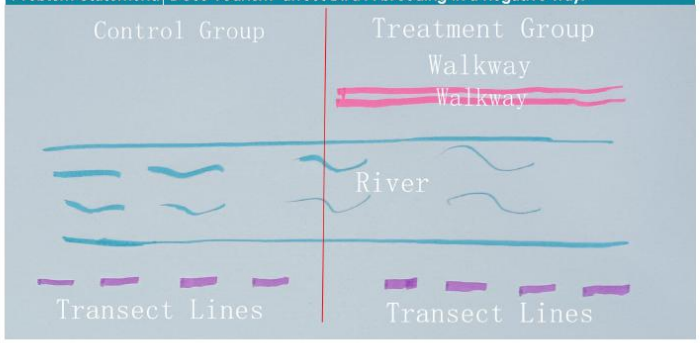
Problem:	Is Subject A different from Subject B?
Hypothesis	Ho: A = B
	Ha: A ≠B
Test hypothesis	The kind of data to be collected: weight, length, volume, speed,
	Take measures (n=10)
	Compile and analyze data:
	Statistical test:
Conclusion	Reject Ho, Accept Ha

To Tell the Difference: Exercise One

Problem Statement:	Which is a better place to see common shelducks, Pond A or Pond B?
Hypothesis	Ho: There is equal chance to find common shelducks at Pond A and Pond B;
	Ha: The chance is different to find common shelducks at Pond A and Pond B.
Test hypothesis	The kind of data to be collected: the numbers of visits that finds common shelducks.
	Take measures: Pond A (1,0,1,1,0,1,1,1,1,1) (n=10) 8/10 = 80%
	Pond B (0,1,0,0,1,0,0,0,1,0) (n=10) 3/10 = 30%
	Compile and analyze data: The chance to see common shelducks at Pond A is 8/10 = 80%; and 30% at Pond B.
	Statistical test:
Conclusion	Accept Ha: The chance is different to find common shelducks at Pond A and Pond B.
Conservation application	Pond A would be a better place to set up a bird watching site for common shelducks

To Establish Causal Effects: Exercise Two

Problem Statement:	Does Tourism affect Bird A breeding in a negative way.



To Establish Causal Effects: Exercise Two

Problem Statement:	Does Tourism affect Bird A breeding in a negative way.
Hypothesis	Ho: Tourism has no effect on the breeding of Bird A;
	Ha: Tourism has a negative effect on the breeding of Bird A.
Test hypothesis	To count the number of active nests (number of chicks hatched, fledged etc) on transect lines in treatment and control groups, respectively.
	Take measures: number of nests in control group (25, 31, 32, 40)
	number of nests in treatment group (5, 8, 2, 5)
	Average in control group = 32; average in treatment group = 5
	Statistical test:
Conclusion	Accept Ha: Tourism has a negative effect on the breeding of Bird A.
Conservation application	To reduce volume of visitation, demolish walkways, and to scrutinize suggestion to put up more walkways more carefully.

How can Bird Watchers Help?

Contribution	Management Appplications
Provision of graphic, audio-video materials	Production of educational, promotional publications
	Educational and public awareness campaigns
	Scientific Journals, news letter, website
Technical Assistance	Bird Watching tour guide
	Natural Interpretation guide
	Bird watching contests
Collection of data to guide management measures	Baseline survey
	Scientific Research
	Decision-making
	Environmental and Socio-economic Impact Assessment
	Assessment of specific management measures,
	general performance evaluation

Labor-division between Mangrove Managers and Birdwatchers

Mangrove Managers

- To design project based on goal and objectives, resources, time frame and technical knowhow;
- To decide on the data required and methodology to collect them;
- To compile, collate and analyze data coming in;
- To reach conclusion according to the project results;
- To take adequate interventions.

Bird Watchers

- To identify and record the species of birds, numbers, sex, age, breeding status at designated time and sites.

Activities by Mangrove Managers to Ensure Successful Cooperation

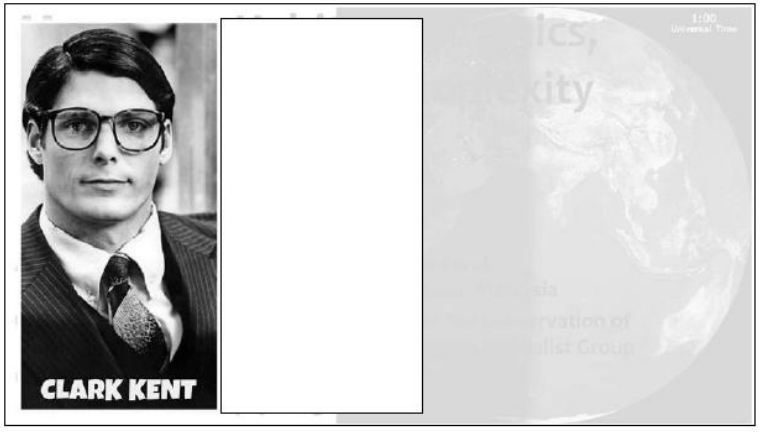
- Timely and Full Communications
- Training in Data Collection, Methodology
- Project Ownership
- Necessary Logistic Support
- Rewards, like chance to bird watching Perks, e.g., areas not open to general public
- Acknowledgement

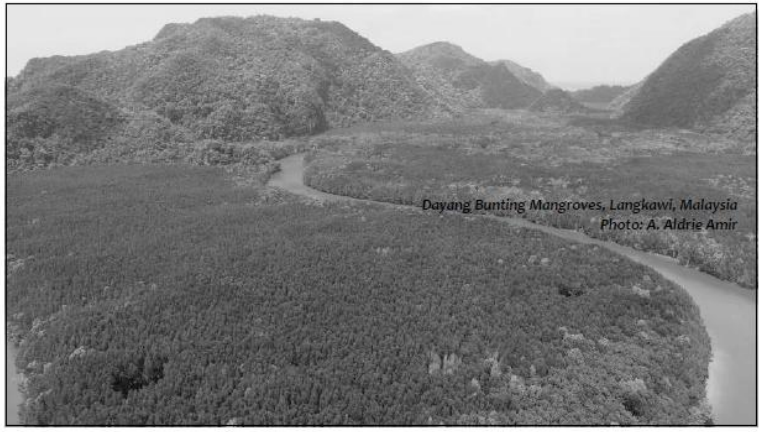

TO AIM HIGH
Black-winged Kite
Elanus caeruleus
THANK YOU

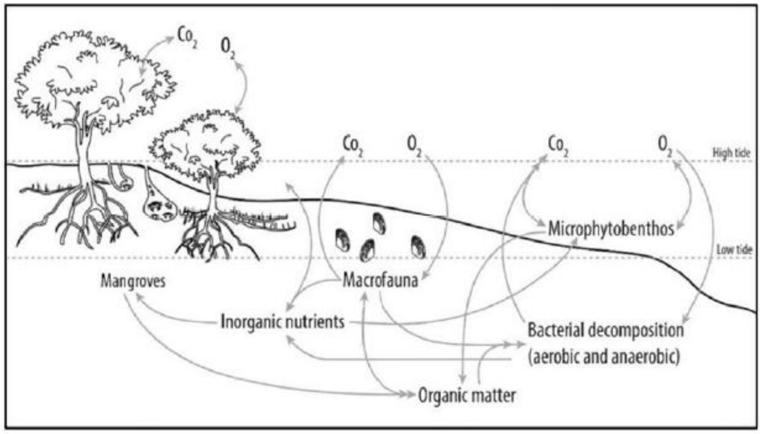
LECTURE 8: MANGROVE HABITAT DYNAMICS, CONNECTIVITY AND COMPLEXITY

1


3







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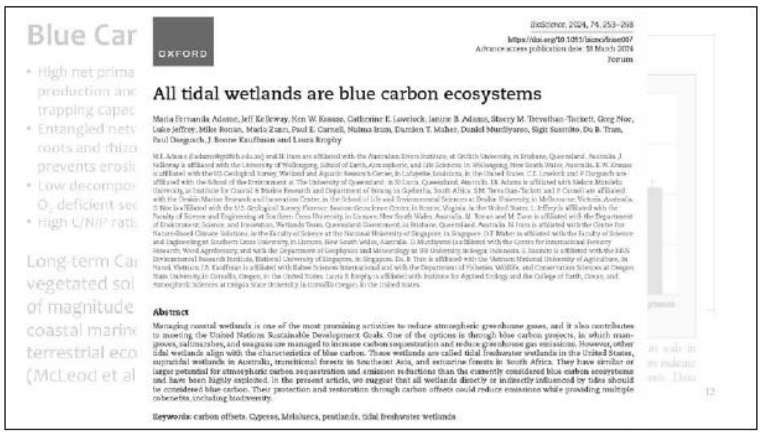

BioScience, 2024, 74, 253–268
Advance access publication date: 18 March 2024
Forum

All tidal wetlands are blue carbon ecosystems

Abstract

Managing coastal wetlands is one of the most promising activities to reduce atmospheric greenhouse gases, and it also contributes to meeting the United Nations Sustainable Development Goals. One of the options is through blue carbon projects, in which mangroves, saltmarshes, and seagrass are managed to increase carbon sequestration and reduce greenhouse gas emissions. However, other tidal wetlands align with the characteristics of blue carbon. These wetlands are called tidal freshwater wetlands in the United States, supratidal wetlands in Australia, transitional forests in Southeast Asia, and estuarine forests in South Africa. They have similar or larger potential for atmospheric carbon sequestration and emission reductions than the currently considered blue carbon ecosystems and have been highly exploited. In the present article, we suggest that all wetlands directly or indirectly influenced by tides should be considered blue carbon. Their protection and restoration through carbon offsets could reduce emissions while providing multiple cobenefits, including biodiversity.

Keywords: carbon offsets, Cypress, Melaleuca, peatlands, tidal freshwater wetlands

Inland or freshwater wetlands

- Rivers and streams
- Riverine floodplains
- Freshwater lake
- Freshwater ponds (>8ha)
- Marshland
- Freshwater swamp
- Peat swamp forests
- *Melaleuca* forests
- Other swamps
- Freshwater springs

Coastal and Marine Wetlands

- Marine waters
- Subtidal aquatic beds
- Seagrass beds
- Seaweed beds
- Coral reefs
- Rocky shores
- Sandy beaches
- Mangrove forests
- Salt marshes
- Lagoons and bays
- Intertidal mud and sand flats

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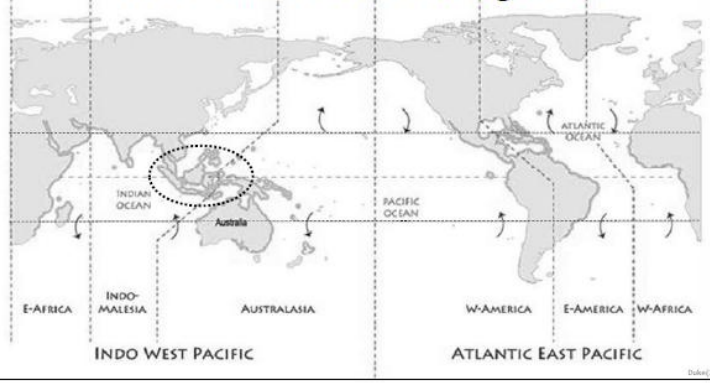
Man-made or Constructed Wetlands

- Water storage areas;
  - reservoirs
  - barrages
  - hydroelectric dams
- Aquaculture;
  - fish ponds
  - shrimp ponds
- Excavations;
  - mining pools
- Wastewater treatment;
  - sewage farms
  - settling ponds
  - oxidation ponds
- Irrigated land (incl. channels);
  - rice field
  - canals
  - ditches
- Other ponds (>8 ha);
  - farm ponds
  - ash ponds
  - stock ponds
- Constructed wetlands;
  - marsh
  - ponds
  - lakes
  - saltwater lakes

The Distribution of Mangroves



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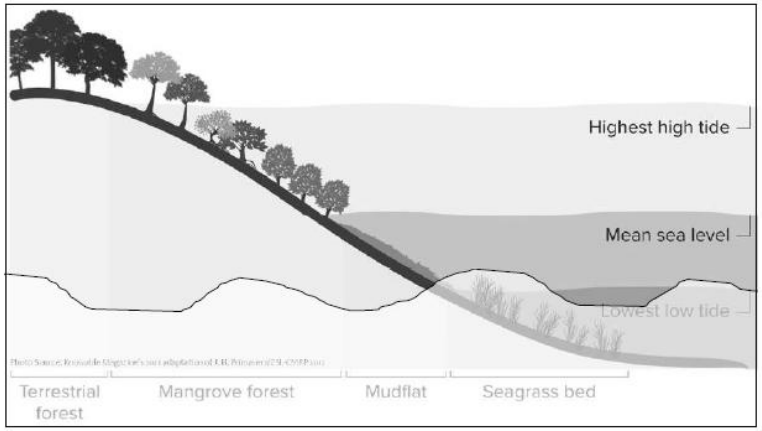
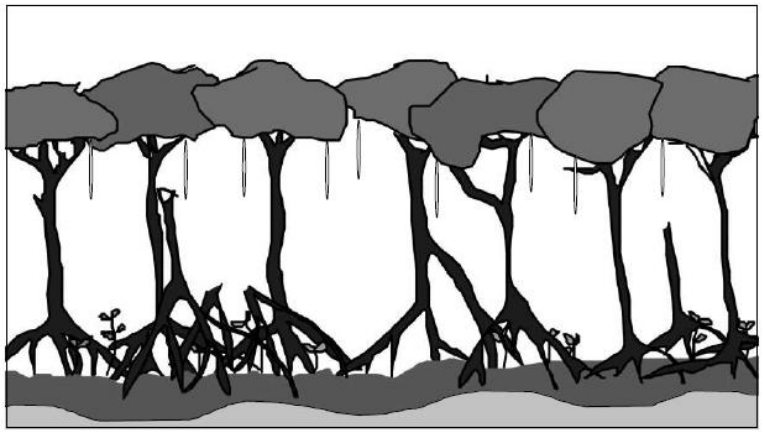



reproductive
uce by bearing
edlings, an adaptation
ally flooded coastal
y at sea before
, vivipary plus seeds
for living
sediments.

13




XYZ Mangrove Island, Malaysia
Photo: A. Aldrie Amir

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XYZ Mangrove Island, Malaysia
Photo: A. Aldrie Amir


XYZ Mangrove Island, Malaysia
Photo: A. Aldrie Amir

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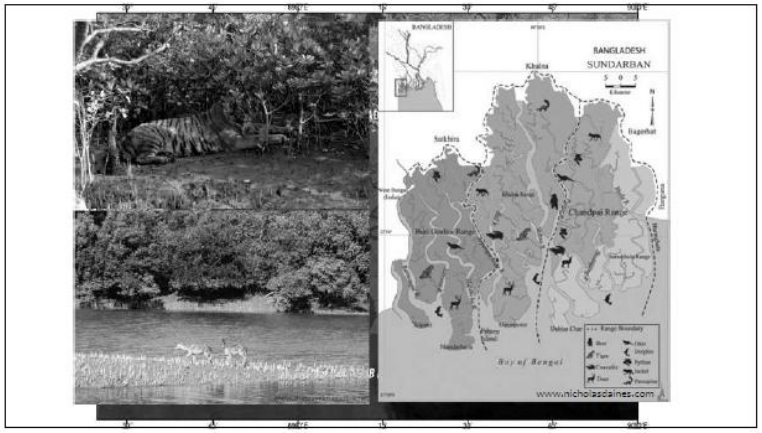
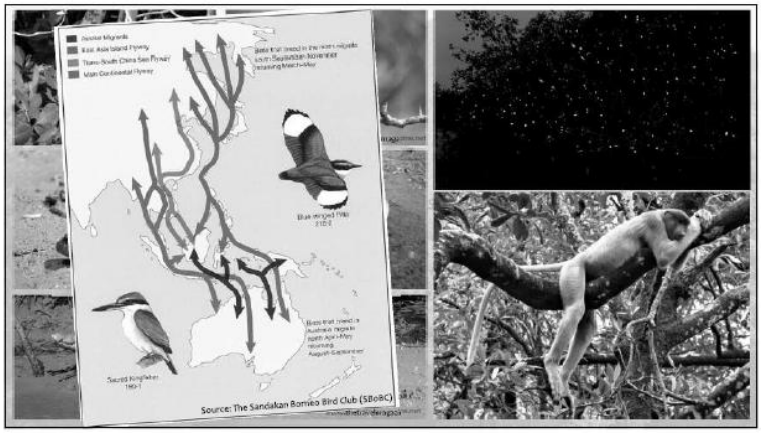
Kubang Badak Mangroves, Langkawi, Malaysia
Photo: A. Aldrie Amir

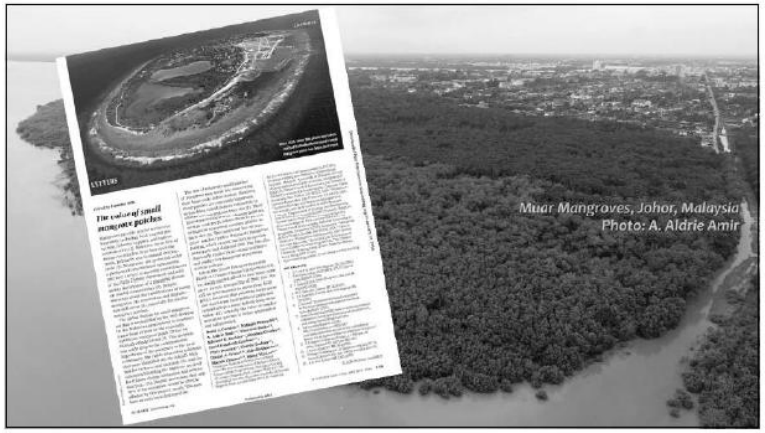

Cyclone Yaas: Two dead in Odisha, embankments damaged in Sundarbans as landfall process wraps up

21

23


BANGLADESH
SUNDARBAN
Khulna
Sukhira
Bagerhat
Chandpai Range
Bay of Bengal
www.nicholasdaines.com


Source: The Sandakan Borneo Bird Club (SBoBC)


Muar Mangroves, Johor, Malaysia
Photo: A. Aldrie Amir

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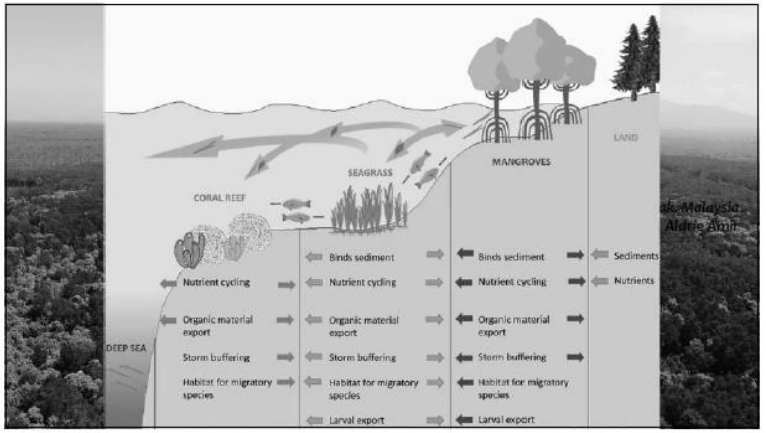
LAND
MANGROVES
SEAGRASS
CORAL REEF
DEEP SEA
Binds sediment
Nutrient cycling
Organic material export
Storm buffering
Habitat for migratory species
Larval export
Sediments
Nutrients

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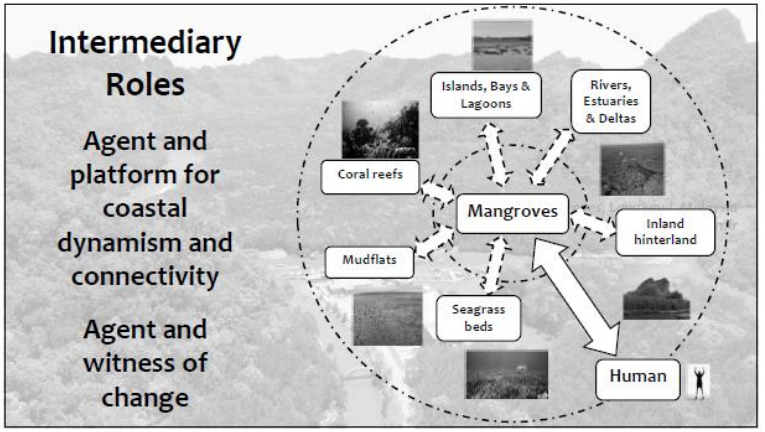
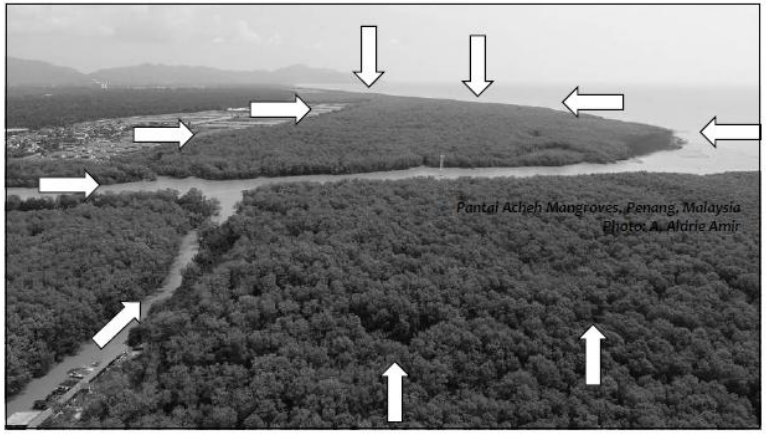
Seri Buat Mangroves, Pahang, Malaysia
Photo: A. Aldrie Amir


Intermediary Roles
Agent and platform for coastal dynamism and connectivity
Agent and witness of change
Islands, Bays & Lagoons
Rivers, Estuaries & Deltas
Coral reefs
Mangroves
Inland hinterland
Mudflats
Seagrass beds
Human


Pantai Acheh Mangroves, Penang, Malaysia
Photo: A. Aldrie Amir

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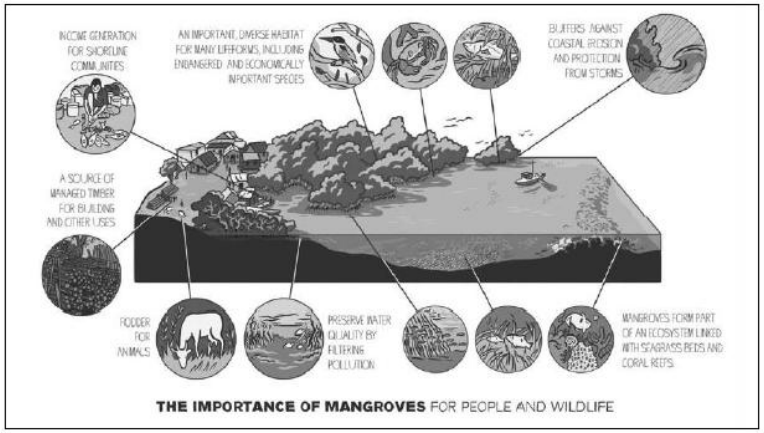
INCOME GENERATION FOR SHORELINE COMMUNITIES
AN IMPORTANT, DIVERSE HABITAT FOR MANY LIFEFORMS, INCLUDING ENDANGERED AND ECONOMICALLY IMPORTANT SPECIES
BUFFERS AGAINST COASTAL EROSION AND PROTECTION FROM STORMS
A SOURCE OF MANAGED TIMBER FOR BUILDING AND OTHER USES
FODDER FOR ANIMALS
PRESERVE WATER QUALITY BY FILTERING POLLUTION
MANGROVES FORM PART OF AN ECOSYSTEM LINKED WITH SEAGRASS BEDS AND CORAL REEFS
THE IMPORTANCE OF MANGROVES FOR PEOPLE AND WILDLIFE


PORTWELD
KTM
1885
KTM

31

Malaysia's major cities, towns and districts are on the coast

33

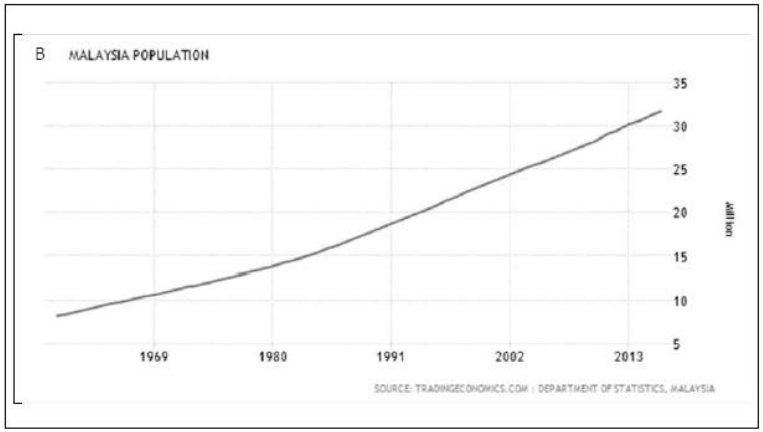

Table 2. Percentage of the total deforested mangrove (2000–2012) converted to different land uses

Country	Aquaculture	Rice	Oil palm	Mangrove forest	Urban	Other category
Indonesia	48.6	0.1	15.7	22.6	1.9	11.2
Myanmar	1.6	87.6	1.1	0.5	1.6	7.6
Malaysia	14.7	0.1	38.2	17.6	12.8	16.7
Thailand	10.8	5.6	40.0	5.1	14.4	24.1
Philippines	36.7	0.9	11.1	7.3	2.7	41.3
Cambodia	27.7	1.5	8.9	9.8	4.6	47.6
Vietnam	21.0	10.4	0.5	0.6	62.5	4.9
Brunei	29.2	0	27.7	12.5	15.9	14.8
Timor-Leste	0	26.1	0	0	0	73.9*
Singapore	0	0	0	0	0	0
Total	29.9	21.7	16.3	15.4	4.2	12.3

Countries are ordered by total mangrove lost. Percentages might not sum to 100 owing to rounding.
*The small amount of mangrove deforestation in Timor-Leste is due mainly to shoreline erosion.

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Anthropogenic Disturbances

- Excessive logging
- Toxic chemicals runoff
- Reclamation (agriculture, aquaculture)
- Mining for peat, coal, sand, gravel, etc.
- Excessive siltation and deposition
- Impoundment
- Wash and erosion
- Long-term flooding
- Oil spills


Balik Pulau Mangroves, Penang, Malaysia
Photo: A. Aldrie Amir

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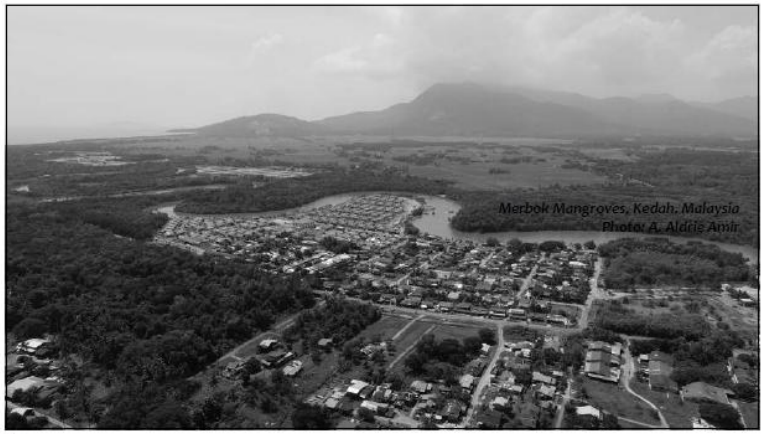
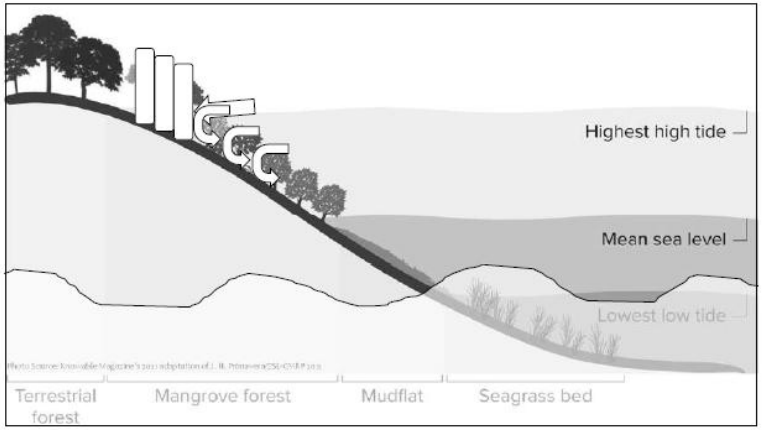

Merbok Mangroves, Kedah, Malaysia
Photo: A. Aldrie Amir

39


Bukit Malut Mangroves, Langkawi, Malaysia
Photo: A. Aldrie Amir


Sungai Pulai Mangroves, Johor, Malaysia
Photo: A. Aldrie Amir


Highest high tide
Mean sea level
Lowest low tide
Terrestrial forest
Mangrove forest
Mudflat
Seagrass bed

41


Sungai Kertih Mangroves, Terengganu, Malaysia
Photo: A. Aldrie Amir

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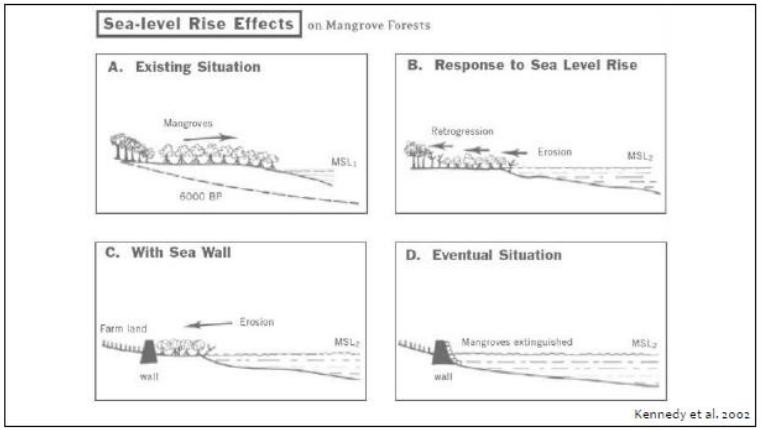
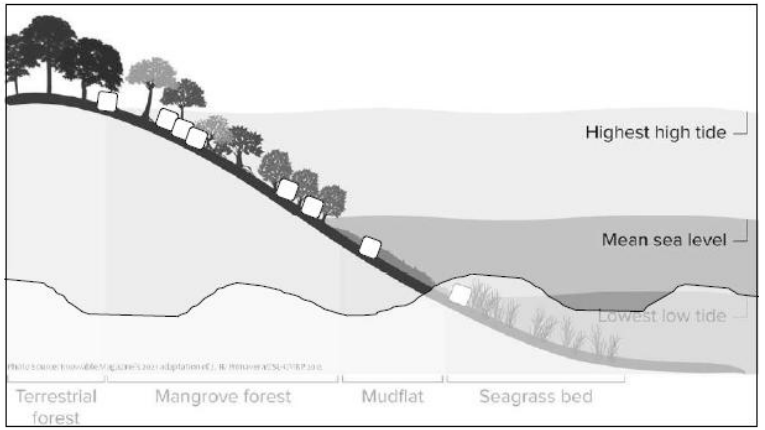
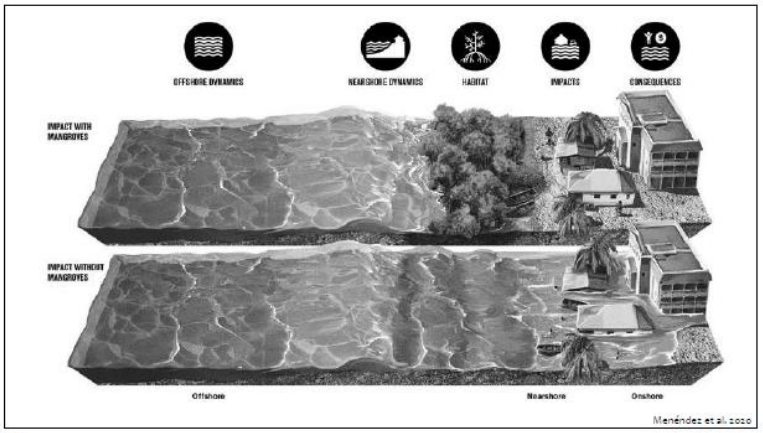

Sea-level Rise Effects on Mangrove Forests
A. Existing Situation
Mangroves
MSL1
6000 BP
B. Response to Sea Level Rise
Retrogression
Erosion
MSL2
C. With Sea Wall
Farm land
Erosion
MSL2
wall
D. Eventual Situation
Mangroves extinguished
MSL2
wall
Kennedy et al. 2002


Highest high tide
Mean sea level
Lowest low tide
Terrestrial forest
Mangrove forest
Mudflat
Seagrass bed

45


OFFSHORE DYNAMICS
NEARSHORE DYNAMICS
HABITAT
IMPACTS
CONSEQUENCES
IMPACT WITH MANGROVES
IMPACT WITHOUT MANGROVES
Offshore
Nearshore
Onshore
Menéndez et al. 2020

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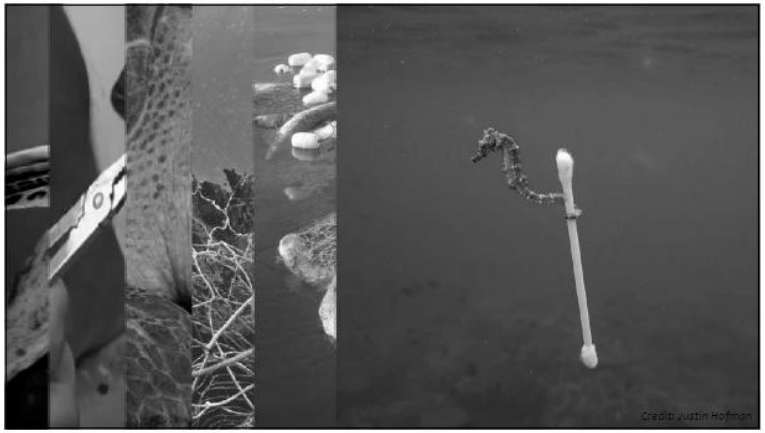
Credit: Justin Hofman


Matang Mangroves, Perak, Malaysia
Photo: A. Aldrie Amir

1. Continental Shelf Act (1966) (Revised 1972)
2. Economic Exclusive Zone Act (1984)
3. Environmental Quality Act (1974) (Amended 2012)
4. Fisheries Act (1985)
5. Five-Fuel Policy (2001)
6. Four-Fuel Diversification Policy (1981)
7. Green Technology and Climate Change Council (2010)
8. Land Conservation Act 1960 (revised 1989)
9. Local Government Act 1976
10. Low Carbon Cities Framework (2011)
11. National Agricultural Policies (NAP 1-3)
12. National Agro food Policy (2011)
13. National Automotive Policy (2014)
14. National Biofuel Policy (2006)
15. National Coastal Zone Physical Plan (2012)
16. National Depletion Policy (1980)
17. National Energy Policy (1979) (Revised 2008)
18. National Forestry Act (1984) (Amended 1993)
19. National Forestry Policy (1978) (Revised 1992)
20. National Green Technology Policy (2009)
21. National Integrity Plan (2004)
22. National Parks Act 1980 (Updated 2013)
23. National Petroleum Policy (1975)
24. National Physical Plans
25. National Policy on Biological Diversity (2016)
26. National Policy on Climate Change (2009)
27. National Policy on the Environment (2002)
28. National Strategic Plan for Solid Waste Management (2005)
29. National Water Resources Policy (2012)
30. National Wetlands Policy (Draft)
31. New Economic Model, Government Transformation Program and Economic Transformation Program (2010)
32. Protection of Wild Life Act 1972
33. Renewable Energy Policy and Action Plan (2010)
34. Sabah Biodiversity Enactment (2000)
35. Sabah Parks Enactment (1984) (2008)
36. Sabah Wildlife Conservation Enactment (1997)
37. Sarawak Forests Ordinance (1958) (Amended 2015)
38. Sarawak Wildlife Protection Ordinance (1998)
39. Street, Drainage and Building Act 1974 (Amended 2006)
40. Territorial Sea Act (2012)
41. Town and Country Planning Act 1976 (Amended 2006)
42. Waters Act (1920) (Revised 1989)

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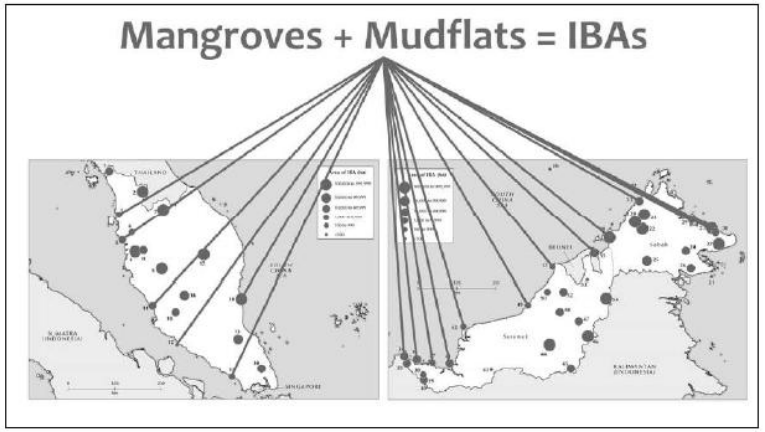

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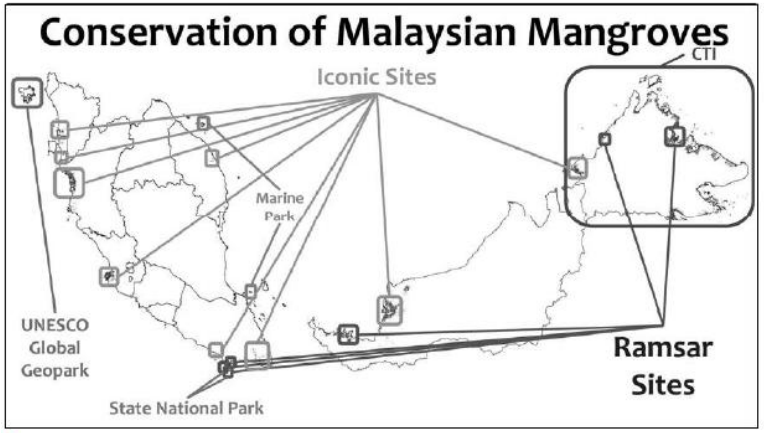

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Natural Disturbances

- Severe winds and gusts
- Hurricane, storm
- Hail
- Lightning strikes
- Tidal surges, tsunami
- Severe herbivory
- Drought

Disturbance	Causes	Impact	Location	Mean Gap Size	Reference
Natural	Lightning strike	Small to large gaps	Everglades, Florida	332 m²	Whelan and Smith, 2004
			Everglades, Florida	283 m²	Wheler, 2005
			Moreton Bay, Queensland	86.2 m²	Amir, 2011
			Pulau Kecil, Matang, Malaysia	1763.1 m²	Amir, 2013
			Kosrae, Micronesia	~700 m²	Allen et al., 2001
			Los Haitises, Dominican Republic	734 m²	Sherman et al., 2000
			Punta Galeta, Panama	626.6 m²	Sousa and Mitchell, 1999
			Punta Galeta, Panama	529 m²	Sousa et al., 2003
			Everglades, Florida	55 m²	Zhang, 2008 Zhang et al., 2008
			Galley Reach, Papua New Guinea	~1500 m²	Johns, 1986
			Galley Reach, Papua New Guinea	1300-700 m²	Putmans and Rollet, 1977
	Insect	Small gaps	Central Belize	12 m² (Ag) 72 m² (Rma)	Feller and McKee, 1999
			Matang, Malaysia	-	Putz and Chan, 1986
	Hurricane	Major dieback	Everglades, Florida	-	Smith et al., 1994
		Major dieback	Rio Del Venado, Nicaragua	-	Roth, 1992
		Patches of gaps	Los Haitises, Dominican Republic	~700 m²	Sherman et al., 2001
	Hail	Major dieback	Port Curtis, Queensland	1649 ha	Hopkins, 1993
	Tree-fall / Branch-fall	Small gaps	Rarong, Thailand	1442 m²	Imai et al., 2006
		Small gaps	Kosrae, Micronesia	64.4 m²	Pinzon et al., 2003
	Severe drought	Major dieback	Gulf of Carpentaria, Australia	7900 ha	Duke et al., 2017
	Crown shyness	Channel-like gaps between canopy crowns	Parque Nacional de Santa Rosa, Guanacaste, Costa Rica	0.9-5 m width	Putz et al., 1984
Anthropogenic	Small-scale Cutting	Patches	Kosrae, Micronesia	-	Allen et al., 2001
		Small gaps	Kosrae, Micronesia	158 m²	Ewel et al., 1998
		Patches	Kosrae, Micronesia	-	Hauff et al., 2006
		Small to large patches	Metinaro, Timor Leste	-	Alongi and de Carvalho, 2008
		Small gaps	Bais Bay, The Philippines	2.6 m²	Walters, 2005
		Large gap	Somone, Senegal	1.4 km²	Sakho et al., 2011
	Logging	Small to large gaps	Kosrae, Micronesia	114 m²	Pinzon et al., 2003
		Large gaps	Matang, Malaysia	41.4 ha	Muda and Mustafa, 2003
	Oil Spill	Major dieback	Bahia Las Minas, Panama	307 ha	Duke et al., 1997
	Experiment	Small gaps	North Queensland	50 m² & 225 m²	Clarke, 2004

Amir & Duke 2019 ECSS

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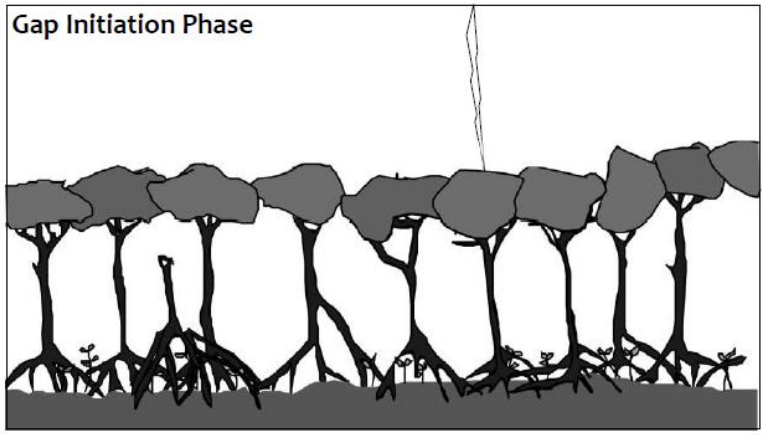

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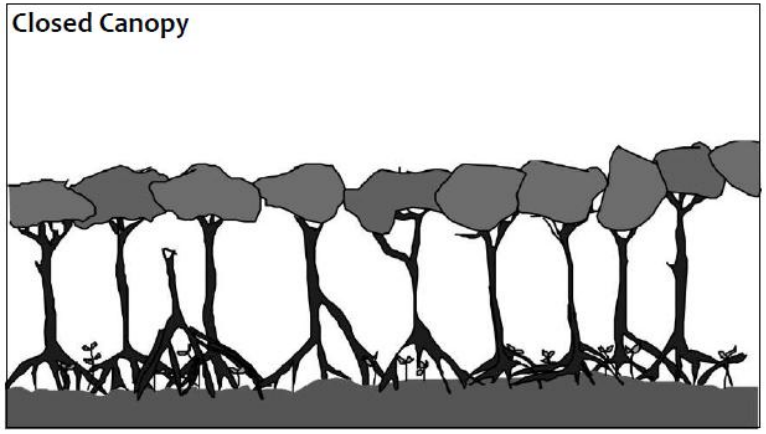
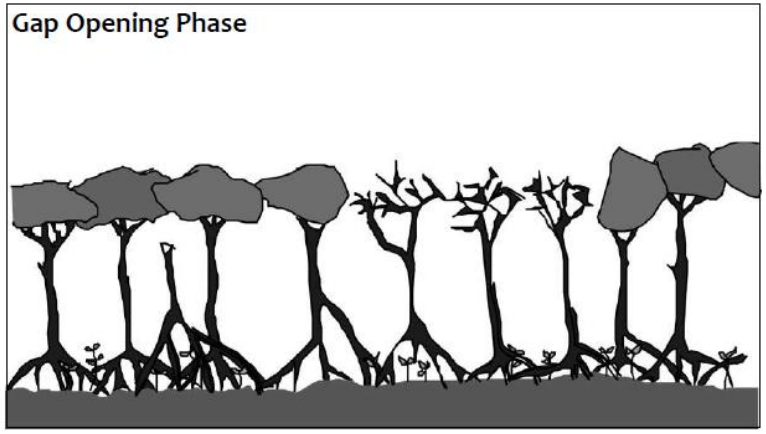
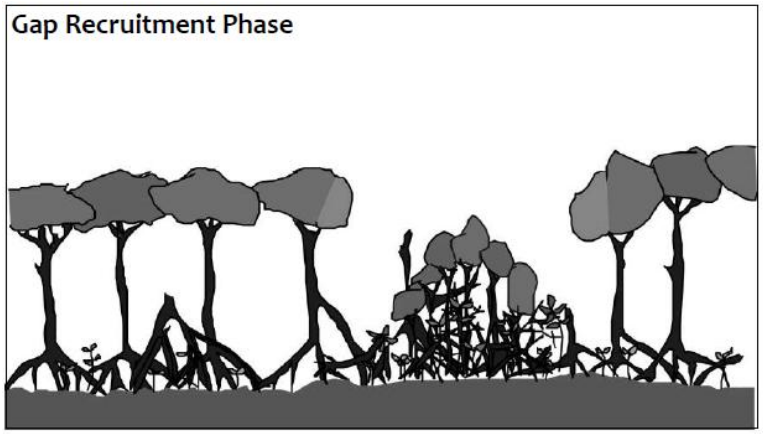
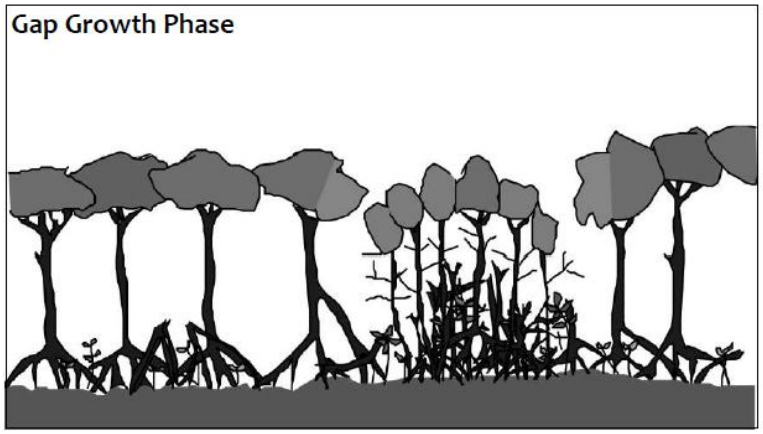
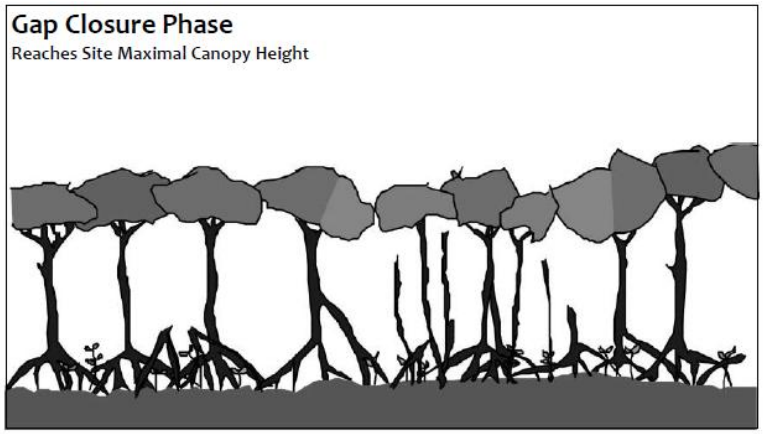




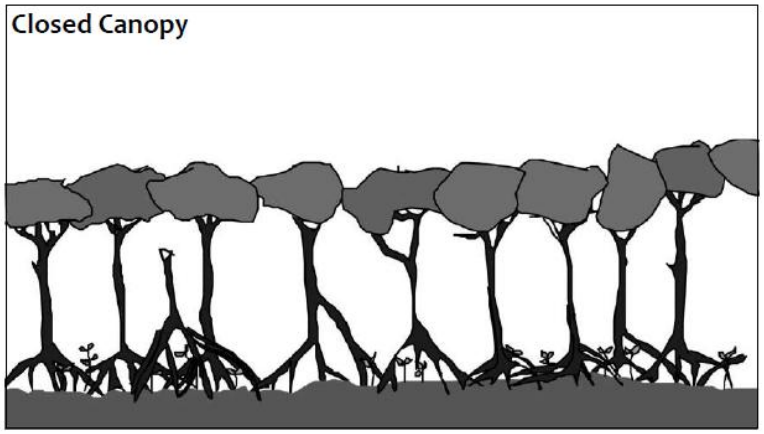

Gap Recruitment Phase

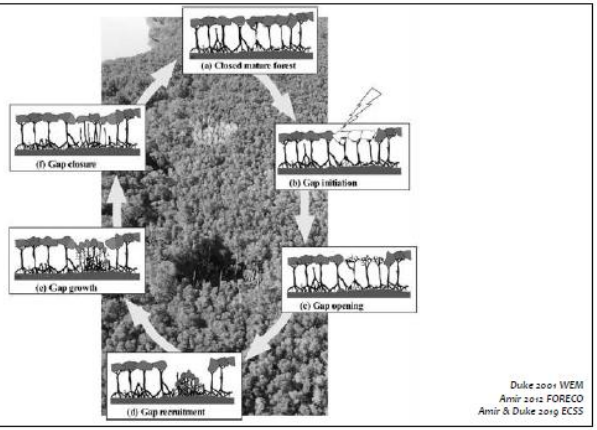
61


Gap Growth Phase


Gap Closure Phase
Reaches Site Maximal Canopy Height

63


Closed Canopy



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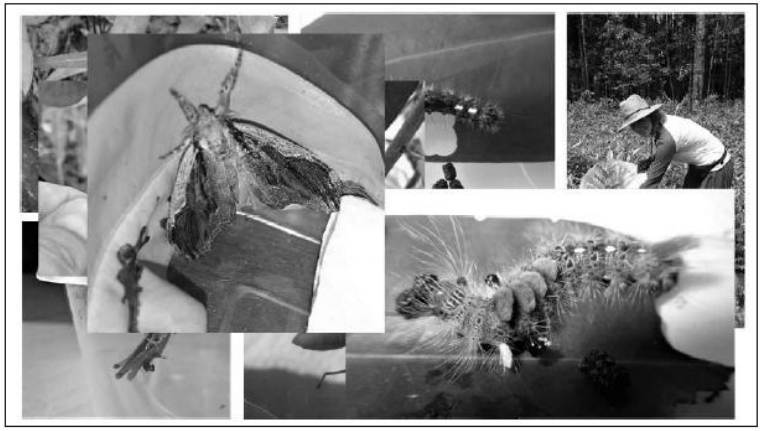

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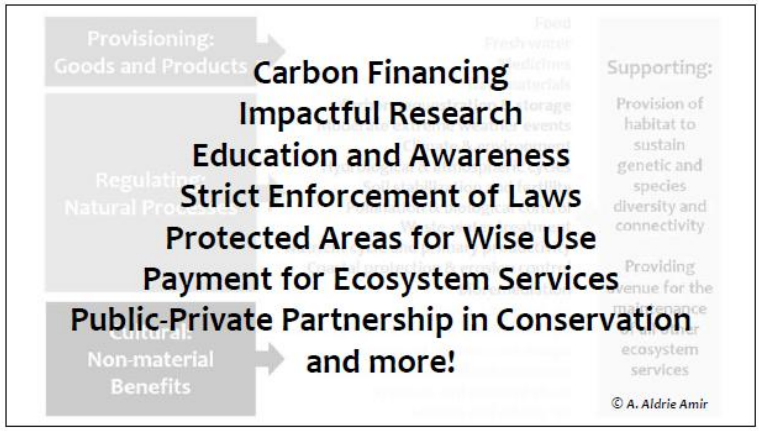
- Canopy gaps create opportunities for seedlings to progress
- Mangroves naturally rejuvenate through continuous dynamics of gap creation, thus maintaining the youth conditions
- An indication of healthy habitat dynamics

^ strike, ^ gap frequency
If, gap creation > gap recovery
Δ ecosystem collapses

Community-Based Ecological Mangrove Restoration


Provisioning:
Goods and Products
Carbon Financing
Impactful Research
Education and Awareness
Strict Enforcement of Laws
Protected Areas for Wise Use
Payment for Ecosystem Services
Public-Private Partnership in Conservation
and more!
Supporting:
Provision of habitat to sustain genetic and species diversity and connectivity
Providing avenue for the ecosystem services
Cultural:
Non-material Benefits
© A. Aldrie Amir

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Public Perceptions of Mangrove Forests Matter for Their Conservation

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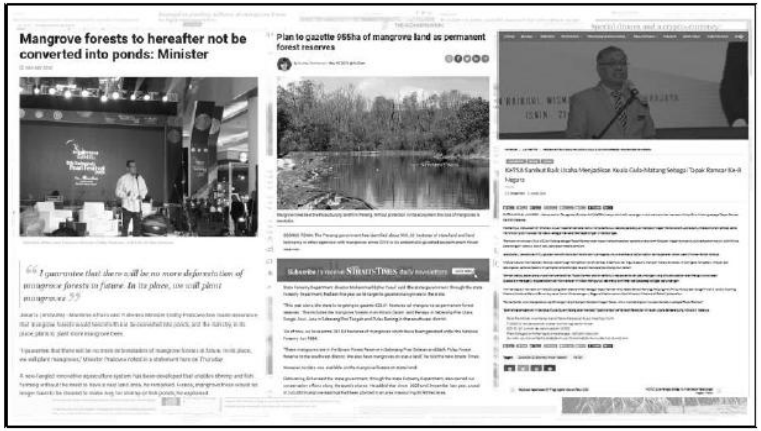
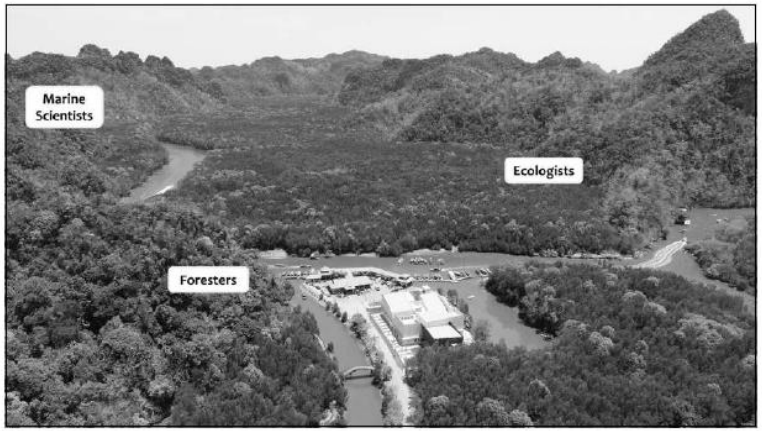

Mangrove forests to hereafter not be converted into ponds: Minister
Plan to gazette 955ha of mangrove land as permanent forest reserves


Marine Scientists
Ecologists
Foresters

73

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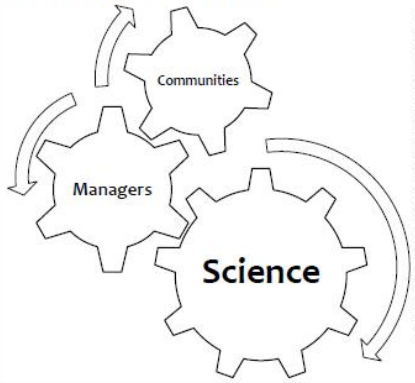
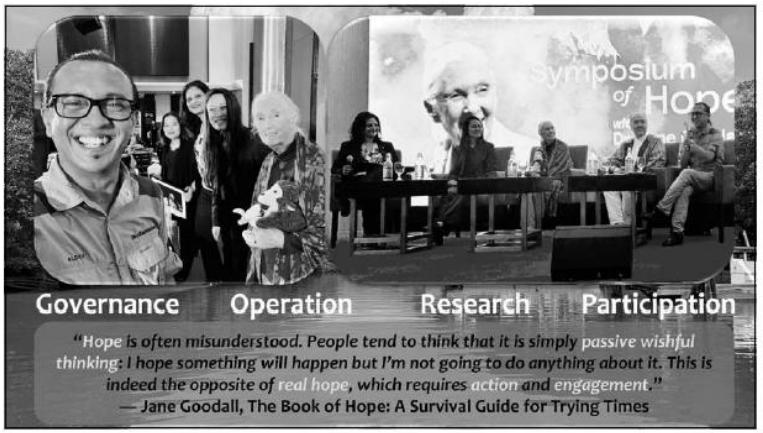
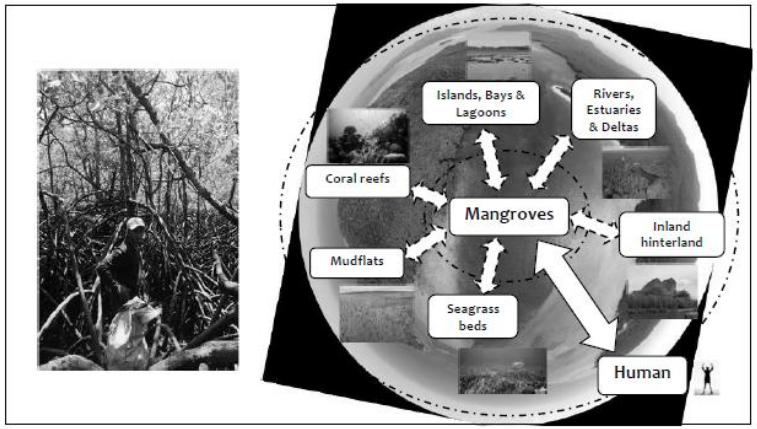
The Ways Forward



- Build stronger capacity in research, management, conservation, restoration, enforcement;
- Translate science & policies into actions;
- Propaganda – High impact education and awareness programs and marketing;
- Strengthen coordination, involvement and partnerships by and with all stakeholders;
- Enhance technical capacity & capability – CBRM;
- Incentivise protection of BC ecosystems, systematic national & global funding mechanism.





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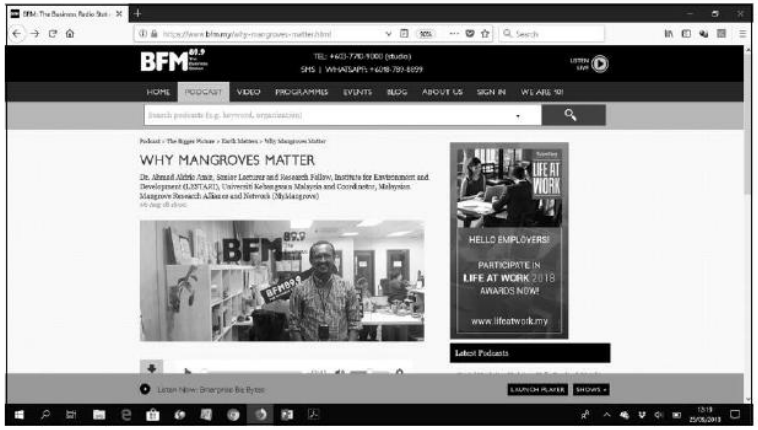
LETTERS

MASS TOURISM HURTS MANGROVES

14 OPINION

PROTECTING OUR MANGROVES AND COASTAL WETLANDS

79



OPINION

THERE'S BENEFIT IN THEM MANGROVES

LETTERS

The value of small mangrove patches


LETTERS

Shortfin mako sharks threatened by inaction

Mitigate risk for Malaysia's mangroves

India's Ph.D. scholar outreach requirement

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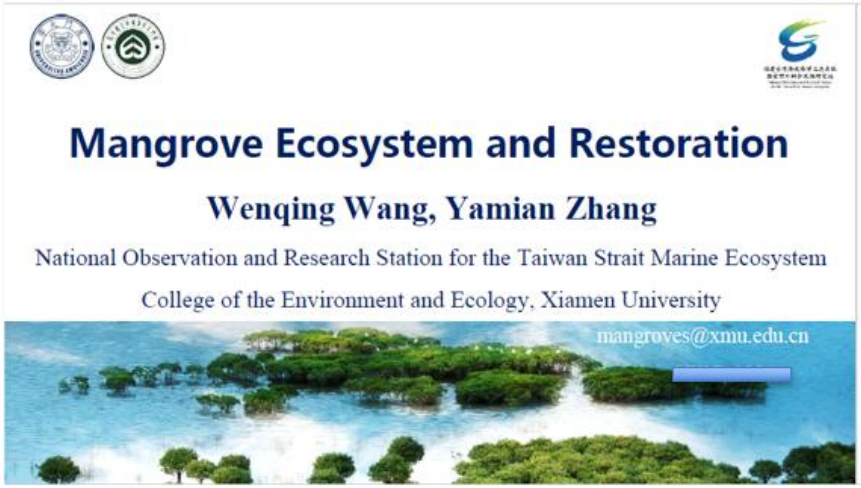
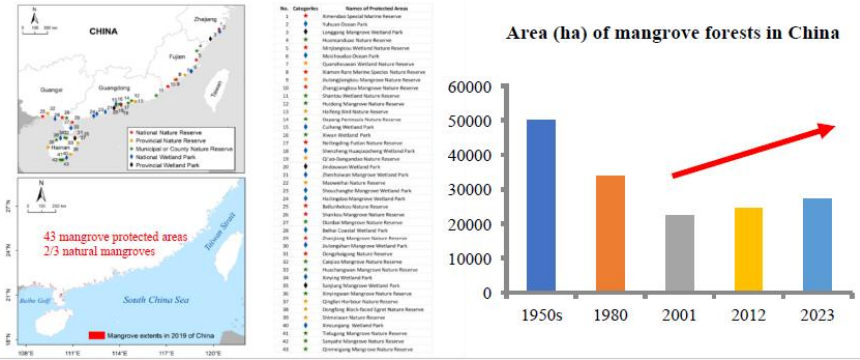
LECTURE 9: INTRODUCTION TO MANGROVE ECOSYSTEM AND RESTORATION PRACTICE



1 Background

福建台湾海峡海洋生态系统 National Observation and Research Station for the Taiwan Strait Marine Ecosystem

Main reasons: strict protection and large-scale afforestation



国家林业和草原局
国家公园管理局

搜索

Special action for mangrove protection and restoration (2020-2025)

自然资源部 国家林业和草原局关于印发
《红树林保护修复专项行动计划（2020-2025年）》的通知

自然资发〔2020〕135号

1 Background

福建台湾海峡海洋生态系统 National Observation and Research Station for the Taiwan Strait Marine Ecosystem

Special action for mangrove protection and restoration (2020-2025)
(Promulgated in August, 2020)

Afforestation: 9050 ha

Degradated mangrove forest restoration: 9750 ha

Coastal shelterbelt system construction project plan (2016-2025)
(Promulgated in May, 2017)

Afforestation: 48650 ha

1 Background

福建台湾海峡海洋生态系统 National Observation and Research Station for the Taiwan Strait Marine Ecosystem

Special action for mangrove protection and restoration (2020-2025)

Before 2020 | **Since 2020**

Increase mangrove area

- Mangrove forest area (as appropriate)
- Biodiversity
- Quality of the ecosystem
- Capacity to supply ecological products

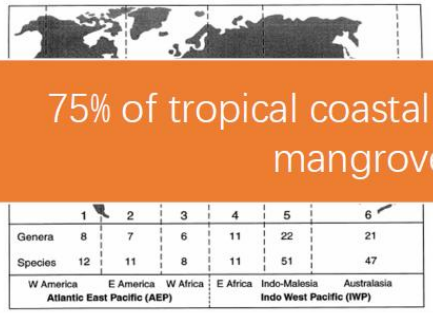
Agenda

- Background
- Rethinking mangrove biodiversity
- Mangrove protection and restoration in China

2 Rethinking mangrove biodiversity

Mangroves are low biodiversity

Mangrove species distribution



Mangrove species diversity in

et al. 1991).

75% of tropical coastal line is occupied by 80 mangrove species.

2 Rethinking mangrove biodiversity

Mangroves are low biodiversity

Mangrove area and true mangrove species diversity (Luther et al., 2009)

Region	Mangrove area (km²)	Mangrove genera	Mangrove species
Atlantic-Caribbean-Eastern pacific	68000		
Eastern Pacific	12000	4	7
West Atlantic-Caribbean	32000	3	6
Western Africa	24000	3	5
Indo-West Pacific	83000		
East Africa	8000	8	9
Indo-Malaysia	60000	17	39
Australasia	15000	16	35

2 Rethinking mangrove biodiversity

Mangroves are low biodiversity

- Mangrove forest in Guangxi, China
- Total area: 230 ha
- 1 mangrove species: *Avicennia marina*

2 Rethinking mangrove biodiversity

Mangroves species distribution in China

	Fujian	Guangdong	Guangxi	Hainan	Hong Kong	Macau	Taiwan	IUCN
Kandelia obovata	√	√	√	√	√	√	√	LC
Bruguiera gymnorhiza	√	√	√	√	√		Ex	LC
Bruguiera sexangula				√				NT
B. s. var. *rhynchopetala*	√			√				VU
Rhizophora stylosa		√	√	√	Ex		√	LC
Rhizophora apiculata				√				VU
R. lamarkii				√				CR
Ceriops tagal			Ex	√			Ex	LC
Pemphis acidula				√			√	EN
Sonneratia caseolaris				√				NT
S. × *gulngai*				√				EN
S. × *hainanensis*				√				CR
Sonneratia ovata				√				CR
Sonneratia alba				√				LC

2 Rethinking mangrove biodiversity

Mangroves species distribution in China

	Fujian	Guangdong	Guangxi	Hainan	Hong Kong	Macau	Taiwan	IUCN
Xylocarpus granatum				√				VU
Lumnitzera racemosa		√	√	√	√		√	LC
Lumnitzera littorea				√				CR
Acanthus ilicifolius	√	√	√	√	√	√	√	LC
Acanthus ebracteatus		√	√	√				EN
Scyphiphora hydrophyllacea				√				EN
Acrostichum aureum	Ex	√	√	√	√	√	√	LC
Acrostichum speciosum		√		√				EN
Nypa fruticans				√				VU
Avicennia marina	√	√	√	√	√	√	√	LC
Aegiceras corniculatum	√	√	√	√	√	√	√	LC
Excoecaria agallocha	Ex	√	√	√	√		√	LC

2 Rethinking mangrove biodiversity

Mangroves are low biodiversity

Relationship between population genetic biodiversity and death rate of mangrove species suffered a abnormal flooding in Yalong Bay, Sanya, Hainan, China (Guo et al., 2017)

2 Rethinking mangrove biodiversity

Mangroves are high biodiversity

Mangrove biodiversity: lower plant biodiversity supports higher animal biodiversity.

Neckton	249	Total	**2901**

Species number of each organismal group recorded in mangrove wetland in China (He et

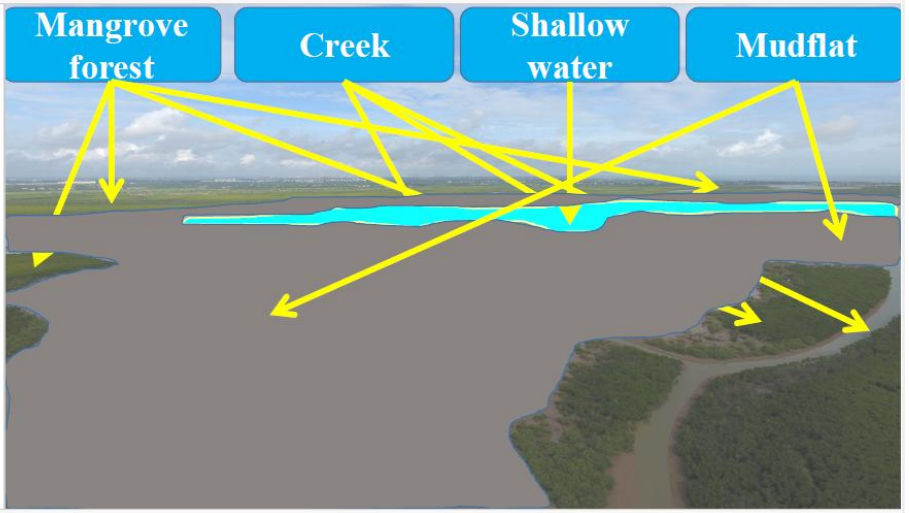
2 Rethinking mangrove biodiversity

福建台湾海峡海洋生态系统
National Observation and Research Station for the Taiwan Strait Marine Ecosystem

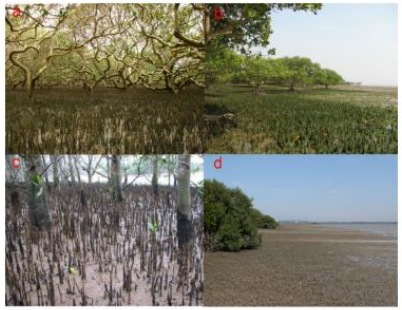
Maintenance of mangrove biodiversity

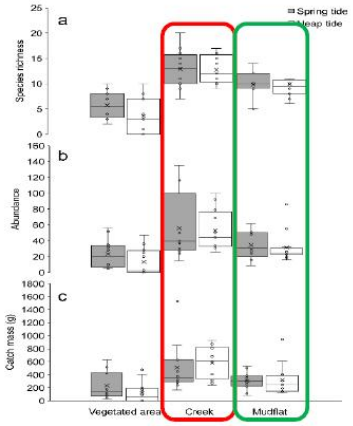
What is mangrove?

- Tree: in intertidal mudflats of tropical areas
- Ecosystem: trees, algae, fish/crab/shrimp/mollusks, microorganisms, habitats
- Wetland: different biotics (mangrove forest, mudflat, creek, shallow water area)



Nursery ground for fish...

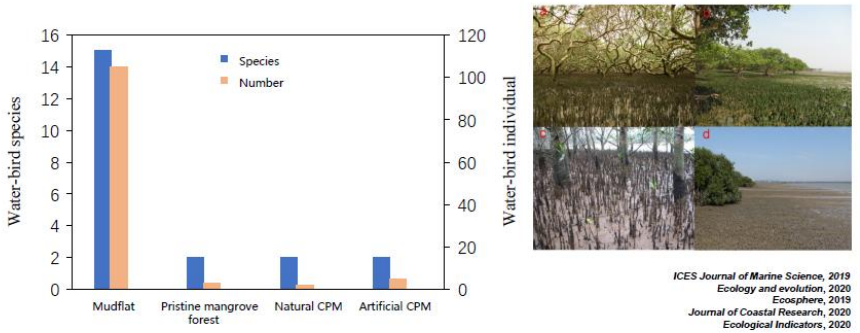




(Zhang et al. 2019; Zhang et al. 2021)

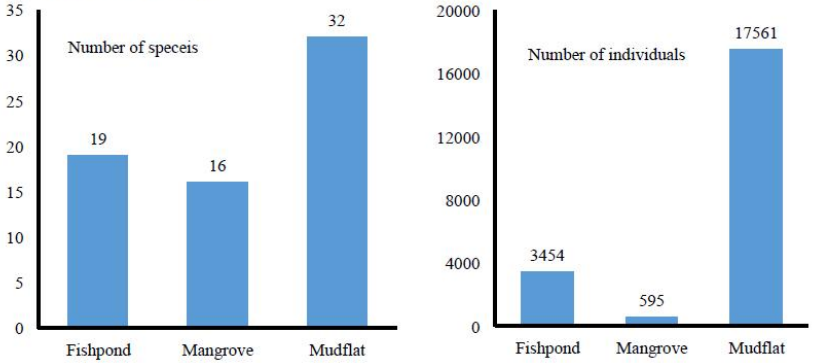
2 Rethinking mangrove biodiversity

Maintenance of mangrove biodiversity



ICES Journal of Marine Science, 2019
Ecology and evolution, 2020
Ecosphere, 2019
Journal of Coastal Research, 2020
Ecological Indicators, 2020

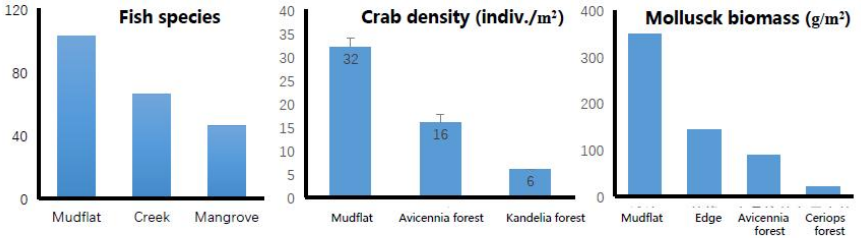
Mangrove wetlands provide important roosting, foraging and breeding habitats for birds...



Wader distribution in the different habitats of Leizhou Peninsula, Guangdong, China (Winter, 2014) (Liu et al., 2014)

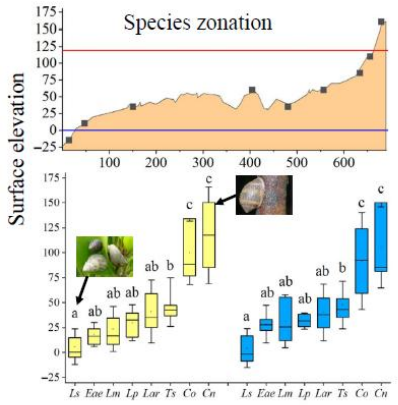
2 Rethinking mangrove biodiversity

Maintenance of mangrove biodiversity

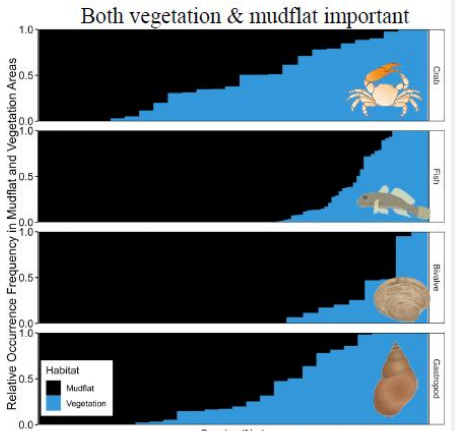


Dongzhaigang, Hainan | **Zhangjiang Estuary, Fujian** | **Dongzhaigang, Hainan**

Diverse habitats for biodiversity



(Ma et al. 2020, *Ecology and Evolution*)



(Zhang, unpublished)

2 Rethinking mangrove biodiversity

Take home message

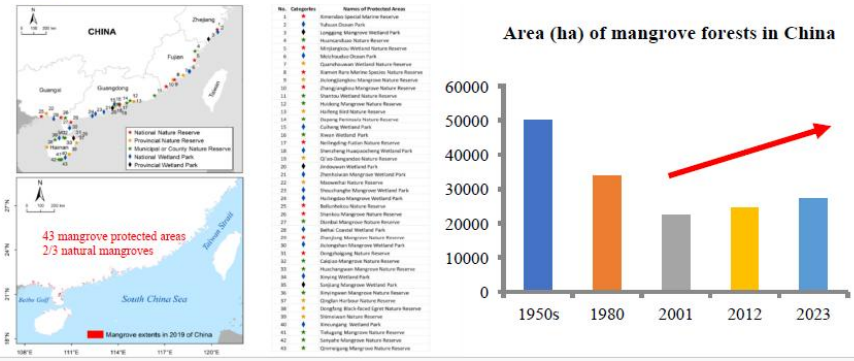
- Lower plant diversity supports higher animal diversity;
- Different parts (forest area, creek, mudflat, shallow water area) support different biotics;
- Mangrove wetland = mangrove forest+creek+mudflat+shallow water area.

Agenda

- Background
- Rethinking mangrove biodiversity
- Mangrove protection and restoration in China

3 Mangrove restoration in China

Main reasons: strict protection and artificial afforestation



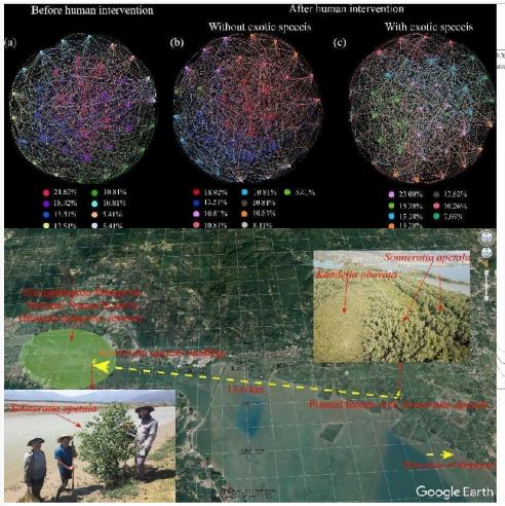
3 Mangrove restoration in China

Mangrove afforestation plan in China

Promulgation time	Department	Time	Goal (hm^2)	Actual performance
2001	State Forestry Administration	2001-2010	60000	~13% (2023)
2016	State Oceanic Administration	2016-2020	2500	?
2017	State Forestry Administration	2016-2025	48650	?

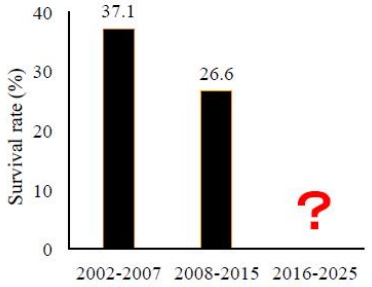
Mudflat afforestation project at Lingshui, Hainan

Mudflat afforestation project at Lingshui, Hainan



- Increased the species diversity of local mangrove and changed the latitude pattern of alpha diversity.
- Resulted in the homogenization of mangrove plant community.
- Reduced the complexity and stability of the biogeographic network of mangrove communities (Chen et al., 2021, 2022).

➢ Restoration through planting mangrove seedlings on mudflats has been the priority for mangrove protection in the past two decades



Changes of the survival rate of mangrove seedlings in Guangxi, China (Fan & Mo, 2018)

Disadvantages:

- Higher cost
- Higher technical difficulty
- Fewer species
- Lower survival rate
- Lower carbon storage rate
- Encroachment of waterbird habitat
- Limited ecological benefits

3 Mangrove restoration in China

福建台湾海峡海洋生态系统 National Observation and Research Station for the Taiwan Strait Marine Ecosystem

Special action for mangrove protection and restoration (2020-2025)

Before 2020 | **Since 2020**

Increase mangrove area

- **Mangrove forest area (as appropriate)**
- **Biodiversity**
- **Quality of the ecosystem**
- **Capacity to supply ecological products**

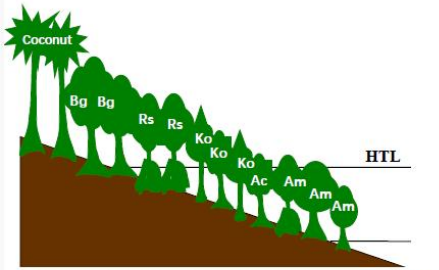
3 Mangrove restoration in China

福建台湾海峡海洋生态系统 National Observation and Research Station for the Taiwan Strait Marine Ecosystem

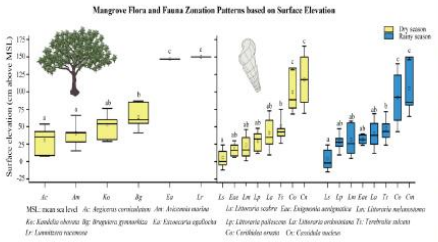
- More mangrove species used (rare or endangered species).
- Higher survival rate of mangrove seedlings.
- Ecosystem functions: biodiversity, blue carbon, disaster prevention and mitigation, stability, sustainable development, ….

3 Mangrove restoration in China

Site elevation



Intertidal distribution model of mangrove species



Intertidal distribution of mangrove species and mollusks at Huangzhujiang, Guangxi (Ma et al., 2020)

3 Mangrove restoration in China

3 Mangrove restoration in China

Site elevation

- Reason for the low survival rate: insufficient site elevation.
- The lower the site elevation and the higher the water salinity, the more serious the barnacle damage.
- The determination of the critical elevation of mangrove forest is the key to the success of mangrove forestation.

3 Mangrove restoration in China

Site elevation

3 Mangrove restoration in China

Site elevation

3 Mangrove restoration in China

Site elevation

Insufficient elevation

3 Mangrove restoration in China

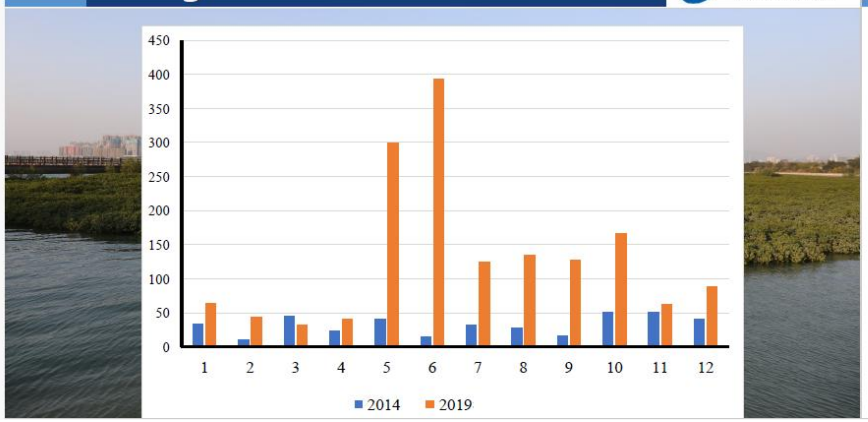
Site elevation

Too high!!!

3 Mangrove restoration in China

Seedling raising

3 Mangrove restoration in China



3 Mangrove restoration in China

Mangrove restoration in abandoned acquaculture ponds

- Aquaculture expansion is the key driver of mangrove lose (Alongi 2002, 2019);
- Numeral disadvantages of mudflat afforestation.

Abandoned fish ponds in southern China in 2014 (Fan et al., 2017)

Province	Total area of fish pond in use (ha)	Total area of fish pond (ha)	Vacancy rate (%)
Zhejiang	32 025	45 750	30
Fujian	29 949	46 075	35
Guangdong	72 641	85 460	15
Guangxi	20 307	46 152	56
Hainan	12 665	16 887	25
Total	167 587	240 324	30.3

3 Mangrove restoration in China

Mangrove restoration in abandoned acquaculture ponds

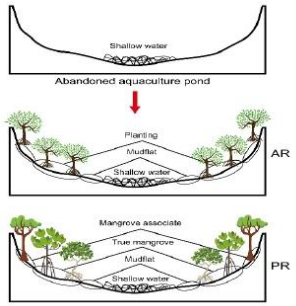
Disadvantages:

- Higher cost
- Higher administrative costs
- Higher ecological benefits
- No standard

Advantages:

- Higher technical difficulty
- Higher survival rate
- More species
- Higher carbon storage rate

c) Pond-to-mangrove rehabilitation methods



3 Mangrove restoration in China

Standard system for mangrove restoration

- Occupation and local standards: 16 items
- Seeding raising, site selection, water, soil, planting, pest control, invasive plant control, check and accept
- National standard: in preparing

3 Mangrove restoration in China

Biodiversity conservation-based mangrove restoration

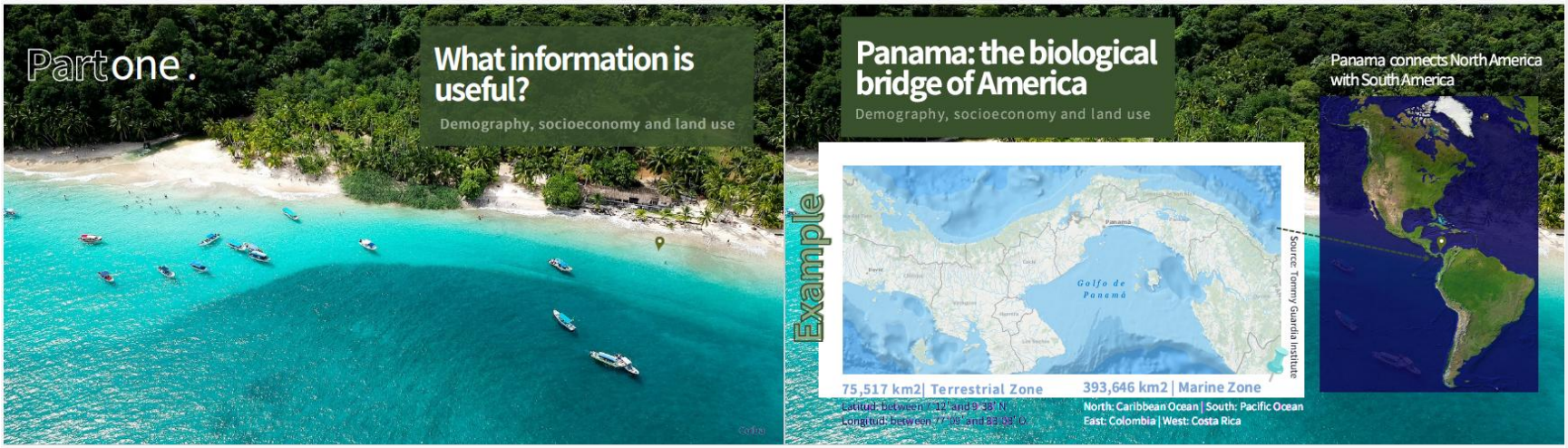
- Mangrove forest ≠ mangrove wetland
- Mangrove wetland =mangrove forest + mudflat+ creek + shallow water area
- Mangrove forest management → Mangrove ecosystem management
- Mudflat afforestation → Mangrove restoration in abandoned acquaculture ponds
- Leave more than 40% of the mudflats blank
- More mangrove species (rare or endangered species)

3 Mangrove restoration in China

Take home message

- Lower plant biodiversity supports higher animal biodiversity
- Mangrove biodiversity maintenance: mangrove forest + mudflat + creek+ shallow water area
- Leave more than 40% of the mudflats blank
- "Mangrove+": mangrove afforestation + ecotourism + ecological breeding + blue carbon

LECTURE 10: MANGROVE MANAGEMENT, GOVERNANCE, AND INSTITUTIONALITY



Demography

4.5 millions habitants | 2024

Mestizos
65-70%

Afrodescendents
15%

Indigenous
12% | 7 grous: Ngäbe, Guna, Emberá, Wounaan, Buglé, Naso Tjër Di and Bri Bri.

White and others
5-8%, including descendents from: Europe, Asia and recent inmigrants.

1 Official language Spanish
7 Native languages
3 Native dialects known
2 Afro dialects + English

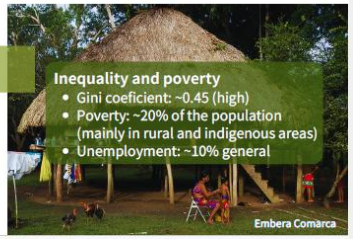
70% of the population lives in urban Areas in 4 cities: Panama City, San Michael, Colón and David.

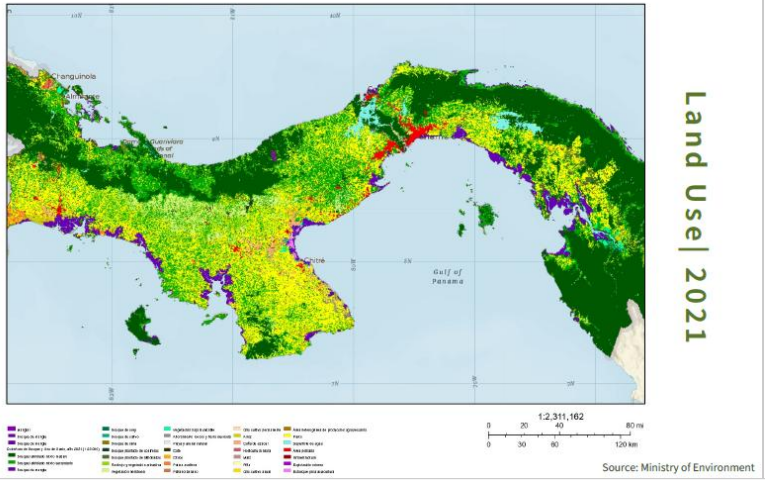
Cromosome Y General: 60% Eurasia | Regional: Caribbean 77% Native | Darién 44% Afrodescendents | Pacific 67% Eurasia
DNAmt X Native | Source: Torroni et. al., 2016.

Economy

US$ 18,000/capita | high inequality
2024

Currency
- US$ Dollar
- PAB Balboa





Land Use | 2021

Forest 61.42%

Forest 46,338 km2 | 2021
26°C-28°C | Dry and Weat season | 70%-90% RH
Caribbean 5000 mm - Pacific 1,200 mm

8 Forest Categories

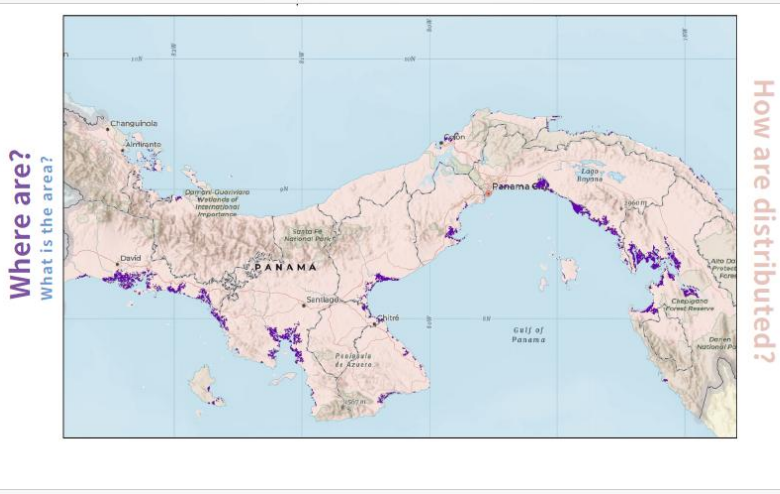
Mature Mixed Broadleaf	2,749,137	59.33%
Secondary Mixed Broadleaf	1,597,001	34.46%
Mangrove	187,064	4.04%
Planted broadleaf	66,553	1.44%
Rafia	15,321	0.33%
Planted Conifer	8,895	0.19%
Orey	6,460	0.14%
Cativo	3,360	0.07%

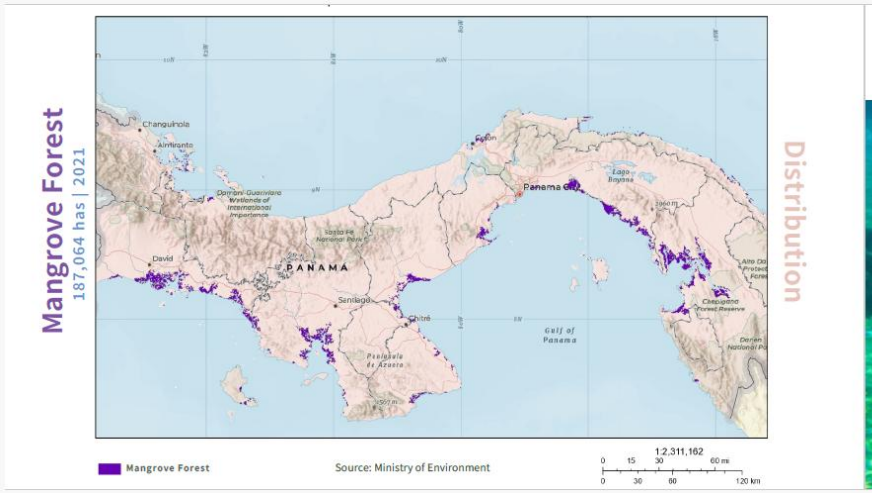
Mangroves are dynamic coastal ecosystems, characterized by salt-tolerant trees and shrubs that grow in intertidal zones of tropical and subtropical latitudes. These ecosystems provide critical services such as coastal protection, habitats for biodiversity, and blue carbon storage. | *FAO (2020), The World's Mangroves 2000-2020.*

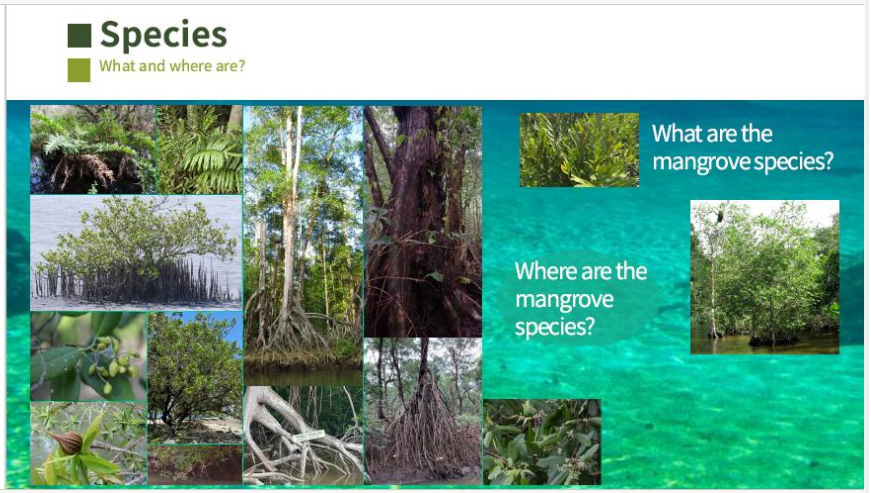
Mangroves are coastal tree wetlands, dominated by species of halophytic plants adapted to saline and anoxic conditions. They are considered wetlands of international importance under the Ramsar criteria due to their role in the conservation of biodiversity and local livelihoods. | *Ramsar (2018), Global Wetland Outlook.*

Mangroves are unique ecosystems at the land-sea interface, with a specialized plant structure (aerial roots, viviparity) that supports fisheries, mitigates climate change, and protects coasts from extreme events. | *IUCN (2021), Mangroves for Coastal Resilience.*

A mangrove plant is an halophy plant means tree, shrub, palm or ground fern, generally exceeding half a meter in height, that normally grows above mean sea level in the intertidal zone of marine coastal environments and estuarine margins.
The State of the World's Mangroves 2024




Mangrove Forest
187,064 has | 2021
Distribution
Changuinola
Almirante
Panama City
Lago Bayano
David
PANAMA
Santiago
Chitré
Gulf of Panama
Península de Azuero
Mangrove Forest
Source: Ministry of Environment
1:2,311,162
0 15 30 60 mi
0 30 60 120 km


Species
What and where are?
What are the mangrove species?
Where are the mangrove species?


Species
10 Mangroves trees species
2 Mangroves ferns
7 Caribbean
12 Pacific
Mangrove Ferns
1. Acrostichum aureum
2. Acrostichum danaeifolium
Mangrove trees
3. Avicennia bicolor*
4. Avicennia germinans
5. Conocarpues erectus
6. Laguncularia racemosa
7. Mora oleifera*
* Only in the Pacific
8. Pelliciera rhizophorae
9. Rhizophora mangle
10. Rhizophora racemosa*
11. Rhizophora x harrisonii
12. Tabebuia Palustris*


What are the Ramsar Sites?
Ramsar
Convention on Wetlands
Convention sur les zones humides
Convención sobre los Humedales


Panama
6 Ramsar Sites
Panamá
Colón
Chiriquí
Veraguas
Coclé
Herrera
Los Santos
Chepo
David
Chitré
Santiago
1
2
3
4
5
6


Ramsar Sites
1 Golfo de Montijo 1990 | 80,765 ha
2 San San - Pond Sak 1993 | 16,413.5 has
3 Punta Patiño 1993 | 13,805 has
4 Humedal de Importancia Internacional de Damani-Guariviara 2010 | 24,089 has
5 Bahía de Panamá 2020 | 85,664,56 has
6 Complejo de humedales de Matusagaratí April, 2025 | 64,750.17 has
San San-Pond Sak


What are the people's livelihood activities?
Isla Cañas
Embera Comarca
Guna Yala
Chiriquí Gulf
Wood extraction
Fishing
Seafood


People
Livelihood
Isla Cañas
Guararé
Tourism

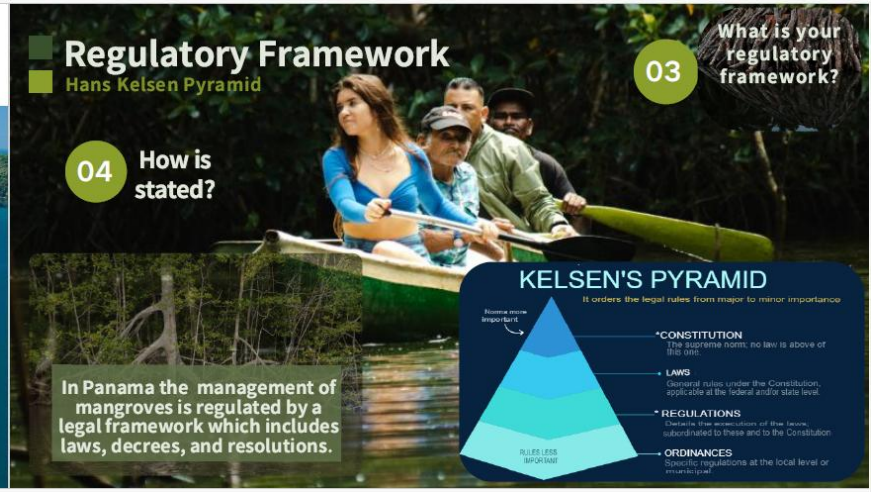

What are the Environmental Challenges?
Gulf of Montijo
Climate Change-G
• Coastal erosion
• Salinity rise
• Sea level rise
• Sea acidification
Environmental Challenges
Local, regional and global
Beach hotels-R
Veracruz
Mega projects in coastal areas-R
Barú
Port in construction
Communities wood extraction-L
Chame
Old Panama
Pollution-LRG
Aquaculture-R
Aguadulce


Part three .
Mangrove management
Governance and Institutionality
Portobelo
Mangrove Management
Organizing
Planning
Leading
Controling
Pedasí
Almirante
Capira
Institutionality
Regulatory Framework
National Budget
International Cooperation
Other sources
Programs & Projects
National | Regional | Locals
Internationals
Public Policies in action
Governance
Governability | Stakeholders
01 How is in your country?

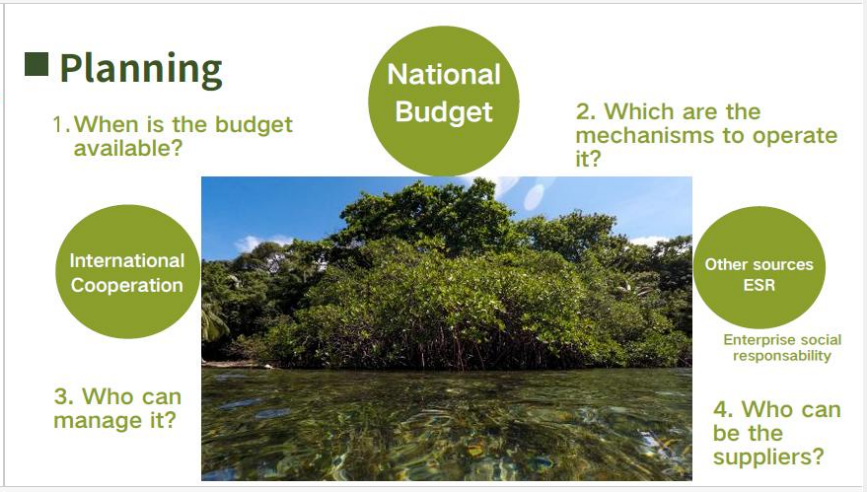

Panama Case
©Ramon Lepage
Verónica Argelis González Quintero | Forestry Officer, Ministry of Environment | Shenzhen University, Phd Student


Type of government
Democratic presidential republic
Local governments
Traditional authorities (5)
5 years with not inmediate reelection
2 years
Naso Tjër Di
Bocas del Toro
Colón
Panamá
Guna Yala
Madugandí
Wargandí
Panamá Oeste
Ngäbe-Buglé
Chiriquí
Coclé
Veraguas
Herrera
Los Santos
Emberá Wounaan
Darién
Political division of Panama

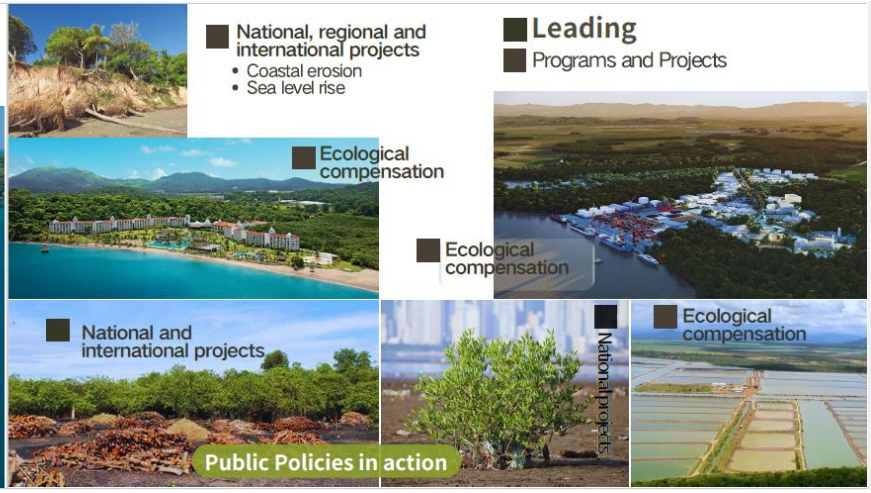

Organizing
Mangrove institutionality
Panama case
Ministry of Environment
Focus: protection
Ruler maker & Auditor
Legislative: National Assembly (unicameral, 71 elected deputies)
Judicial: Supreme Court and independent courts.
*Traditional Authorities
Authority of Aquatic and Fishing Resources
Focus: production
Ministry of Agricultural Development
Focus: production
Ministry of Commerce and Industry
Focus: value chain
02
What are the institutions in your country?
Ministry of Economy and Finance
Focus: financing | investment and operational budget
Ministry of Foreign Affairs
Focus: international treates in support to MiEnvironment
Ministry of Tourism
Focus: promote tourism
Multidisciplinary specialists | scientists | field experts | technicians
Boca Chica


Regulatory Framework
Hans Kelsen Pyramid
03
What is your regulatory framework?
04
How is stated?
In Panama the management of mangroves is regulated by a legal framework which includes laws, decrees, and resolutions.
KELSEN'S PYRAMID
It orders the legal rules from major to minor importance
Norms more important
*CONSTITUTION
The supreme norm; no law is above of this one.
LAWS
General rules under the Constitution, applicable at the federal and/or state level.
REGULATIONS
Details the execution of the laws, subordinated to these and to the Constitution
ORDINANCES
Specific regulations at the local level or municipal
RULES LESS IMPORTANT


Regulatory Framework
Main Legal Framework
Panama case
Constitution
Dictates natural resources protection and state development
General Environmental Law | Law 41 of 1998
Recognizes mangroves as fragile ecosystems of ecological importance
Law 24 of 1995 | Wildlife Protection
Safeguards biodiversity linked to mangroves
Law 44 of 2006 | Wetlands Protection
Classified mangroves as coastal wetlands | Mandates the State to conserve and restore them, in line with the Ramsar Convention
Penal Code | Law 14 of 2007
Imposes criminal penalties for damaging mangroves
Executive Decree No. 57 of 2007 | Regulates Law 41
Establishes mangroves as Legally Protected Areas | Requires special permits for any activity
Decree Law 5 of 2017 | Forest Protection
Includes mangroves in the protective forests
Resolution AG-0059-2016 | Prohibits cutting Rhizophora mangle
0.13% GDP in research


Planning
National Budget
1. When is the budget available?
2. Which are the mechanisms to operate it?
International Cooperation
Other sources ESR
Enterprise social responsability
3. Who can manage it?
4. Who can be the suppliers?

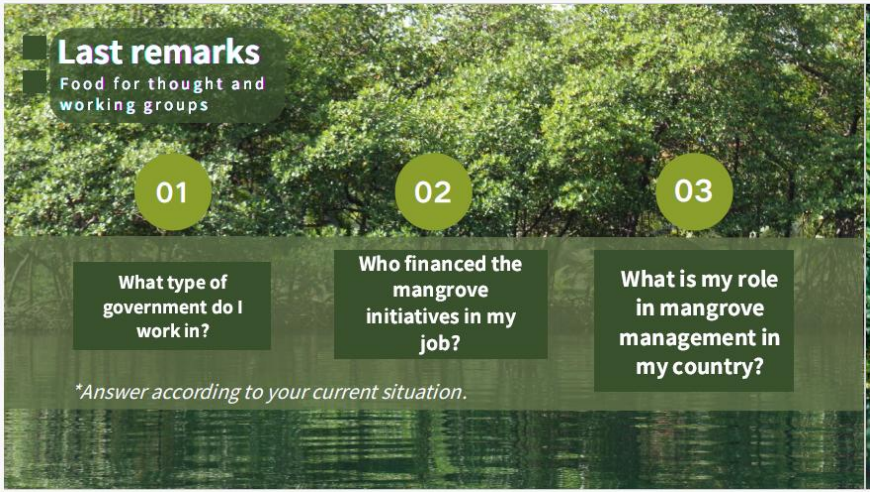

National budget
Investment and operational budget | Yearly
05
Who is in charge?
Ministry of Environment
Authority of Aquatic and Fishing Resources
Ministry of Agricultural Development
Ministry of Commerce and Industry
Ministry of Tourism
Ministry of Economy and Finance
Legislative: National Assembly
*Traditional Authorities
Boca Chica


National, regional and international projects
• Coastal erosion
• Sea level rise
Leading
Programs and Projects
Ecological compensation
Ecological compensation
National and international projects
National projects
Ecological compensation
Public Policies in action


Controling
Governance
Governability
What is Governability?
Capacity of a government to make effective decisions, manage resources, and respond to the needs of society, involving state and non-state actors (private sector and civil society).
&
Stakeholders
Who are the stakeholders?
Government institutions | Private Sector | Civil Society | Academia
What are their roles and interests?
What does governance mean in your political context?
Who cares?


What is important?


Part four .
Last remarks
Food for thought and working groups
San Miguel Island


Last remarks
Food for thought and working groups
01
What type of government do I work in?
02
Who financed the mangrove initiatives in my job?
03
What is my role in mangrove management in my country?
*Answer according to your current situation.


Mangrove Management
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Forestry Officer
PhD student SZU
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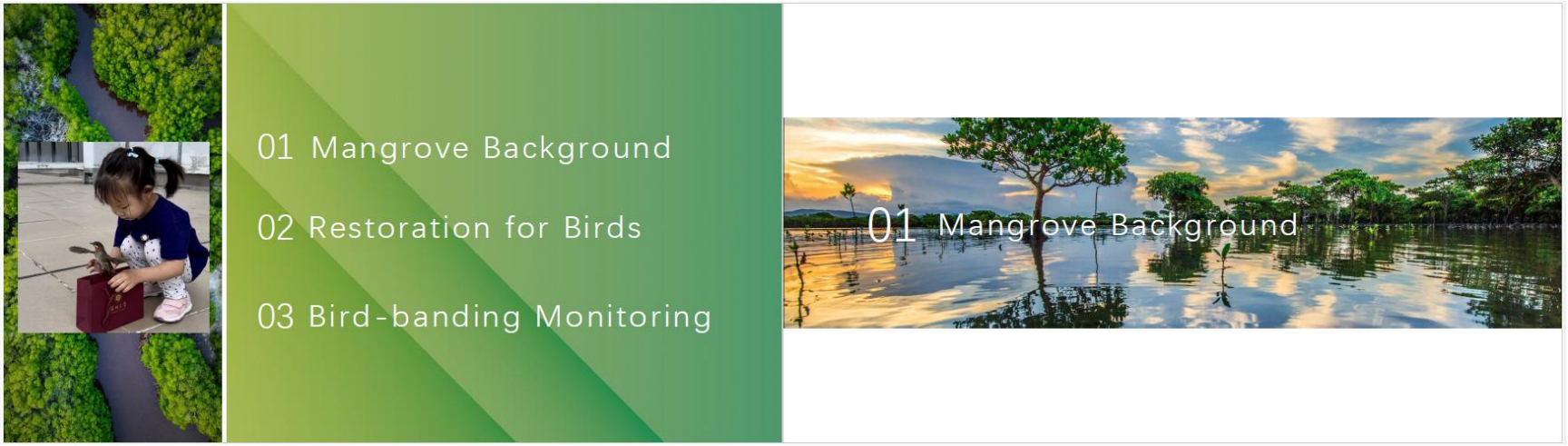
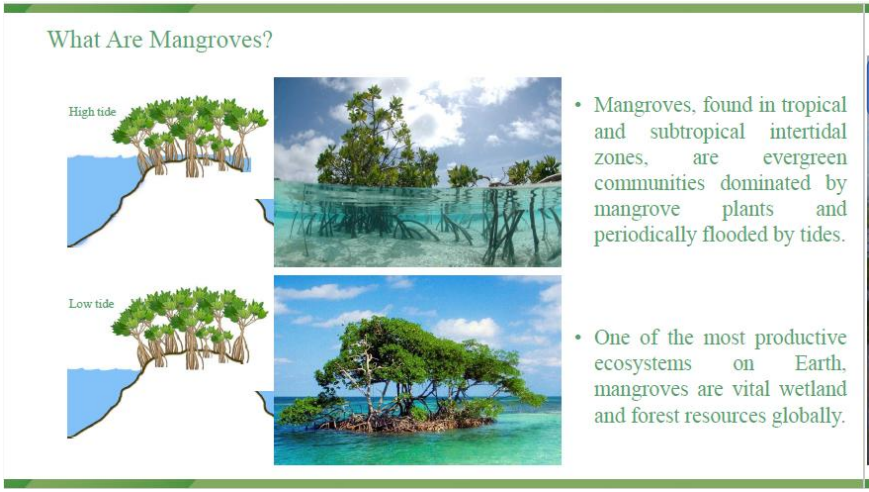
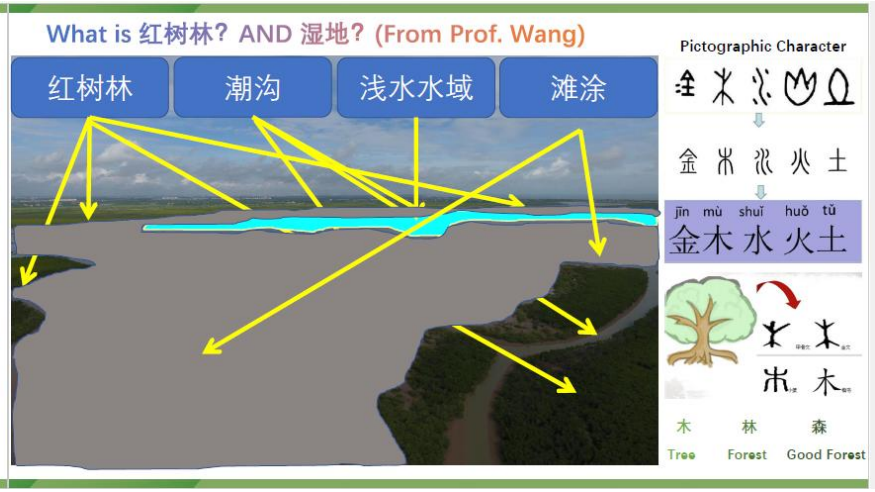
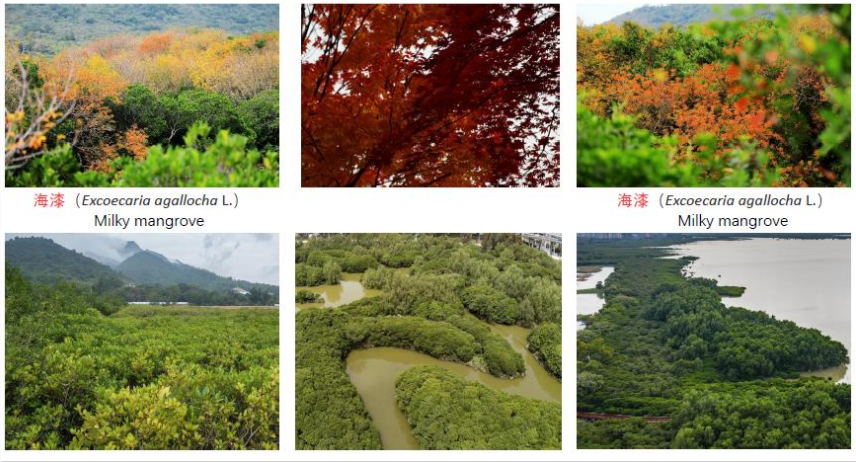
San San Pond-Sak

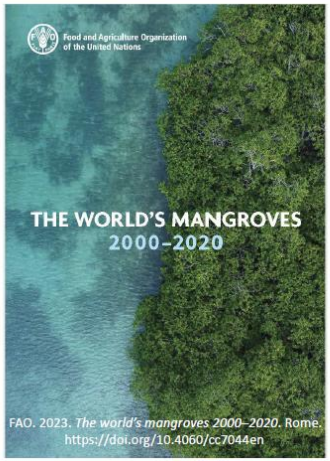
LECTURE 11: MONITORING AND PROTECTION OF MIGRATORY BIRDS IN MANGROVE WETLANDS

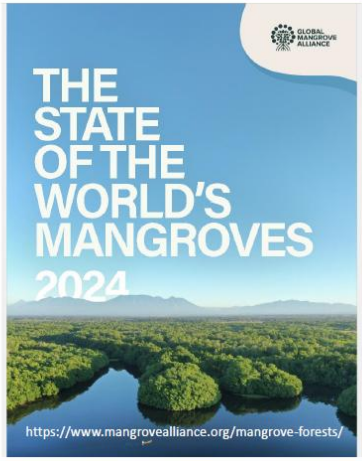



What Are Mangroves?
High tide
Low tide
• Mangroves, found in tropical and subtropical intertidal zones, are evergreen communities dominated by mangrove plants and periodically flooded by tides.
• One of the most productive ecosystems on Earth, mangroves are vital wetland and forest resources globally.


What is 红树林? AND 湿地? (From Prof. Wang)
红树林
潮沟
浅水水域
滩涂
Pictographic Character
jīn mù shuǐ huǒ tǔ
金木水火土
木 林 森
Tree Forest Good Forest

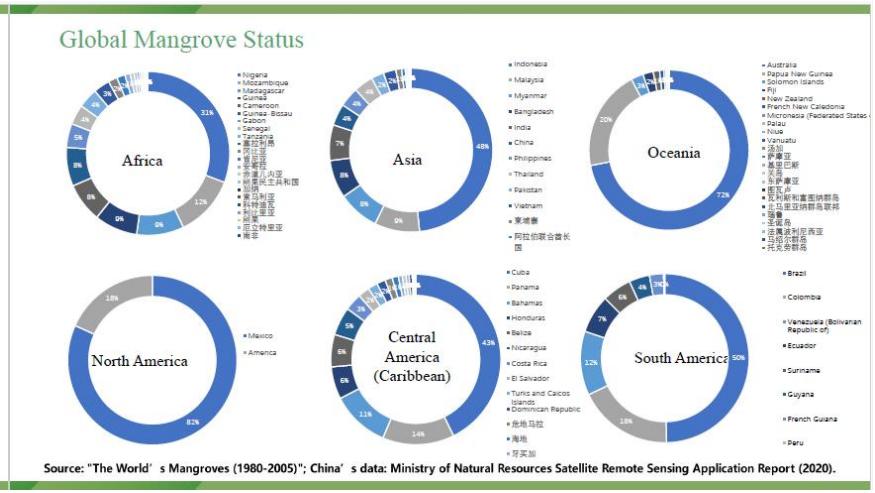

海漆（Excoecaria agallocha L.）
Milky mangrove
海漆（Excoecaria agallocha L.）
Milky mangrove





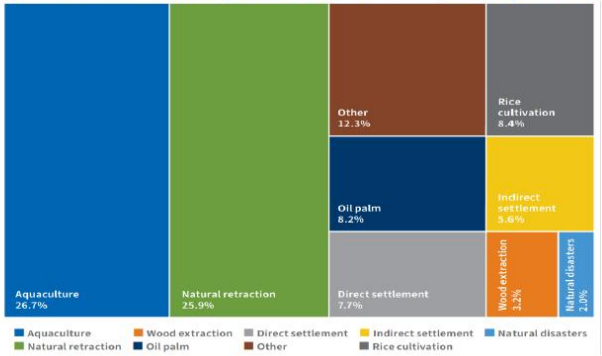
	Region	Country (English/中文)	Official Language(s)	Mangrove Area (ha)
Africa				**2,349,397; 37.08%**
1	Africa	**Burkina Faso 布基纳法索**	French	N/A
2	Africa	**Comoros 科摩罗**	Comorian (Shikomoro), Arabic, French	117
3	Africa	**Gabon 加蓬**	French	152,940.00
4	Africa	**Guinea 几内亚**	French	276,342.00
5	Africa	**Kenya 肯尼亚**	Swahili, English	52,980.00
6	Africa	**Lesotho 莱索托**	Sesotho, English	N/A
7	Africa	**Liberia 利比里亚**	English	9,244.00
8	Africa	**Libya 利比亚**	Arabic	N/A
9	Africa	**Madagascar 马达加斯加**	Malagasy, French	303,729.00
10	Africa	**Mozambique 莫桑比克**	Portuguese	392,749.00
11	Africa	**Sierra Leone 塞拉利昂**	English	105,300.00
12	Africa	**Tanzania 坦桑尼亚**	Swahili, English	127,200.00
13	Africa	**Zimbabwe 津巴布韦**	16 languages (including English, Shona, Ndebele, etc.)	N/A
Americas				**1,188,846; 27.04%**
14	Americas	**Cuba 古巴**	Spanish	545,805.00
15	Americas	**Ecuador 厄瓜多尔**	Spanish	149,556.00
16	Americas	**Nicaragua 尼加拉瓜**	Spanish	69,050
17	Americas	**Panama 巴拿马**	Spanish	174,435
18	Americas	**Venezuela 委内瑞拉**	Spanish	250,000.00
Asia				**2,349,397; 37.08%**
19	Asia	**Bangladesh 孟加拉国**	Bengali	476,215.00
20	Asia	**Cambodia 柬埔寨**	Khmer	72,480.00
21	Asia	**China 中国**	Chinese (Mandarin)	271,000.00
22	Asia	**Laos 老挝**	Lao	N/A
23	Asia	**Malaysia 马来西亚**	Malay	564,971.00
24	Asia	**Myanmar 缅甸**	Burmese	518,646.00
25	Asia	**Pakistan 巴基斯坦**	Urdu, English	158,000.00
26	Asia	**Thailand 泰国**	Thai	244,085.00
27	Asia	**United Arab Emirates 阿联酋**	Arabic	44,000.00
Oceania				**370; 0.02%**
28	Oceania	**Samoa 萨摩亚**	Samoan, English	370
Total				**4,959,214; 31.01%**

(FAO. 2023. The world's mangroves 2000–2020. Rome. https://doi.org/10.4060/cc7044en)



Global Mangrove Status

Globally, the main reasons for mangrove area reduction are aquaculture and natural degradation (FAO. 2023. The world's mangroves 2000–2020. Rome. https://doi.org/10.4060/cc7044en) .



Functions of Mangrove Wetlands

Why is it called mangroves?

The word "mangrove" originates from the Portuguese or Spanish word "mangue" combined with the English word "grove" meaning "a small group of trees".

Scientific research has found that the bark of the mangrove plant is **rich in tannins**, an acidic substance that oxidizes to a red color when it encounters air.

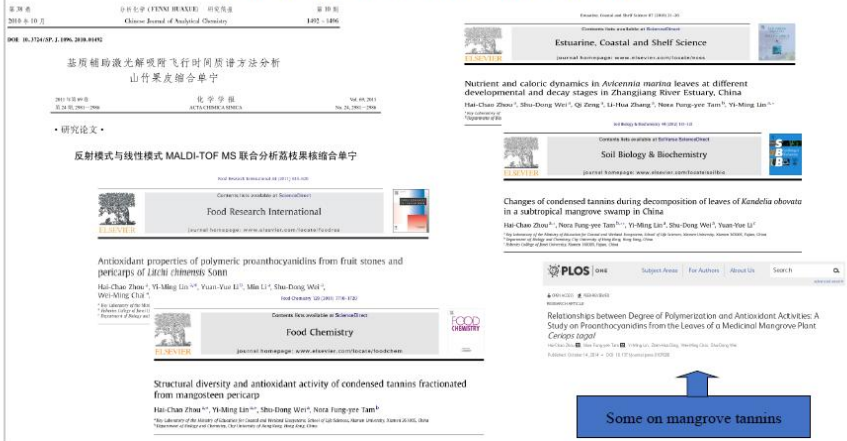
Tannins in food and their astringency (单宁在食物中及其收敛性和涩味)

- 1-2 g of tannins per day in our daily diet

What are tannins/polyphenols, and Why?

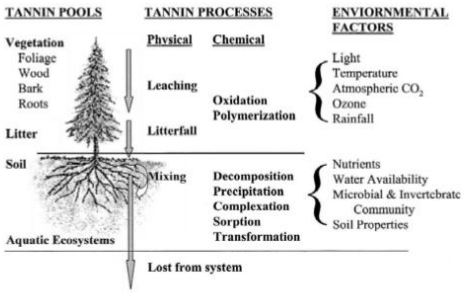
- Tannins is "丹宁" in Chinese word firstly, and the word "丹" means red.
- Up to 40% of the dry weight of mangrove plant tissues (leaves, bark, seeds, wood) is comprised of polyphenols, or tannins.
- High level of tannins is one of the reasons that mangrove called "Red grove/forest" in Chinese (红树林).

Published works on tannins



Some on mangrove tannins

What are tannins/polyphenols, and Why?

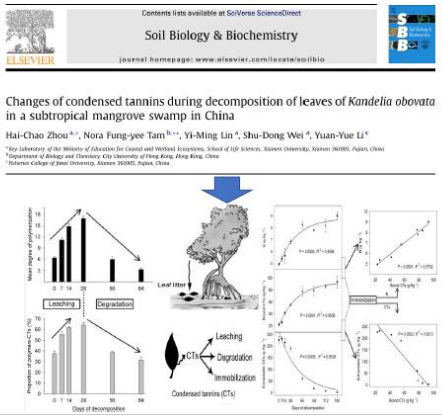


Ecological roles:

Chemical defense
Litter decomposition
Nutrient cycling
Microbial activity
Humification
Metal-complexes
...

Tannin pools, processes and environmental factors influencing their production, fate and potential roles in forest ecosystems (Kraus et al., 2003)

Doctoral Dissertation: Study on the Biogeochemical Significance and Antioxidant Activity of Mangrove Plant Polyphenols



- **What about tannins in the other mangrove plants?**
- **Are the fate and roles of tannins different among each other?**
- **What about the effects of tannins on nutrient cycling?**
- **Firstly, it need to figure our what type of tannins in different mangrove plants.**

Experiment set-ups

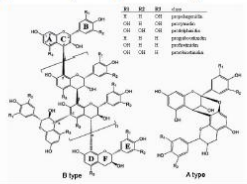
- Dongzhai Harbor national nature reserve, 22 mangrove species;
- Thirty trees with similar growth conditions were chosen and labeled. Three development stages (50-100 leaves) were demarcated as: (from left to right) Young (the first pair of leaves), Mature (the third pair of leaves) Senescent (turning yellow leaves);

- The column chromatography, colorimetric assays, reversed-phase HPLC-ESI-MS and MALDI-TOF MS techniques were used to identify chemistry of polyphenols;
- The N and P content of leaf samples was determined by the microKjeldahl method and ascorbic acid-antimony reducing phosphate colorimetric method, respectively.

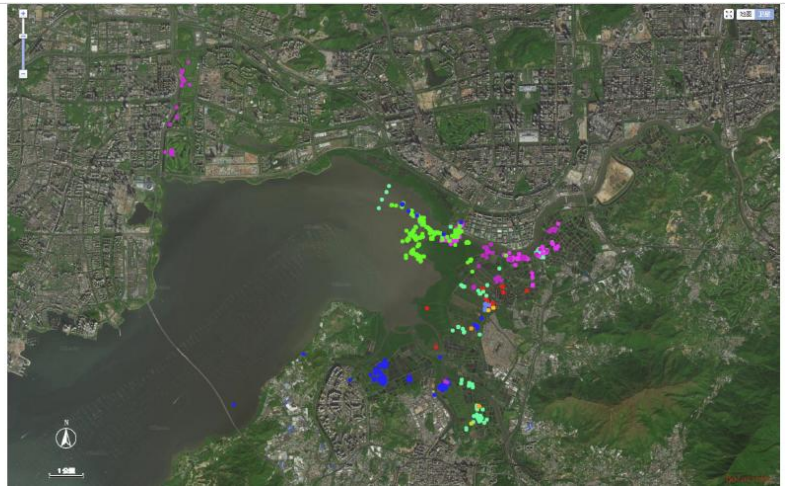
Plant polyphenols, N and P of leaves from 22 mangrove plant species

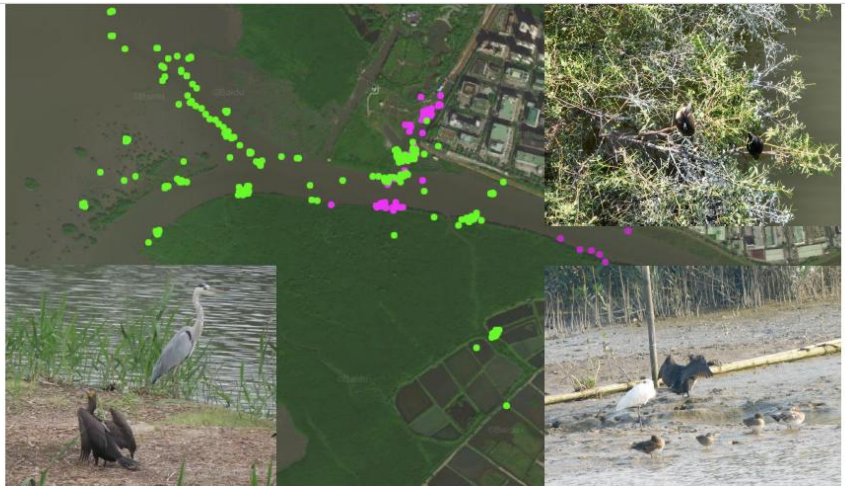
Mangrove species	TP	ECT	Polyphenol types	N	P	N:P
Kandelia obovata	237.61	196.06	CT	15.33	1.54	10.00
Ceriops tagal	274.47	201.23	CT	12.26	0.93	13.17
Bruguiera gymnorrhiza	175.89	140.73	CT	15.59	1.46	10.69
Bruguiera sexangula	262.50	202.50	CT	18.85	1.18	15.96
B. s. var. rhynchopetala	145.44	137.92	CT	14.21	0.90	15.78
Rhizophora mangle	259.82	194.13	CT	16.40	1.03	16.01
Rhizophora stylosa	205.83	192.23	CT	14.12	1.06	13.34
Rhizophora mucronata	297.57	173.71	CT	11.00	1.32	8.36
Aegiceras corniculatum	200.85	212.08	CT	30.53	1.80	16.95
Lumnitzera racemosa	243.73	215.03	CT	16.40	1.03	16.01
Acrostichum aureum	201.37	207.36	CT	30.53	1.80	16.95
Sonneratia caesolaris	278.34	113.35	HT	34.46	2.18	15.78
Sonneratia alba	267.97	38.05	HT	33.22	2.16	15.41
Sonneratia apetala	212.19	47.64	HT	20.80	0.95	22.00
Sonneratia ovata	300.22	53.92	HT	23.31	1.59	14.66
Sonneratia hainanensis	218.80	21.94	HT	15.33	1.54	10.00
Sonneratia guingai	222.87	27.40	HT	12.26	0.93	13.17
Laguncularia racemosa	318.21	46.19	HT	14.12	1.06	13.34
Aegialitis annulata	210.86	34.55	HT	11.00	1.32	8.36
Avicennia marina	31.38	0	LMWP	18.85	1.18	15.96
Excoecaria agallocha	95.11	0	LMWP	15.59	1.46	10.69
Xylocarpus granatum	14.76	0	LMWP	14.21	0.90	15.78

11 species (mainly Rhizophoraceae), 8 species(mainly Sonneratiaceae) and 3 species(*Avicennia marina*, *Excoecaria agallocha*, *Xylocarpus granatum*) are condensed tannin (CT), hydrolysable tannin (HT) and low molecular weight polyphenol (LMWP) as the main type of plant polyphenol, respectively.



Rescue a Group of Great Cormorants Trapped by High Buildings，2021

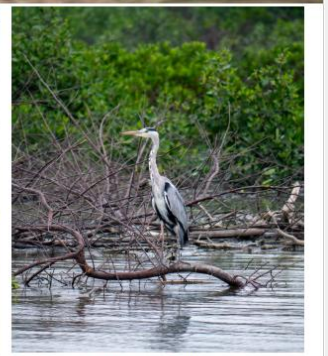




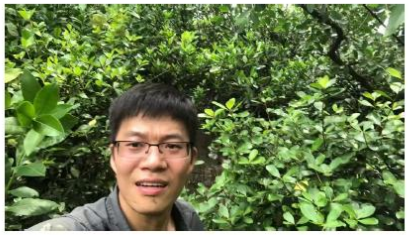
Background: Restoration for Birds

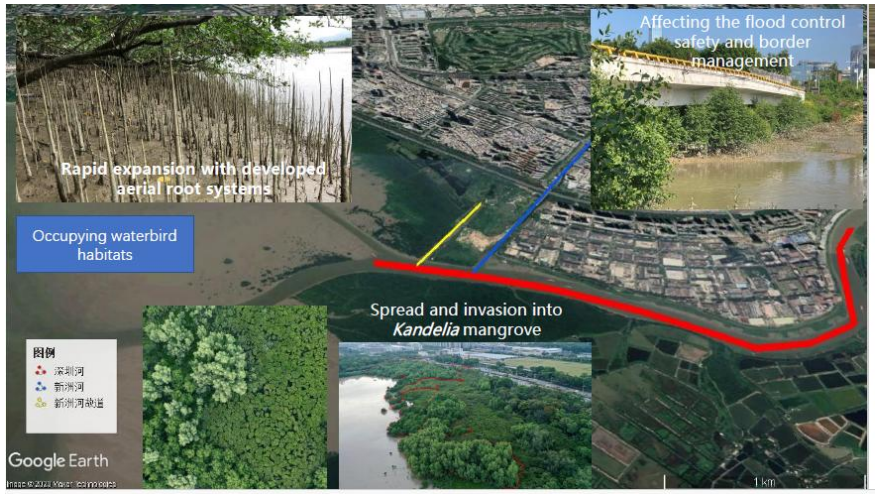
Shenzhen River estuary restoration area: bordered to the north by the Guangdong Neilingding Futian National Nature Reserve, to the east by the Futian Mangrove Ecological Park, and separated from Hong Kong's Mai Po Nature Reserve by a waterway to the south.

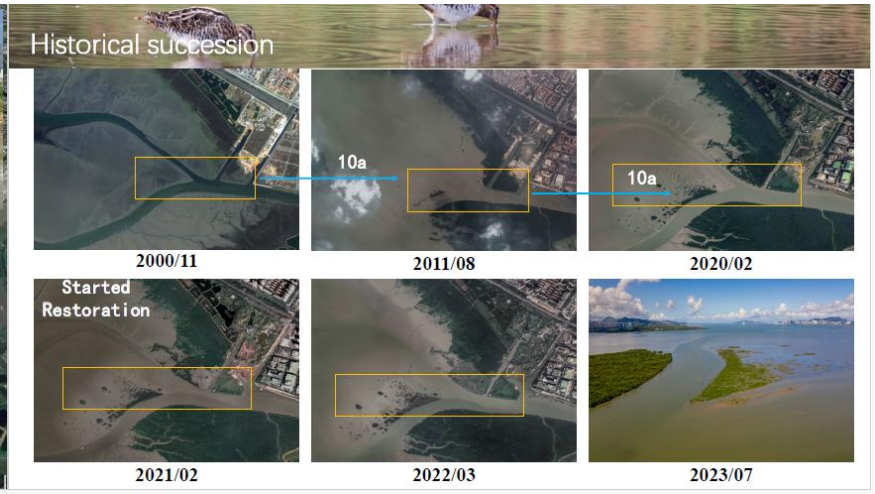
Dominant species: *Sonneratia* mangrove plants

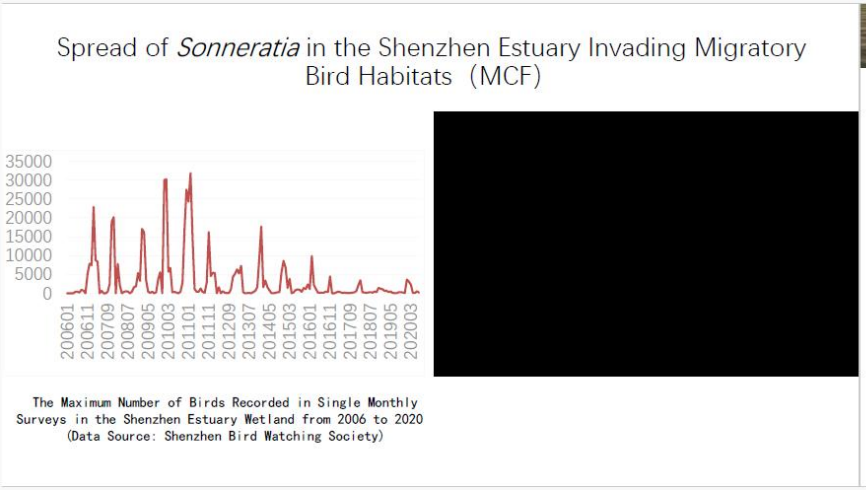


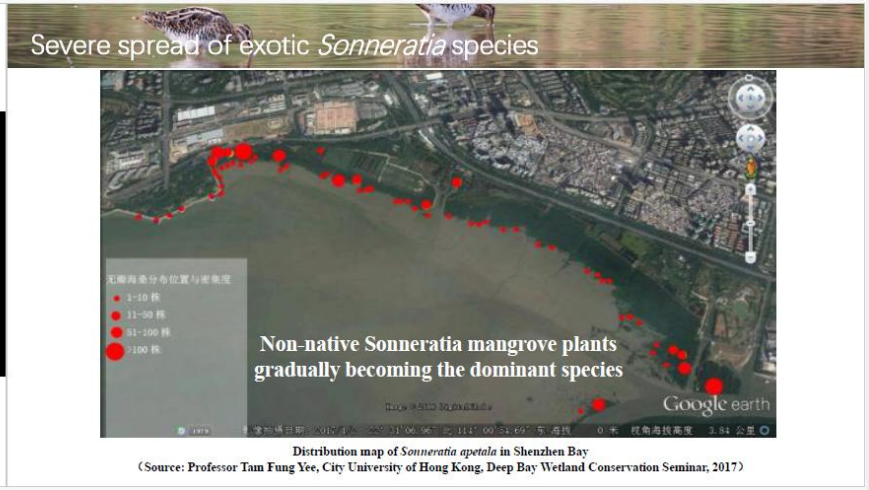
- Since 1990s, *Sonneratia* species were introduced to Shenzhen Bay for rapid afforestation. By 2017, these plants had spread to nearly 20 ha in the Shenzhen River estuary.
- The extensive spread of the non-native *Sonneratia* species has promoted siltation and land formation, reducing the river's water flow capacity and potentially affecting the city's flood control and drainage.





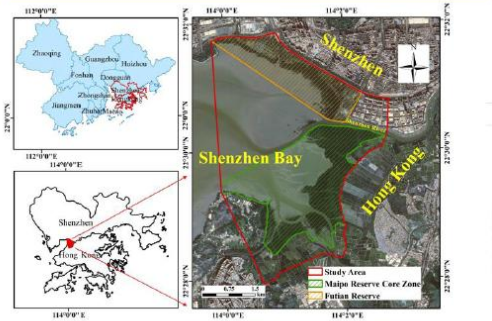




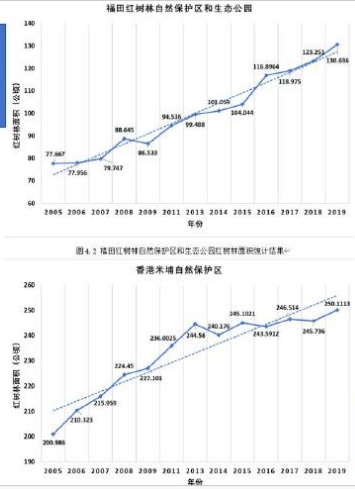


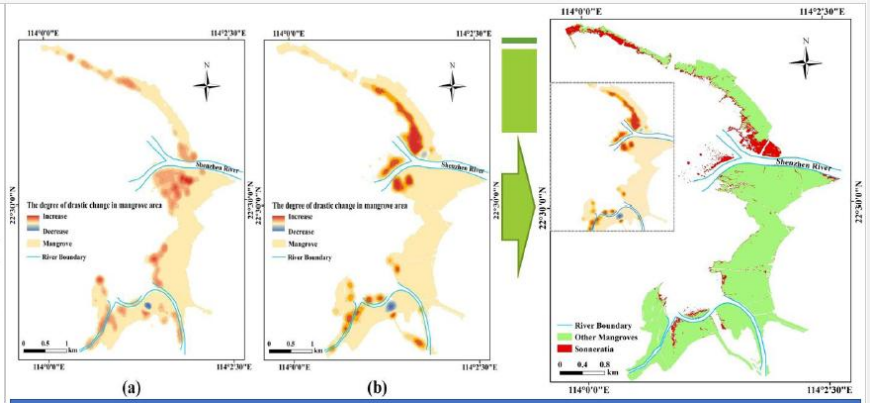
Distribution map of *Sonneratia apetala* in Shenzhen Bay
(Source: Professor Tam Fung Yee, City University of Hong Kong, Deep Bay Wetland Conservation Seminar, 2017)

Utilize high-resolution satellite imagery to analyze changes in mangrove vegetation area in Shenzhen Bay



利用高分辨卫星影像分析深圳湾红树林面积时间动态





Hotspot map of area changes, comparing native versus non-native *Sonneratia* mangrove vegetation

Sonneratia plants have strong invasive potential

Sonneratia apetala Buch.Ham in the mangrove ecosystems of China: An invasive species or restoration species?

(Ren et al., 2017)

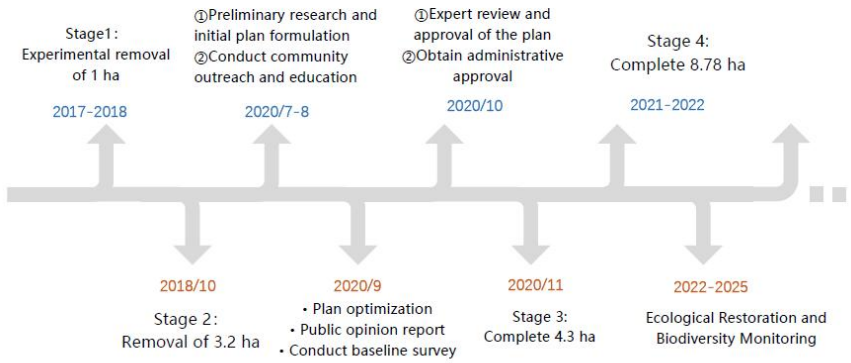
SCIENTIFIC REPORTS

Introduced non-native mangroves express better growth performance than co-occurring native mangroves

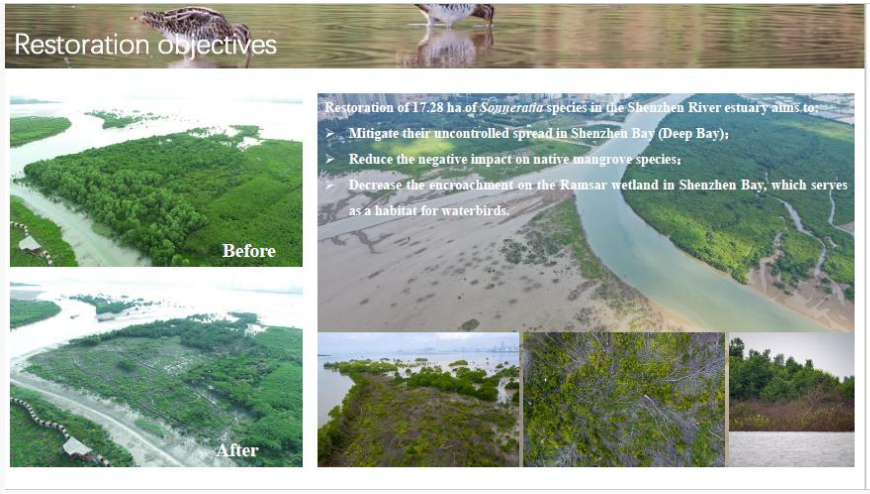
(Fazlioglu et al., 2020)

- **The growth rate of the non-native Sonneratia apetala surpasses that of native species, indicating a potential trend of ecological invasion.**
- **Over the past 20 years, Sonneratia species in the Shenzhen River estuary have grown from nothing to cover an increasing area each year.**

Timeline for the Restoration and Monitoring of *Sonneratia*



In October 2020, the Wildlife Protection Department organized an expert review meeting, and the "Plan" was approved. The project was approved in the same month.



Sonneratia still quickly regrows

2019/10

2020/10

Remove fast-growing *Sonneratia* seedlings

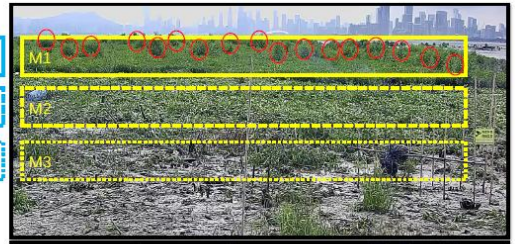
Adaptive vegetation restoration methods

- **M1** Canopy closure (85-95%)
- **M2** Canopy closure (30-40%)
- **M3** Remove almost < 5%

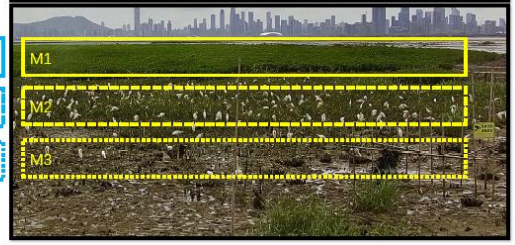
- Finished on 4/7, use on-site camera monitoring and drone surveillance to track bird distribution.

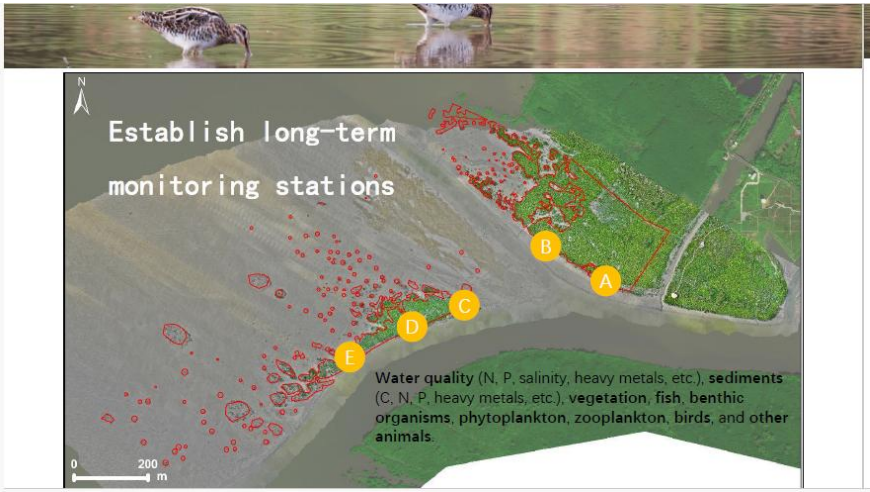
- Monitoring on 18/7、20/7 and 21/7

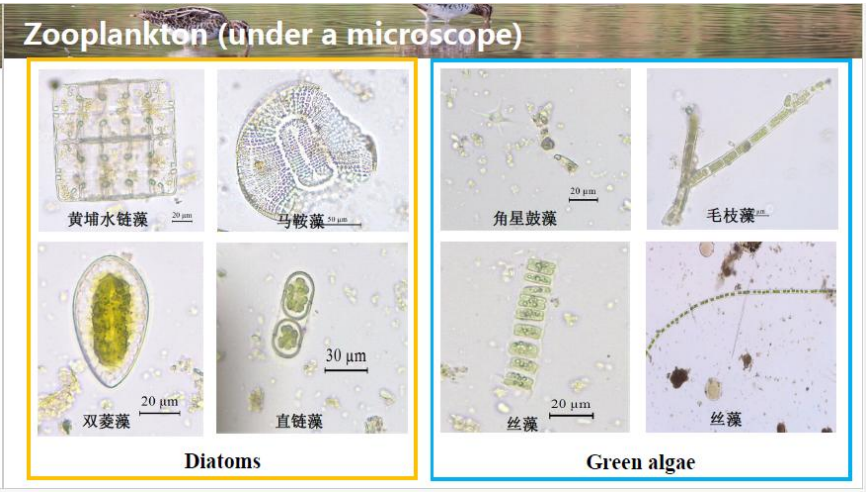
M1: 85-95%
M2: 30-40%
M3: < 5%



M1: 85-95%
M2: 30-40%
M3: < 5%

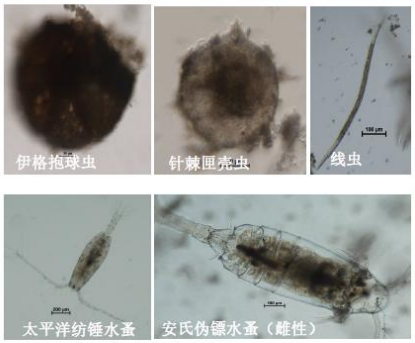



Establish long-term
monitoring stations
A
B
C
D
E
Water quality (N, P, salinity, heavy metals, etc.), sediments (C, N, P, heavy metals, etc.), vegetation, fish, benthic organisms, phytoplankton, zooplankton, birds, and other animals.
0
200
m


Zooplankton (under a microscope)
黄埔水链藻
20 μm
马鞍藻
20 μm
双菱藻
20 μm
直链藻
30 μm
Diatoms
角星鼓藻
20 μm
毛枝藻
20 μm
丝藻
20 μm
丝藻
Green algae

Phytoplankton (under a microscope)

Benthic larvae



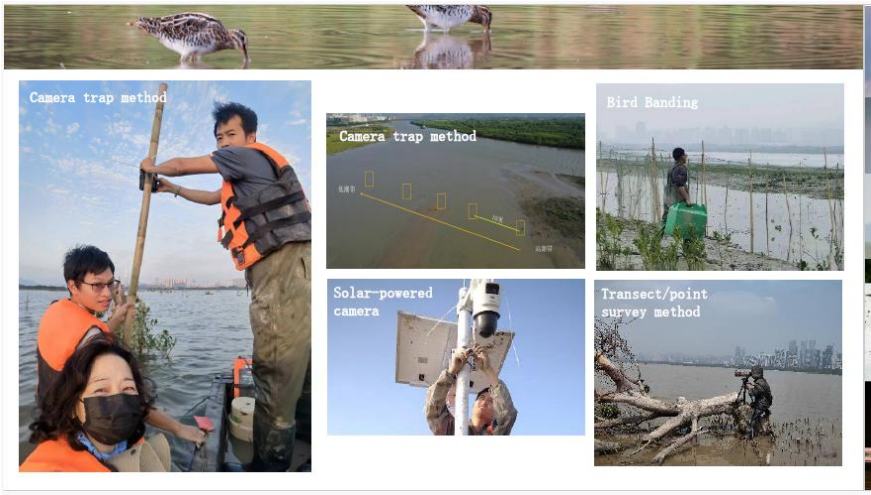
Fleas and nematodes etc.

Benthic organisms

Fish

A total of 31 fish species from 19 families and 8 orders were collected, including 20 economically important species. Among them, catfish and Nile tilapia are non-native invasive species

目	科名	属名	种名	Species
鲱形目	鲱科	鲚属	刀鲚	*Clupanodon thrissa*
		海鲚属	凤鲚	*Nematalosa nasus*
		斑鰶属	斑鰶	*Konosirus punctatus*
鲻目	虹科	辛虹属	赤虹	*Hemitrygon akajei*
海鲢目	海鲢科	海鲢属	大眼海鲢	*Elops machnata*
			海鲢	*Elops saurus*
颌针目	鳗科	异鳗鲡属	异鳗鲡	*Zenarchopterus buffonis*
鲈形目	鲹科	鲹属	细鳞鲹	*Terapon jarbua*
		棘鲹属	黄错棘鲹	*Acanthopagrus latus*
			黑棘鲷	*Acanthopagrus schlegelii*
			黄鳍鲷	*Acanthopagrus berda*
	慈鲷科	慈鲷属	长鳍慈鲷	*Gerres filamentosus*
	塘鳢科	塘鳢属	尖头塘鳢	*Eleotris oxycephala*
	石首鱼科	叫姑鱼属	大黄叫姑鱼	*Johnius macrorhynus*
	鳢科	鳢属	乌鳢	*Channa argus*
	鰕虎鱼科	舌鰕虎鱼属	舌鰕虎鱼	*Glossogobius giuris*
		大眼狼鰕虎鱼属	大眼狼鰕虎鱼	*Boleophthalmus pectinirostris*
		弹涂鱼属	大鳍弹涂鱼	*Periophthalmus magnuspinnatus*
			普通弹涂鱼	*Periophthalmus cantonensis*
		青弹涂鱼属	青弹涂鱼	*Scartelaos histophorus*
		细鰕虎属	阿部细鰕虎鱼	*Mugilogobius abei*
	金钱鱼科	金钱鱼属	金钱鱼	*Scatophagus argus*
	丽鱼科	罗非鱼属	尼罗罗非鱼	*Oreochromis niloticus*
	塘鳢科	乌塘鳢属	中华乌塘鳢	*Bostrychus sinensis*
	鲻科	花鲻属	中国花鲻	*Liza haematocheila*
	鲻科	鲻鱼属	布氏鲻鱼	*Trachinotus blochii*
鲽形目	鲽科	型鲽属	三线型鲽	*Pseudobagrus trilineatus*
鲇形目	胡子鲇科	鲇属	革胡子鲇	*Clarias fuscus*
		鲻属	鲻	*Mugil cephalus*
鲽形目	鲽科	真鲽属	长鳍真鲽	*Moolgarda cunnesius*
		龟鲽属	拟鲽龟鲽	*Chelon affinis*



Bird survey data (Transect/point monitoring)

Jan. to June 2024, 7945 birds across 117 species, 42 families, and 14 orders

47 species of water birds with 6606 individuals, and 66 species of other birds with 1339 individuals

The categories and numbers of waterbirds are as follows: ducks and grebes (6 species, 1697 individuals, 25.69%), waders and plovers (22 species, 4097 individuals, 62.02%), gulls (5 species, 422 individuals, 6.39%), herons, egrets, and spoonbills (11 species, 355 individuals, 5.37%), cormorants (1 species, 15 individuals, 0.23%), and rails (2 species, 20 individuals, 0.30%).

First-class protected: 4

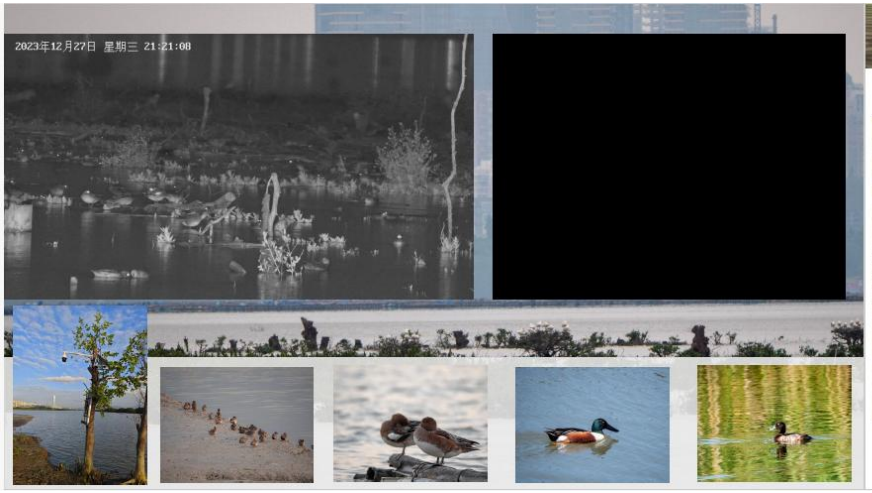
乌雕、白肩雕、黑脸琵鹭、黄嘴白鹭

Second-class protected: 13

白胸翡翠、栗喉蜂虎、褐翅鸦鹃、白腰杓鹬、大杓鹬、翻石鹬、鹗、黑翅鸢、黑鸢、白腹鹞、普通鵟、游隼、蓝喉歌鸲

IUCN EN species：2

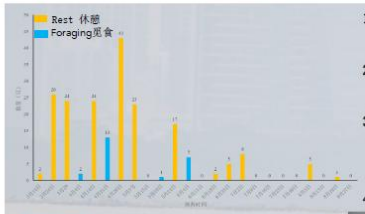
大杓鹬、黑脸琵鹭



2012/12/14 HK firstly banding

2014/10/25 HK firstly banding

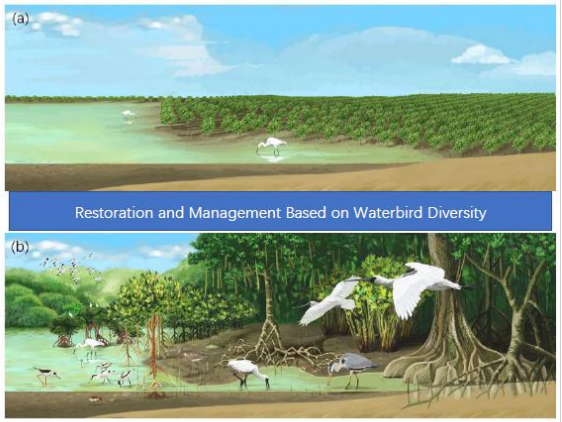
Black-faced Spoonbill



1. In August 2023, the maximum number in the Delta survey area was 43;
2. Juveniles can still be detected during the breeding season;
3. In 2024, the number remained stable with two small populations, each greater than 50 individuals, with the highest recorded number being 56;
4. In 2024, first banding of the Black-faced Spoonbill A53.

Some take home messages：

- Mangrove restoration requires not only expanding the area but also focusing on biodiversity;
- Afforestation is mangrove restoration! BUT deforestation is also mangrove restoration;
- Strengthen cross-regional and cross-departmental cooperation and innovation in mechanisms.



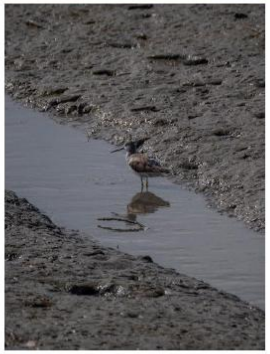
《Convention on Wetlands》

Convention on Wetlands: Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar Convention)

Ramsar
CONVENTION ON WETLANDS
CONVENTION SUR LES ZONES HUMIDES
CONVENCIÓN SOBRE LOS HUMEDALES
(Ramsar, Iran, 1971)


WY37


WY63


WY07

What is Bird Banding and its role?

Bird Banding is the process of attaching a small, uniquely numbered ring to the leg of a bird to track its movements, behavior, and lifespan. (**ID card!**)
This method provides essential data for studying bird migration patterns, population dynamics, and ecological requirements, aiding in conservation and management efforts.

Rich in bird species | High numbers of migratory birds

There are currently 1505 species of birds in China, of which more than 820 species have migratory habits, making it one of the countries with the largest number of migratory birds.

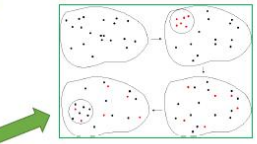
A brief history of the development of bird banding

- **Early Beginnings** (Late 19th Century): Bird banding started in the late 1800s with Hans Christian Cornelius Mortensen, a Danish schoolteacher, who began attaching aluminum rings to birds to study their movements.
- **Expansion and Standardization** (Early 20th Century): The practice spread to North America and Europe, with organizations like the American Bird Banding Association (1909) and the British Trust for Ornithology (1933) establishing standardized methods and large-scale banding programs.
- **Modern Techniques and Technology** (Late 20th Century to Present): Advances in technology, such as GPS and radio telemetry, have enhanced the precision and scope of bird banding, allowing for more detailed tracking and data collection on bird migration and behavior.
- **The National Bird Banding Center of China (in 1982)** was established by the former Ministry of Forestry at the Chinese Academy of Forestry. It is a national-level R & D and management center, mainly responsible for the national bird banding technical management, information collection and compliance with the International Migratory Bird Protection Agreement.

Research Methods in Ecology: Marked-recapture

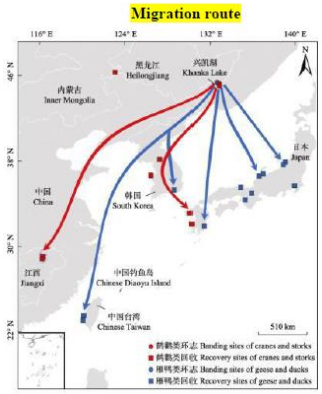
- Definition: Capture a portion of individuals in the environment of the population under investigation, mark these individuals and release them back to the original environment, recapture them after a period of time, and estimate the population size based on the proportion of marked individuals in the recapture to the total number of individuals captured.
- We set: m: number of marked; n: number of recaptured individuals; m: number of marked individuals among recaptured individuals; N: total number of survey sites.

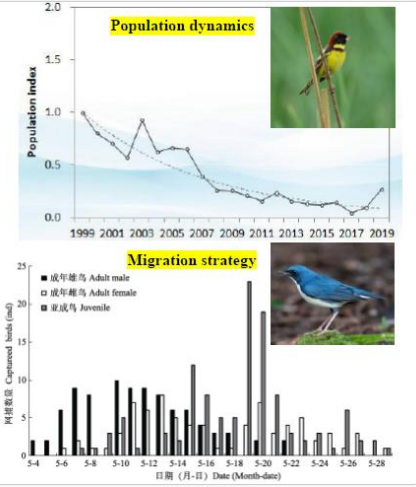
Then there's the formula: $\frac{N}{M} = \frac{n}{m}$ → $N = \frac{M \times n}{m}$



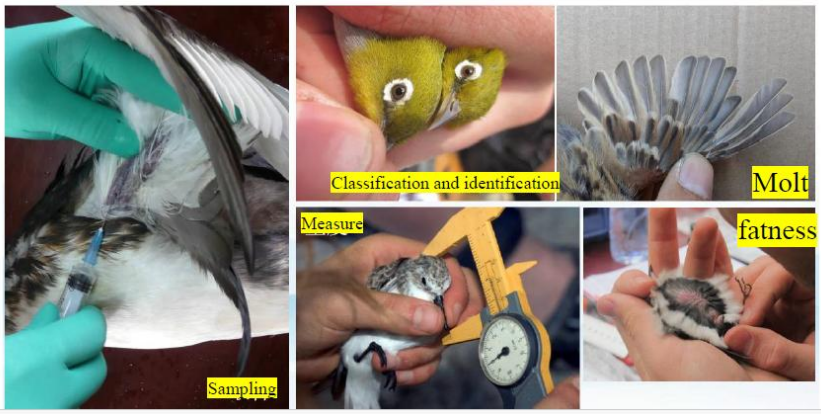
- **Question:** In a survey on the number of Common Cormorants in Shenzhen Bay, 100 cormorants were captured for the 1st time and released with marking rings on their legs; a few days later, 100 cormorants were captured again, of which only 1 had a marking ring. So how many Common Cormorants can we estimate in Shenzhen Bay?

Why bird banding?





Why bird banding?



全国鸟类环志中心

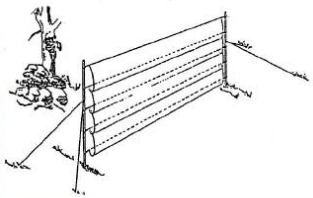
"Mist netting method"

Field selection and catching time

全国鸟类环志中心

Open a net

- Selection of mist net
- Open net method



全国鸟类环志中心

Patrol the net

- Frequency: once every 30 minutes
- Adjust according to climatic factors: cold and hot summer, windy and rainy.

全国鸟类环志中心

Close the net

全国鸟类环志中心

Untie the bird and temporary preservation of birds

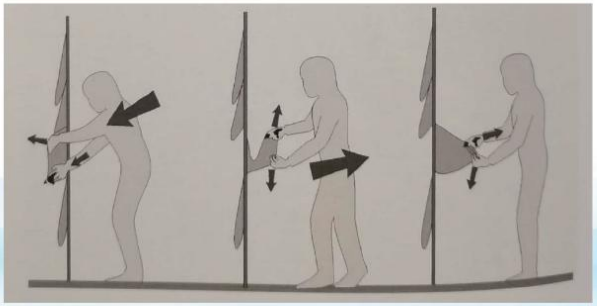
Tool to hold the birds: bird bag

The principle of keeping bird bags: ensure the safety and health of birds.

- Dry, clean, dark and ventilated;
- A bag of individuals of the same species or at least the same species;
- Preservation: tie a slipknot and put it in a safe place to avoid natural enemies;
- Release as soon as possible;
- Check the bird bag after the end of bird banding;
- Clean the holding tools regularly.

全国鸟类环志中心

General procedures for untie the bird: trunk, head, wings and toes.



全国鸟类环志中心

Bird rings and Data Collection

- Check the bird's leg to determine whether there is a ring.
- Species identification
- Choose and wear the appropriate ring.
- Measurement and photography

At the same time, someone must record it at the same time; Pay special attention to accurately record the ring number.

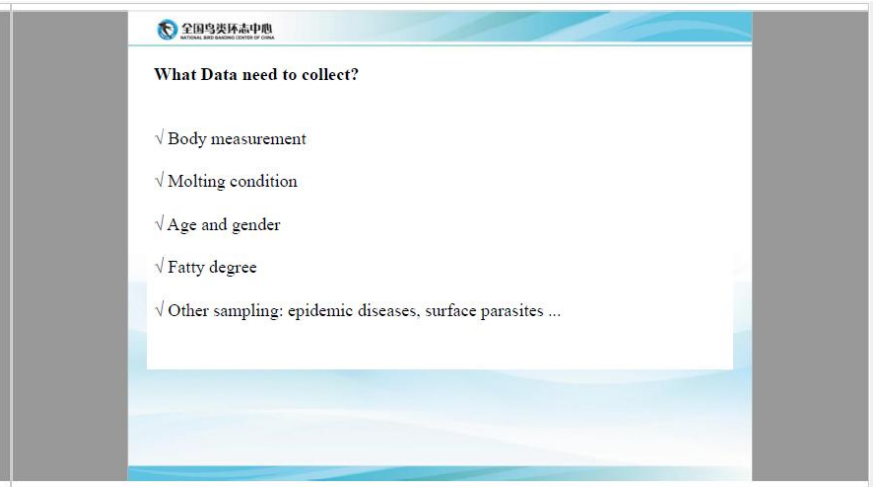
全国鸟类环志中心

Table and tools for bird banding

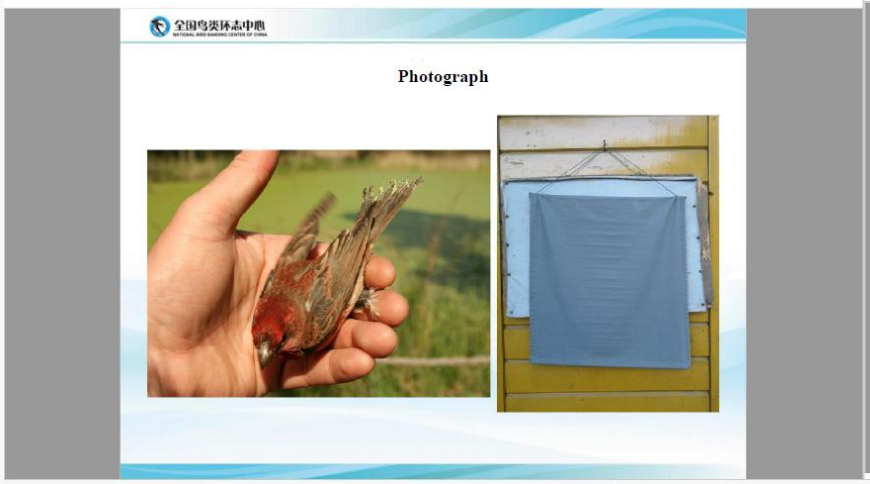

全国鸟类环志中心
Holding method:


全国鸟类环志中心
Absolutely forbidden:
Grasping flying feathers and tail feathers
Hold very tightly
√


全国鸟类环志中心


全国鸟类环志中心
What Data need to collect?
√ Body measurement
√ Molting condition
√ Age and gender
√ Fatty degree
√ Other sampling: epidemic diseases, surface parasites ...


Fatty degree judgment
布斯 (Busse) 脂肪等级
脂肪等级 0
脂肪等级 1
脂肪等级 2
脂肪等级 3
脂肪等级 4
脂肪等级 5
脂肪


Photograph


Ring number

全国鸟类环志中心

Release

- You should put the bird on the palm of your hand or the ground and let it fly away by itself (no throwing!).
- Avoid dangerous places (including nets) and release them in suitable habitats.
- When adults, young birds, couples and family groups are caught at the same time, the ring will be released at the same time.
- Young bird: released at the capture site.
- After dark, diurnal birds should be kept overnight and released early the next morning.

Right

Wrong

全国鸟类环志中心

Death and safety of birds in the process of ring-marking

- The mortality rate of most passerine migratory birds in autumn is as high as 70-85%(Newton,2008);
- Ring-marking operation will bring pressure and stress reaction to birds, but 99% of ring-marking birds are not significantly affected in the subsequent migration;
- The causes of birds' death in the process of ring-marking include technical reasons (tools and methods of catching birds, methods of solving birds, methods of holding them, etc.) and non-technical reasons (individuals caught in nets are preyed by natural enemies, etc.), so the technology should be improved to avoid the death caused by technical reasons as much as possible;
- Although there are a few deaths in the process of environmental records, more birds' lives can be saved by promoting protection through environmental records;
- Based on the above reasons, the normal mortality rate in the process of environmental records is acceptable.

全国鸟类环志中心

Personal protection

- Risks in bird catching: terrain, environment, tools and time.
- Physical damage of birds to environmental volunteers: raptors, fish eaters and grain eaters.
- Birds carry a variety of viruses and bacteria.

全国鸟类环志中心

Publicity of bird rings

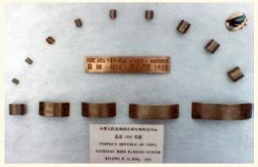
Management of bird banding in China

The forestry administrative authority is responsible for nationwide bird banding management;

The forestry administrative authority at or above the county level are responsible for the management of bird ringing within their jurisdiction;

In 1981, in order to implement the Agreement on the Protection of Migratory Birds and their Habitats signed between China and Japan, the National Bird Ringing Office was established in the former Ministry of Forestry;

In 1982, the National Bird Ringing Centre was established in the Chinese Academy of Forestry.



The types of metal rings used in China are A, B, C, D, E, F, G, H, I, J, K, L, M, N, Q, S, R total 17 kinds of

Banner tool and adhesive net with logo

Satellite positioning tracker

Responsibilities of the National Bird Banding Center

Located at No. 1 Dongxiaofu, Haidian District, Beijing

- Prepare sign banding plans and technical procedures, organize the implementation, guide and coordinate sign banding activities;
- Supervise and distribute banding tools and markers, and coordinate the color marking of birds across the country;
- Collect and manage ring information;
- Carry out image ring training;
- Carry out international cooperation and information exchange

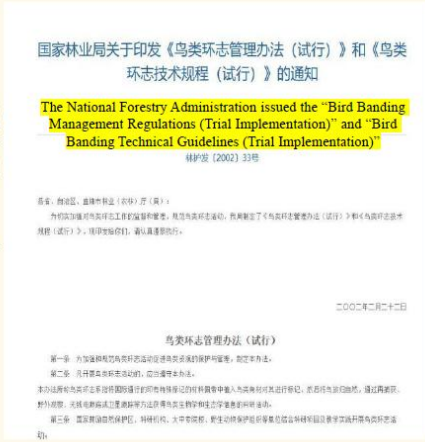
The way to carry out the work:

- Bird banding activities should be conducted at designated bird banding stations or institutions confirmed by the local bird banding station or forestry administrative authority. Other organizations and individuals are not allowed to conduct bird banding activities independently.
- Forestry administrative authorities should submit a list of bird banding stations or institutions conducting bird banding activities within their jurisdiction to the State Council's forestry administrative authority annually. This list will be compiled and published by the National Bird Banding Center.

Heilongjiang Xinglong Qingfeng bird protection ring station

National Bird Banding Management Regulations

- The establishment of a bird banding station requires the supporting organization to submit an application to the local forestry administrative authority. It must be confirmed by the banding center that the station has at least two qualified banding personnel, a fixed location for banding activities, and a source of funding;
- Before conducting banding activities, it is necessary to obtain administrative permission from the local or national forestry authority and to have the appropriate banding qualifications;
- Obtain bird banding tools and bands from the banding center or use tools and bands recognized by the banding center;
- Comply with relevant laws, regulations, and technical standards.



国家林业局关于印发《鸟类环志管理办法（试行）》和《鸟类环志技术规程（试行）》的通知

The National Forestry Administration issued the "Bird Banding Management Regulations (Trial Implementation)" and "Bird Banding Technical Guidelines (Trial Implementation)"

林护发〔2002〕33号

鸟类环志管理办法（试行）

Bird Banding Station duties

- Formulate rules and regulations on bird ringing to ensure that it is operated in strict accordance with the technical regulations and to prevent the loss of bird resources due to bird ringing.
- Submit annual plans for bird ringing in the location on time, and apply for administrative licences in a timely manner in accordance with the law if it involves statutory administrative licences.
- Set up stable locations for bird ringing.
- After the completion of the ringing activities, report the ringing situation and recovery information to the National Bird Ringing Centre in a timely manner.
- Carry out publicity, education and technical training on bird protection, stop illegal ringing or indiscriminate hunting and other behavious that damage bird resources and habitats, and report them to the competent wildlife authorities in a timely manner.

Chongming Dongtan Bird Banding Station

Hubei Wanghu Bird Banding Station

Jiangxi Suichuan Bird Banding Station

Requirements for bird banding personnel

- Staff and volunteers participating in bird banding activities should receive technical training from the China Bird Banding Center, Bird Banding Station or corresponding institutions, and can participate in organized banding activities only after passing the test.
- Foreign personnel to carry out bird banding work in China need to have effective bird banding qualifications and comply with relevant laws and regulations in China.

Access to administrative licenses in accordance with the law and regulation

The National Bird Ringing Centre, Bird Ringing Station or other institutions organizing bird ringing activities shall put forward a bird ringing plan on an annual basis, in which the birds that are planned to be captured:

1) If the wildlife is protected at the national level, it shall be reported to the forestry administrative department for approval in accordance with the law;

2) For wildlife under the second level of nation protection, it shall be reported to the provincial forestry administrative department for approval;

3) For non-National key protected wildlife, according to the relevant regulations of the location.

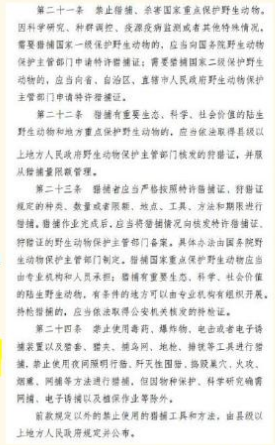
Those who implement the national bird ring plan approved by the National Forestry and Grassland Administration will no longer apply for a special hunting and catching license.

国家林业和草原局办公室文件

国家林业和草原局办公室关于
做好委托实施野生动物特许猎捕证或许可事项工作的通知

三、其他规定

实施经国家林业和草原局批准的全国鸟类环志计划的，不再另行办理《特许猎捕证》。



第二十一条 禁止猎捕、杀害国家重点保护野生动物。因科学研究、种群调控、疫源疫病监测或者其他特殊情况，需要猎捕国家一级保护野生动物的，应当向国务院野生动物保护主管部门申请特许猎捕证；需要猎捕国家二级保护野生动物的，应当向省、自治区、直辖市人民政府野生动物保护主管部门申请特许猎捕证。

第二十二条 猎捕有重要生态、科学、社会价值的陆生野生动物和地方重点保护野生动物的，应当依法取得县级以上地方人民政府野生动物保护主管部门核发的狩猎证，并服从猎捕量限额管理。

第二十三条 猎捕者应当严格按照特许猎捕证、狩猎证规定的种类、数量或者限额、地点、工具、方法和期限进行猎捕。猎捕作业完成后，应当将猎捕情况向核发特许猎捕证、狩猎证的野生动物保护主管部门备案。具体办法由国务院野生动物保护主管部门制定。猎捕国家重点保护野生动物应当由专业机构和人员承担；猎捕有重要生态、科学、社会价值的陆生野生动物，有条件的地方可以由专业机构有组织开展。特检猎捕的，应当依法取得公安机关核发的特检证。

第二十四条 禁止使用毒药、爆炸物、电击或者电子诱捕装置以及猎套、猎夹、捕鸟网、地枪、排铳等工具进行猎捕，禁止使用夜间照明行猎、歼灭性围猎、掏窝巢穴、火攻、烟熏、网捕等方法进行猎捕，但因物种保护、科学研究确需网捕、电子诱捕以及植保作业等除外。

前款规定以外的禁止使用的猎捕工具和方法，由县级以上地方人民政府规定并公布。

Wildlife Protection Law of the People's Republic of China

Treatment of ringed birds

- If it is approved to catch birds to carry out ringing activities, the captured birds should be released on the spot after loading markers or signal transmitting devices in a timely manner, and should not be hidden or retained for other purposes.
- In the process of bird ringing, if unauthorised birds are captured by mistake, those suitable for ringing should be properly ringed, and those unsuitable for ringing should be released on the spot; and timely rescue measures should be taken for injured or sick individuals.
- In order to carry out the ringing activities, the birds released for artificial breeding, confiscation by law enforcement, sheltering and rescuing should be carried out in their natural distribution areas, and must be qualified for quarantine.

Some Important Things

Currently, bird ringing is managed as wildlife hunting.

The principle of 'whoever applies is responsible' is observed.

The ringing of birds in restricted areas and during restricted periods requires a license.

Anyone who captures birds for ringing without approval or in violation of the provisions of these Measures, or who keeps birds for other purposes, shall be dealt with by the competent administrative department of wildlife in accordance with illegal hunting and trapping of wildlife.

If the situation is serious and constitutes a crime, criminal responsibility shall be investigated according to law.

Establishment of Shenzhen University Bird Banding Monitoring Station 2023/6/15

大湾区红树林湿地研发中心
Greater Bay Area Mangrove Wetland R&D Centre

全国鸟类环志中心
深圳大学鸟类环志监测站
深圳大学环志监测点
Shenzhen University Bird Banding Monitoring Station

全国鸟类环志中心
深圳大学鸟类环志监测站
深圳宝安国际机场环志监测点
Shenzhen International Airport Bird Banding Monitoring Station

全国鸟类环志中心
深圳大学鸟类环志监测站
广东内伶仃福田国家级自然保护区环志监测点
Futian Mangrove Reserve Bird Banding Monitoring Station

2023年秋季全国鸟类环志监测技术培训日程安排表

日期	时间	日程安排
10月12日	全天	全天报到
10月13日	10:00-10:30	开班仪式（主持：陈军） 1. 国家林草局领导讲话 2. 新疆维吾尔自治区林草局领导讲话 3. 环志中心领导讲话
	11:00-14:00	1. 全国鸟类环志概况（钱法文） 2. 野生动物保护法与鸟类环志管理（杨荣龙） 3. 鸟类学基础知识（张国钢）
	16:00-20:00	1. 鸟类环志管理办法与技术规程（钱法文） 2. 彩色脚标的使用规范与管理制作（江红星） 3. 禽流感监测与研究概况（张国钢） 4. 鸟类分类与识别（刘冬平） 5. 雀形目鸟类换羽、性别、年龄判别方法（刘冬平）
10月14日	10:00-14:00	开展环志实习（分组进行，开展张网、取鸟、环志、度量、疫病采样、释放等环志过程培训，培训地点：荔富堡湖）
	14:00-20:00	开展环志实习（分组进行，开展张网、取鸟、环志、度量、疫病采样、释放等环志过程培训，培训地点：荔富堡湖）
10月15日	全天	开展环志实习，内容同上，培训地点：南山
10月16日	10:00-14:00	1. 鸟类环志数据整理，录入（陈丽霞） 2. 鸟类迁徙研究方法与技术（刘冬平） 3. 卫星跟踪器佩戴（刘冬平） 4. 彩色标记制作实习（王毅花） 5. 疫源疫病采样技术（王毅花）
	14:00-18:00	1.环志站点交流（钱法文主持） 2. 考试（1小时） 3. 培训总结
10月17日	全天	野外鸟类识别实地实习，培训地点：水塘沟
10月18日	全天	全体人员返程

There are four main aspects of the bird banding:

① Tracking monitoring based on the support of wildlife rescue work of Shenzhen Nature Reserve Management Centre;

② Mangrove wetland combined with black-headed tern ringing monitoring and protection planning;

③ Bird-strike prevention and ringing protection at Shenzhen Bao'an International Airport;

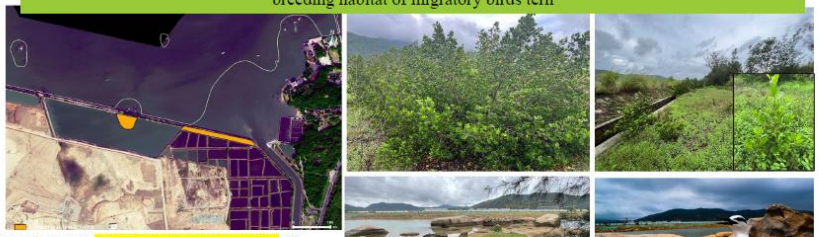
④ Waterbird ringing monitoring in Futian Mangrove Reserve.

Tracking of released rescued birds

Based on the rescue work carried out by the Shenzhen Nature Reserve Management Centre, a total of 13 birds released were fitted with tracking devices, of which 7 out of 10 Common Cormorants migrated successfully to their breeding grounds, 4 kept their data back and migrated southwards to China, of which 2 returned to Guangdong, and 1 has already returned to its wintering site in Shenzhen Bay in 2022.

Mangrove wetland + Discovery of breeding grounds of black-headed terns and monitoring by ring marks

Bright spot restoration project: restoration of rare and endangered mangrove plum community and breeding habitat of migratory birds tern



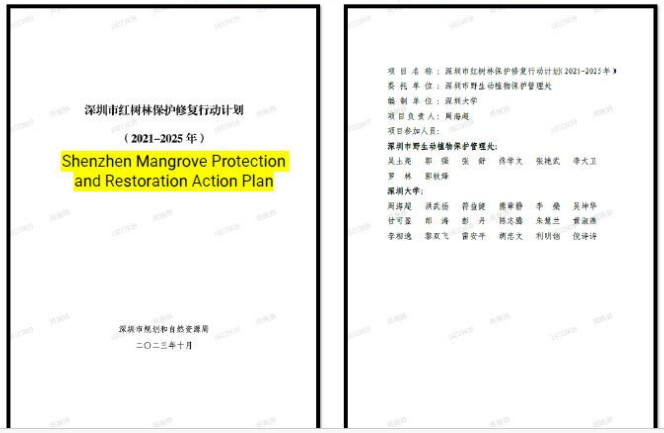
Restoration content: Rescue protection and restoration will enhance the small population of Prunus mume community and the breeding habitat of black-headed tern recorded for the first time in Shenzhen, with an area of 1.30 hectares. The ongoing construction of Yinwan Road (Xianrenshi-Xinhai Avenue) has potential negative impacts;

Highlights of restoration: mangrove wetland restoration+migratory bird migration channel protection.

Ringing of juvenile black-headed terns on their breeding grounds

① When the team conducted a mangrove wetland survey in May 2023, it discovered a black-napped tern breeding ground in the surrounding coastal habitats;
② Problems faced: Due to the sea rush activities in the surrounding area, human activities are frequent, and there are artificial behaviors such as stealing and moving bird eggs;
③ Response methods: Carry out video surveillance on the breeding island, ring the young birds and accumulate incubation rate, young bird survival rate and other data, and plan to promote the breeding island protection plan.
④ There were a total of 27 rings this year, including 3 adult birds and 24 young birds. One young bird that died due to a typhoon was recovered.

The protection of black-napped tern breeding grounds has been included in the mangrove restoration and protection plan



深圳市红树林保护修复行动计划

（2021–2025 年）

Shenzhen Mangrove Protection and Restoration Action Plan

深圳市规划和自然资源局

二〇二三年十月

项 目 名 称：深圳市红树林保护修复行动计划（2021–2025 年）

委 托 单 位：深圳市野生动植物保护管理处

编 制 单 位：深圳大学

项目负责人：周海超

项目参加人员：

深圳市野生动植物保护管理处：

吴土亮　郭　强　张　舒　钟学文　张艳武　李大卫

罗　林　郭秋锋

深圳大学：

周海超　洪武扬　符业健　唐章静　李　荣　吴坤华

甘可意　郎　涛　彭　丹　陈志鹏　朱慧兰　黄淑惠

李相逸　李双飞　雷安平　谢志文　刘明创　倪泽洋

“大鹏新区红树林和候鸟友好社区志愿队活动中心”揭牌暨2025年伏季休渔和国际生物多样性日主题宣传

"Dapeng District Mangrove and Migratory Bird-Friendly Community Volunteer Center" Inauguration Ceremony & 2025 Closed Fishing Season and International Biodiversity Day Themed Awareness Campaign

Haichao ZHOU，Shenzhen University，2025.05.19


IMC and Municipal Planning & Natural Resources Bureau Conducted
Tour of Volunteer Center and Community Awareness Campaign


Locals protecting mangroves and birds helps make conservation laws work better.

Bird banding monitoring for bird strike prevention at Shenzhen International Airport

The team cooperated with Shenzhen Bao 'an Airport to rescue the birds in the bird net in the airport and ring the birds before releasing them back.

Since September, 64 individuals have been ringed, and birds at risk of bird strike have been worn with trackers. Among them, 4 species of turtledoves have been worn with trackers.

Bird banding monitoring in Futian Mangrove Reserve

Public Awareness Education on Bird Banding


携手保护鸟类，共享自然之美——深圳大学生命与海洋科学学院参加第三届"山海连城 自然深圳"生活节活动

11月18日，深圳大学生命与海洋科学学院应邀参加2023年第三届"山海连城 自然深圳"生活节暨第六届福田荔枝节。活动由深圳市规划和自然资源局、福田区人民政府主办，福田区水务局（福田区红树林事务中心）、红树林基金会（MCF）等承办，在福田区卓悦中心节日大道正式开启，近80家自然教育机构为市民奉上了一场逐"绿"向"美"、自然野趣的欢乐"嘉年华"。

深圳大学的参展主题为"携手保护鸟类，共享自然之美"。活动由生命与海洋科学学院周海超、黄夏子和劳宇轩三位教师总体统筹指导，教育学部学科教学（生物）硕士研究生符亭亭、岑颖芸总体策划，志愿服务工作人员由生命与海洋

普通鸬鹚、游隼和夜鹭模型深受小朋友们的喜爱，激发了他们对鸟类的热爱，培养了孩子们保护鸟类的意识。

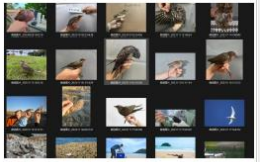
深大观鸟学会成员、生物技术专业陈子杨同学从鸟类环志的定义、意义、方法、步骤和工具等方面，对鸟类环志进行深入浅出的科普。随后，在陈子杨的指导下，市民们利用普通鸬鹚模型亲自动手进行鸟类环志操作。他们将带有编号的金属环志佩戴在鸟儿的脚上，并使用专业工具进行固定，测量和记录数据后"放飞"鸟儿。通过实践体验，参与者们不仅了解了鸟类环志的过程，也更加深入地认识到保护野生鸟类和生态环境的重要性。

Postcards and other small gifts for science popularization activities related to bird banding and monitoring


环志科普明信片设计草案

一、文字页（背面）

二、照片页（正面）



文创作品名称	参考图片
深圳候鸟冰箱贴	
鸟类挂垫	
优质帆布袋集	
趣味鸟类徽章	

Potential Application Areas of Bird Ecology

Transportation (Aviation Safety!)

Urbanization

Public health

Agriculture

Power grid

Wind farm

Aquaculture

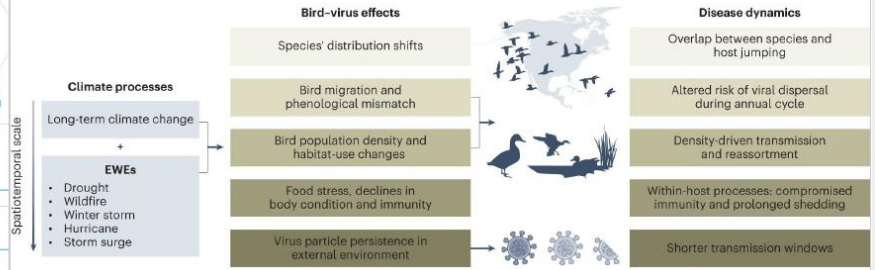
Comment

https://doi.org/10.1038/s41564-023-01538-0

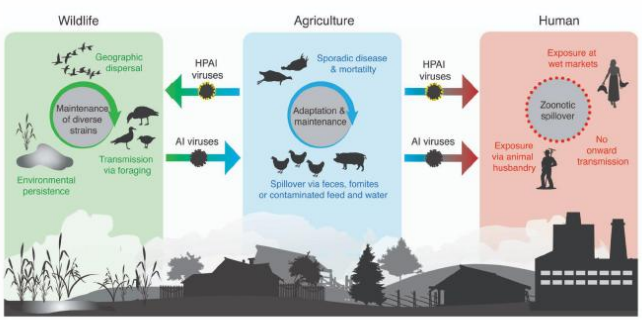
Climate change impacts on bird migration and highly pathogenic avian influenza

Diann J. Prosser, Claire S. Teitelbaum, Shenglai Yin, Nichola J. Hill & Xiangming Xiao

Check for updates

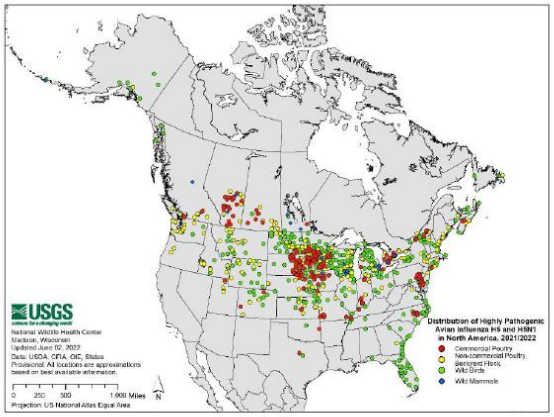


Generalized ecology of avian-origin influenza A viruses showing common directionality of cross-species transmission events



Source: https://americanornithology.org/highly-pathogenic-avian-influenza-hpai-an-emerging-disease-threat-in-north-america/

Distribution of Highly Pathogenic Avian Influenza H5 and H5N1 in North America



Source: https://americanornithology.org/highly-pathogenic-avian-influenza-hpai-an-emerging-disease-threat-in-north-america/

Indicative transmission routes of highly pathogenic avian influenza A(H5N8) through birds migrating into Europe

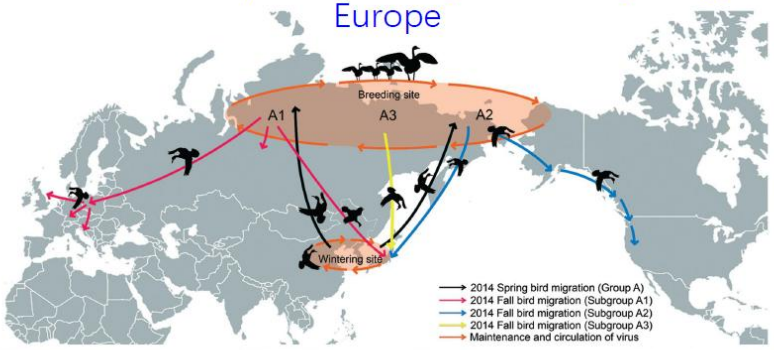
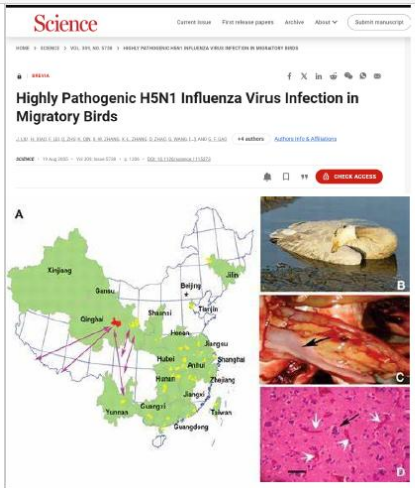
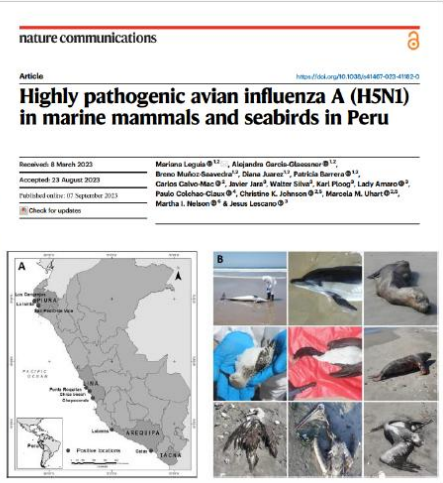
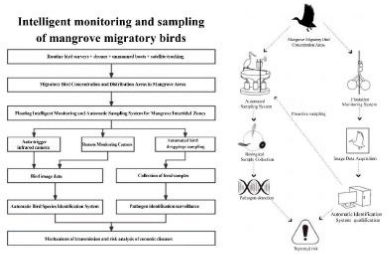


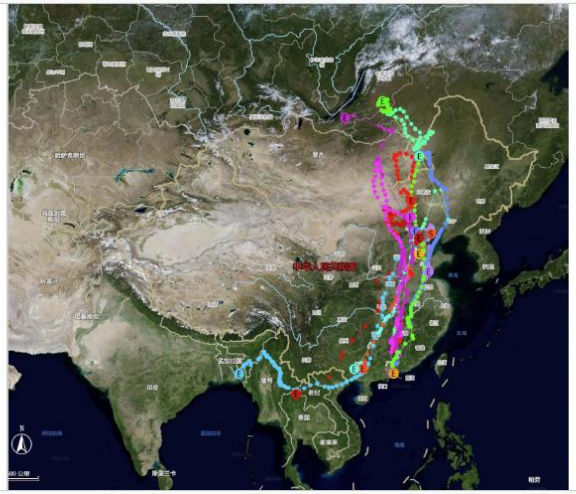
FIG 2 Geographic map showing the movement of H5N8 HPAIV in Asia, Europe, and North America in relation to regional waterfowl migration routes. The map, by Dmthoth, is from Wikipedia Commons (http://commons.wikimedia.org/wiki/File:Blank_Map_Pacific_World.svg).

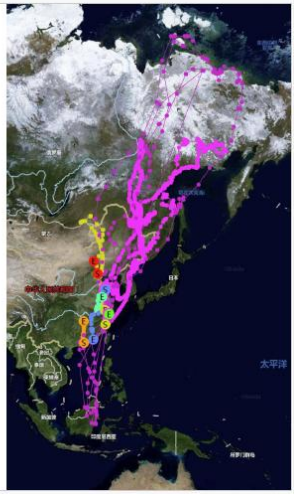




Ongoing Project:
Research and Application Demonstration of Mangrove Migratory Birds Zoonotic Disease Monitoring and Traceability Technology





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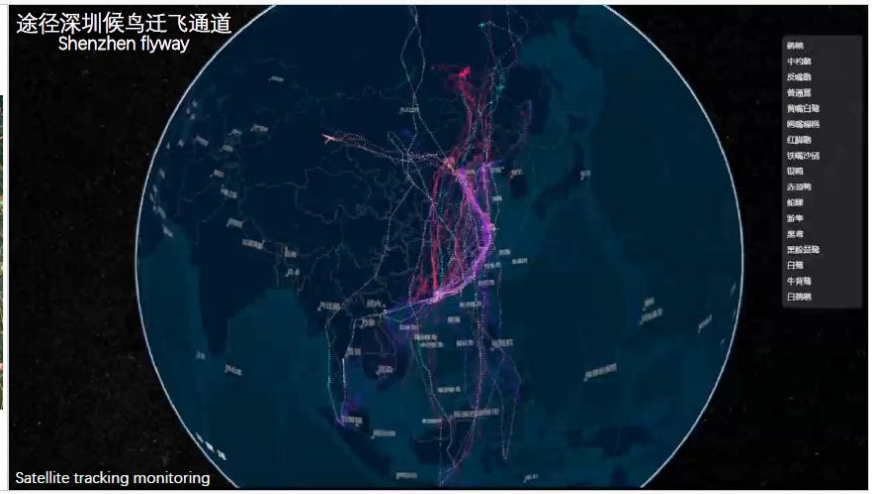
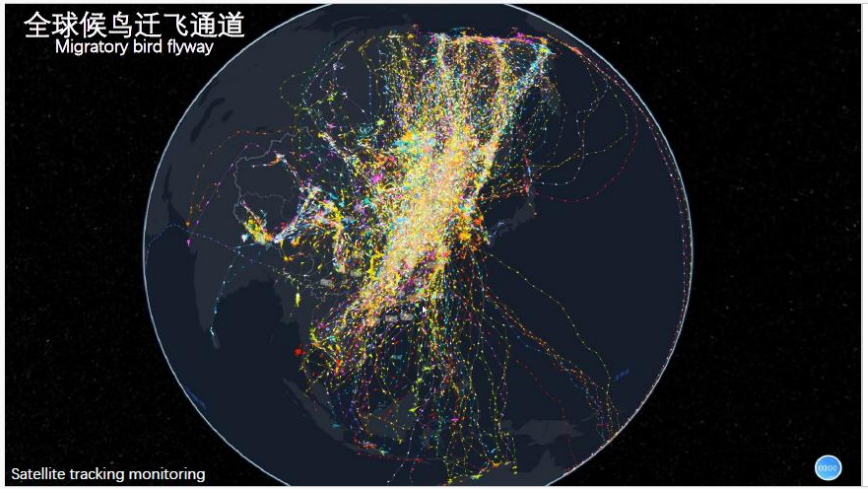
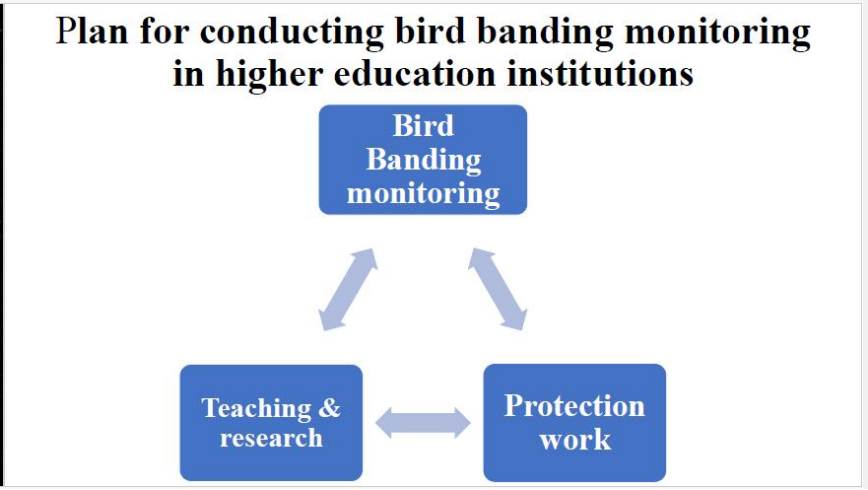
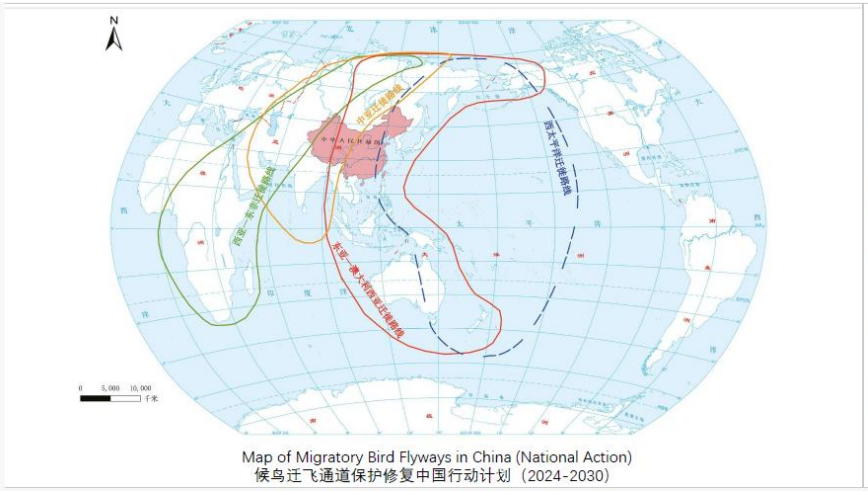
JUNSHAN DISTRICT
Yueyang
岳阳市
Dongdongting Lake
YUEYANG COUNTY
Luhu Lake


途径深圳候鸟迁飞通道
Shenzhen flyway
Satellite tracking monitoring


全球候鸟迁飞通道
Migratory bird flyway
Satellite tracking monitoring


Plan for conducting bird banding monitoring in higher education institutions
Bird Banding monitoring
Teaching & research
Protection work



Map of Migratory Bird Flyways in China (National Action)
候鸟迁飞通道保护修复中国行动计划（2024-2030）

What do we plan to do in the future?

① Based on the project to carry out mangrove wetland migratory bird ringing + zoonotic disease monitoring work;

② Strengthen the cooperation with Shenzhen Airport on bird banding and conservation + bird early warning, etc;

③ Carry out zoology internship for bird ringing and monitoring based on undergraduate teaching practice;

④ Bird ringing education (bird collision survey, etc.) based on undergraduates' competitions and public welfare projects;

⑤ Hope to use IMC opportunity to establish an international network for bird banding and monitoring in mangroves and other wetland areas.

LECTURE 12: MANGROVE ECOLOGICAL CHARACTERS MAINTENANCE

Outline

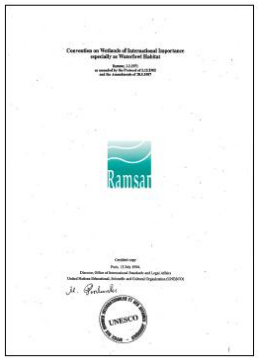
1. Wetland Definition and Categories
2. Ecosystem Services
3. Status, Trends and Drivers
4. Concept of Ecological Characters
5. Ecological Character Description
6. Monitoring and maintenance
7. Group discussion

Ramsar
CONVENTION ON WETLANDS
CONVENTION SUR LES ZONES HUMIDES
CONVENCIÓN SOBRE LOS HUMEDALES
(Ramsar, Iran, 1971)

1. Wetland Definition and Categories

Ramsar
CONVENTION ON WETLANDS
CONVENTION SUR LES ZONES HUMIDES
CONVENCIÓN SOBRE LOS HUMEDALES
(Ramsar, Iran, 1971)

What are wetlands?



Convention on Wetlands
1971

Wetlands Conservation Law
of the People's Republic of China
2022

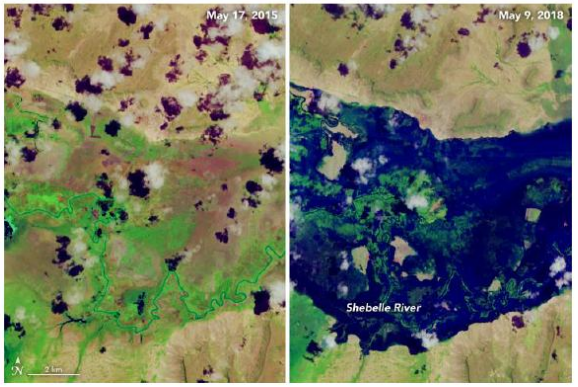
Convention Definition of Wetlands

CONVENTION ON WETLANDS
CONVENTION SUR LES ZONES HUMIDES
CONVENCIÓN SOBRE LOS HUMEDALES
(Ramsar, Iran, 1971)

Article 1 Definition

1. For the purpose of this Convention wetlands are **areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres**.

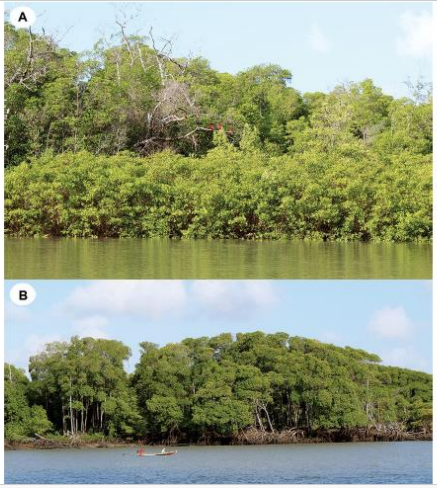
The wetlands include **surrounding areas** of the shores, riverbanks, and entire watercourses.



NASA/Joshua Stevens

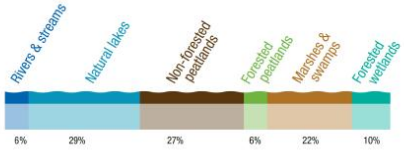
https://earthobservatory.nasa.gov/images/92130/dramatic-flooding-in-eastern-africa

Ottoni et al. 2021
DOI: 10.1590/1676-0611-BN-2020-1172

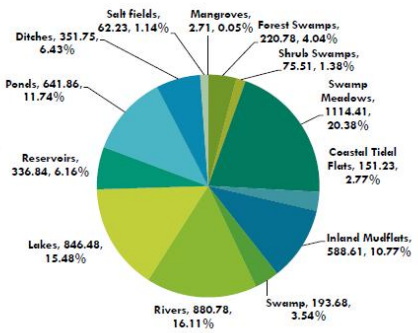


Categories of Wetlands

Ramsar	China
3 classes 42 types • marine wetlands • artificial wetlands • inland wetlands. These groups can be classified further according to the type of water such as the fresh, alkaline, saline, and brackish water.	5 classes 42 types GB/T 24708-2009 • coastal wetlands • riverine wetlands • lake wetlands • marsh/swamp wetlands • artificial wetlands Statics by Ramsar Category is different by China's Category



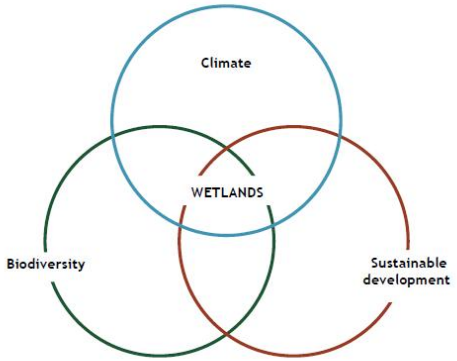
Areas (%) of world natural inland wetland classes



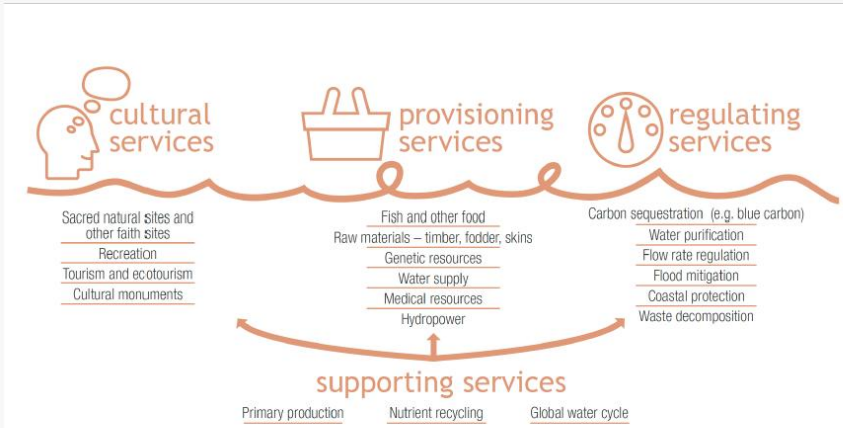
Areas (%) of wetland classes in China

2. Ecosystem Services

- Wetland ecosystem services **far exceed** those of terrestrial ecosystems
  - **critical food supplies** including rice and freshwater and coastal fish, **and fresh water, fibre and fuel**.
  - **regulating** services influence **climate and hydrological regimes**, and **reduce** both **pollution and disaster risk.**
  - natural features of wetlands often have **cultural and spiritual importance.**
- Wetlands offer **recreational possibilities and tourism benefits.**
- Storage and sequestration of **carbon** by wetlands play an important role in regulating the global climate.
  - **Peatlands and vegetated coastal wetlands** are large carbon sinks. Salt marshes sequester millions of tonnes of carbon annually.
  - Despite occupying only 3% of the land surface, peatlands store twice as much carbon as the world's forests
  - **Mangroves store 3-4 more times of Carbon than Rainforest**



Water
Food
Water regulation
Climate regulation
Salinization of soils
Culture heritage
Recreation and tourism



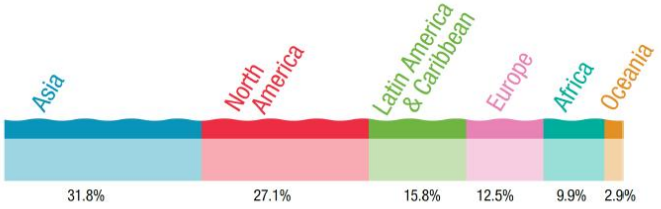
Carbon cycle in/through Wetlands

3. Status ,Trends & Drivers GWO 2018 & 2021

Ramsar
CONVENTION ON WETLANDS
CONVENTION SUR LES ZONES HUMIDES
CONVENCIÓN SOBRE LOS HUMEDALES

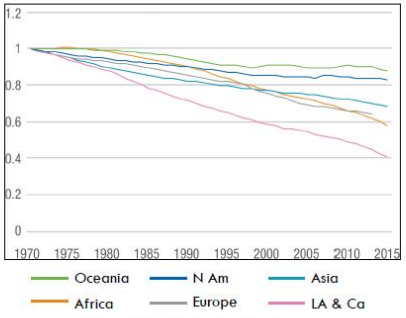
Area of global inland and coastal wetlands

15-16 million km² GWO 2021
12.1 million km² GWO 2018



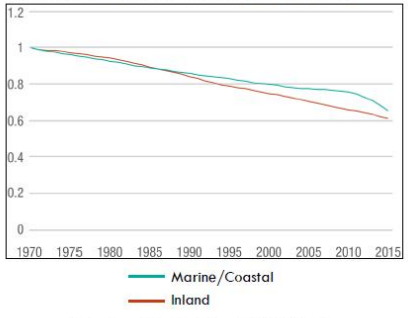
Loss of Wetlands GWO 2018

Up to **87%** of the global wetland resource has been lost since **1700 CE** in places where data exist



Natural WET Index by Region

About **35%** in both marine/coastal and inland natural wetland areas studied between **1970 and 2015**



Inland and Marine/Coastal WET Index

Trends of Wetlands

GWO 2018

Inland natural wetlands	Global area (million km²)			
	Wetland classes	Wetland sub-classes[a]	Global area change (% change)[a]	Global area change (qualitative)[a]
Rivers & streams	0.624-0.662			↓
Natural lakes	3.232-4.200			↓
Natural lakes (>10 ha)		2.670		↓
Natural pools (1-10 ha)		0.562		
Peatlands	4.232		-0.97	→
Non-forested peatlands (bogs, mires & fens)		3.118	+6.80	↑
Forested peatlands		0.606	-25.32	↓
Tropical peatlands		1.505	-28	↓
Temperate & boreal peatlands		3.380		
Marshes and swamps (on alluvial soils), including floodplains	2.530			↓
Tropical freshwater swamps (alluvial soils)		1.460		↓
Forested wetlands (on alluvial soils)	1.170			
Groundwater-dependent wetlands				
Karst & cave systems				
Springs & oases				
Other groundwater-dependent wetlands				

	Global area (million km²)			
	Wetland classes	Wetland sub-classes[a]	Global area change (%)[a]	Global area change (qualitative)[a]
Estuaries	0.660			↓↓↓
Unvegetated tidal flats		0.458		↓↓↓
Saltmarshes		0.550		↓
Coastal deltas		>0.030	-52.4	↓↓
Mangroves	0.143		-4.3%	→
Seagrass beds	0.177		-29	↓
Coral reefs (warm water systems)	0.284		-19	↓
Shellfish reefs			-85	↓↓
Coastal lagoons				↓
Kelp forests			-0.018	→
Shallow subtidal marine systems				↓
Sand dunes/beaches/rocky shores				
Coastal karst & caves				

3. Status ,Trends & Drivers

Ramsar
CONVENTION ON WETLANDS
CONVENTION SUR LES ZONES HUMIDES
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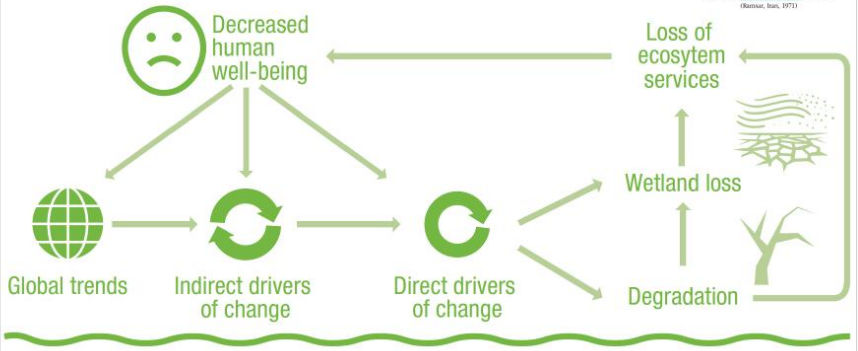
(Ramsar, Iran, 1971)



Type of Drivers

GWO 2018

Direct drivers
Drainage and conversion, introduction of pollution and invasive species, extraction activities, and other actions affecting the water quantity and frequency of flooding and drying

Indirect drivers
Supply of energy, food, fibre, infrastructure, tourism and recreation

Direct and indirect drivers
Climate change: abnormal precipitation and evaporation, extreme weathers, phenology shift, warmer temperature
Global megatrends: demography, globalization, consumption and urbanization, with climate change creating uncertainty
Governance: awareness, inventory, monitoring, research, management

Alteration-Physical regime change
- Flow regime (quantity and frequency)
- Sediment
- Salinization
- Temperature

Extraction-Over use
- Water
- Fishing
- Wood harvesting
- Sand and gravel mining

Introduction-Over load
- Nutrients
- Chemicals
- Solid wastes
- Invasive Species

Conversion-Structure Change
- Drainage
- Reclamation/Construction/urbanization
- Activities/noise
- Buring/ploughing
- Community composition/horticulture

Hot Issues and Priorities of the Ramsar Convention

Themes
- **Climate & Carbon**-Impacts and responses, Blue Carbon, mitigation
- **Agriculture**-Maintaining and restoring the ecological character in agricultural wetlands
- **Biodiversity**-KM Global Biodiversity Framework, OECMs, Working coastal habitats
- **Sustainable Development**-SDGs

Tools
- **Application** of criteria for designating RS
- **Tools** for wetland assessment, mapping and monitoring: Carbon and Small Wetlands

Solutions
- **Financial** cost of wetland loss and degradation and investment required for restoration
- **Policy** and **legal** framework for conservation and wise use

4. Concept of Ecological Characters

Ramsar
CONVENTION ON WETLANDS
CONVENTION SUR LES ZONES HUMIDES
CONVENCIÓN SOBRE LOS HUMEDALES
(Ramsar, Iran, 1971)

Article 3.2 Ecological Character

Each Contracting Party shall arrange to be informed at the earliest possible time if the ecological character of any wetland in its territory and included in the List **has changed, is changing or is likely to change** as the result of technological developments, pollution or other human interference. Information on such changes shall be passed without delay to the organization or government responsible for the continuing bureau duties specified in Article 8.

COP14 2022

14th Meeting of the Conference of the Contracting Parties to the Ramsar Convention on Wetlands

"Wetlands Action for People and Nature"
Wuhan, China, and Geneva, Switzerland 5-13 November 2022

Resolution XIV.13

The status of Sites in the List of Wetlands of International Importance

75% of the 2,439 Sites that had been designated by 30 June 2022, either the Ramsar Information Sheets (RISs) or adequate maps had not been submitted, or relevant RISs or maps had not been updated for over six years, so that recent information on the status of these Sites was not available

Convention on Wetlands (Ramsar, Iran, 1971)
5th Meeting of the Conference of the Contracting Parties
Kushiro, Japan
9-16 June 1993

Resolution 5.4: The Record of Ramsar sites where changes in ecological character have occurred, are occurring, or are likely to occur (Montreux Record)

DETERMINES that the purpose of the Montreux Record is to identify priority sites for positive national and international conservation attention, to guide implementation of the Monitoring Procedure, and to guide allocation of resources available under financial mechanisms;

CONVENTION ON WETLANDS (Ramsar, Iran, 1971)

Proceedings of the 6TH Meeting of the Conference of the Contracting Parties (Brisbane, Australia, 19-27 March 1996)

RESOLUTION VI.1: WORKING DEFINITIONS OF ECOLOGICAL CHARACTER, GUIDELINES FOR DESCRIBING AND MAINTAINING THE ECOLOGICAL CHARACTER OF LISTED SITES, AND GUIDELINES FOR OPERATION OF THE MONTREUX RECORD

3.2 The Montreux Record is the principal tool of the Convention for highlighting those sites where an adverse change in ecological character has occurred, is occurring, or is likely to occur, and which are therefore in need of priority conservation attention. It shall be maintained as part of the Ramsar Database and shall be subject to continuous review.

When we look at people, there are... then we describe...

Common

Style

Wierdo...

When we look at wetlands, there are... then we describe...

typical

unique

degraded

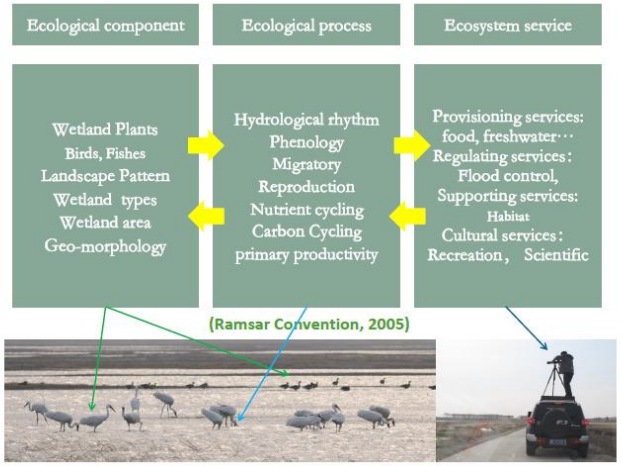
Wetlands also have characters:
ecological characters

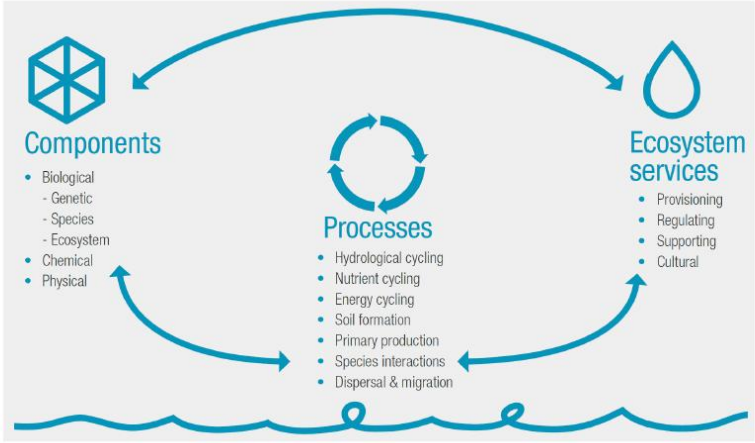
Ecological Characters:
Why a Wetland is THE WETLAND

The Concept of Ecological Character

=Ecological component
+Ecological process
+Ecosystem service

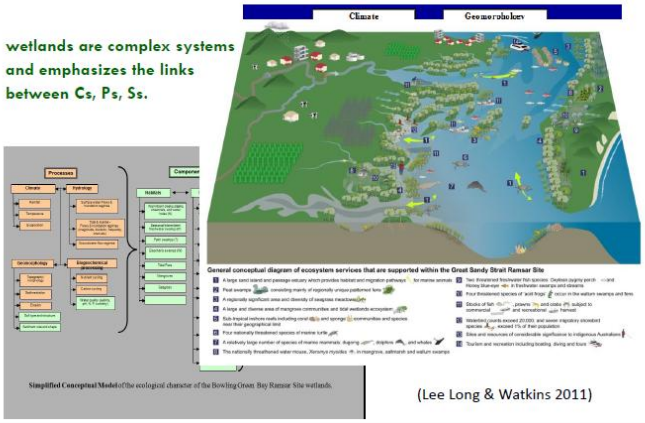
Momoge: World largest stopover site for Siberian Cranes





Conceptual Model for EC

wetlands are complex systems and emphasizes the links between Cs, Ps, Ss.

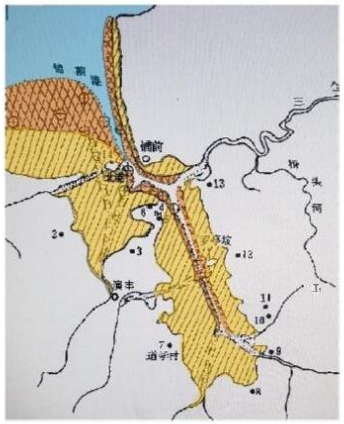


(Lee Long & Watkins 2011)

5. Ecological Character Description

Ramsar
CONVENTION ON WETLANDS
CONVENTION SUR LES ZONES HUMIDES
CONVENCIÓN SOBRE LOS HUMEDALES
(Ramsar, Iran, 1971)

- Describes the **ecosystem services** of a wetland, and the critical **ecological components** and **ecological processes** that underpin those services - **at a given point in time**
- Via ECD
  - provides a benchmark description at the time of listing, natural variability and **limits of acceptable change (LAC)** of the ecosystem
  - better dynamic monitoring on biodiversity
  - provides support for management plans, decisions and actions



1605 Earth Quake at Dongzhaigang, Hainan

Rogers K et al 2017
DOI:10.1007/s10750-017-3257-5.

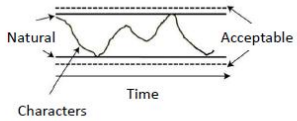
Identifying Critical Characters

Principle of identifying critical character

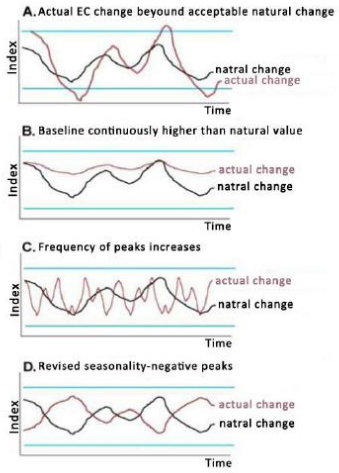
—are key determinants of a sites' character and/or degree of importance and/or unique status;
—if they change beyond their natural range, are likely to cause significant negative consequences to the ecosystem(s) of this site;
—have important ecological links in space or time to other ecosystems or populations

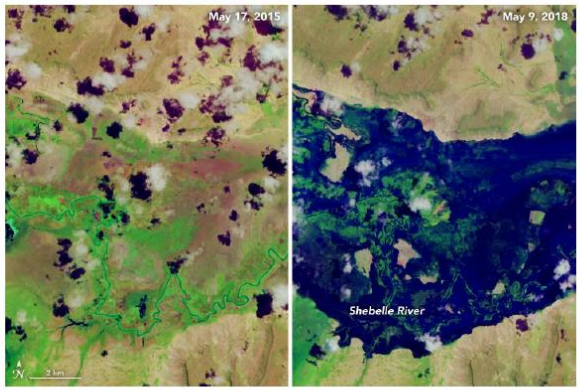
Thus, a critical C,P must meet 1, as well as 2 and/or 3

Setting LAC



(after Phillips 2006).

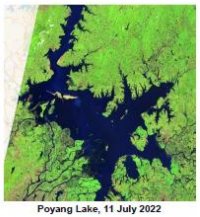




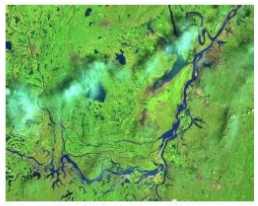
NASA/Joshua Stevens

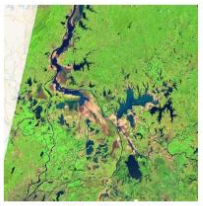
https://earthobservatory.nasa.gov/images/92130/dramatic-flooding-in-eastern-africa


Dongting Lake, 11 July 2022


Poyang Lake, 11 July 2022

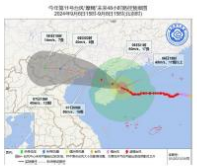
2022

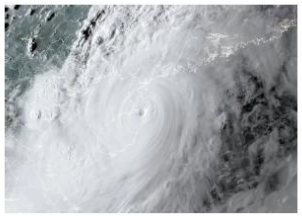

Dongting Lake, 15 August 2022


Poyang Lake, 15 August 2022

Typhoon Yagi in Hainan, 6 September 2024

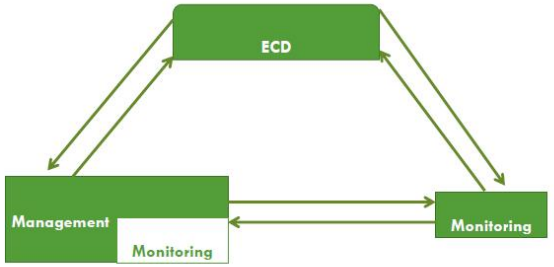
Loss of 80 bn CNY, 9.4% GDP



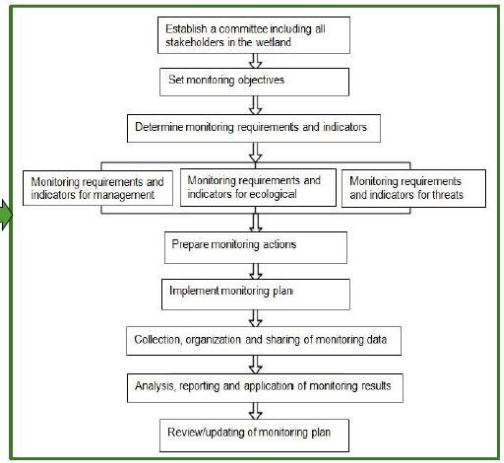


6. Ecological character monitoring and maintenance

Understanding the relationship between the ECD, Management and Monitoring

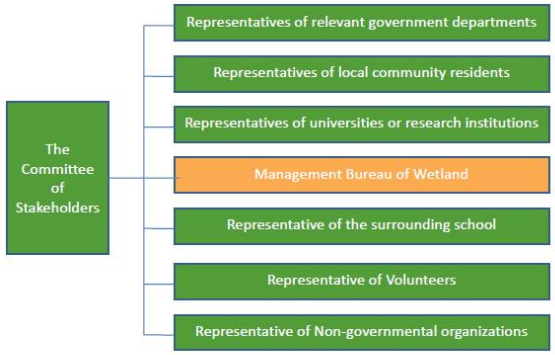


Essential elements for developing monitoring plan for a wetland



CEAAF

Step 1 Establishing Monitoring Committee of Stakeholders



Step 1 Establishing Monitoring Committee of Stakeholders

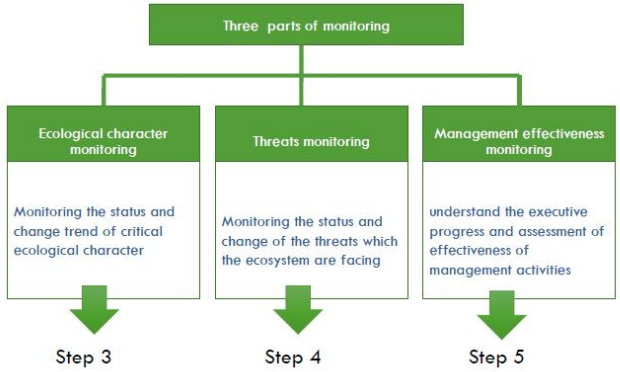
Step 1 Establishing Monitoring Committee of Stakeholders

In order to ensure that

- integrates well with the development plans of all stakeholders,
- secures more supporting resources,
- facilitates implementation,

a committee of stakeholders in monitoring should be established at the outset.

Step 2 Identifying Monitoring Objectives

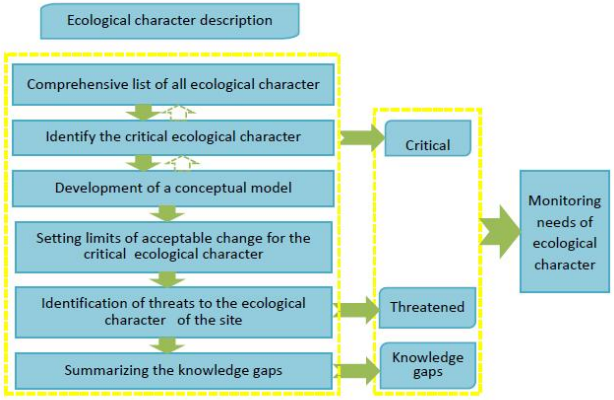


Step 2 Identifying Monitoring Objectives

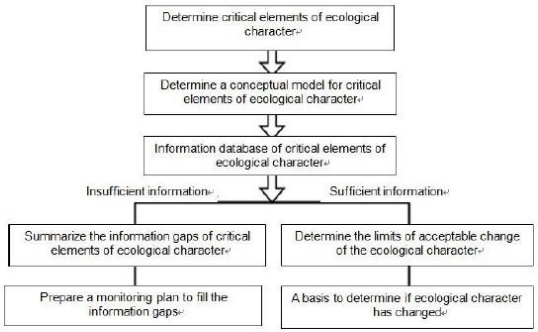
General "Guiding Principles"

- Answer the questions raised in the management process
- Iinvestigate the status and trends of change of ecological character;
- Investigate the threats that may influence ecological character;
- Monitor implementation progress and the effectiveness of management activities;
- Promote public participation and balance the interests of all parties.

Step 3 Identify Monitoring Needs and Indicators for Ecological Character



Step 3 Identify Wetland Monitoring Needs and Indicators for Ecological Character



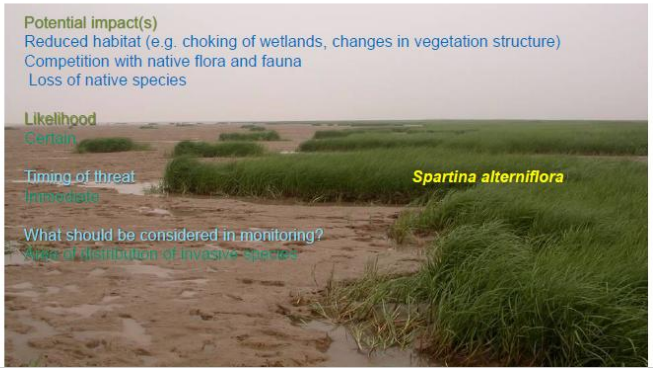
Step 4 Identify Monitoring Needs and Indicators for Threats

CEAAF

Eexisting or potential threats to the ecological character of PAs

Actual or likely threat or threatening activities	Impacted ecological character	Potential impact(s) to ecosystem components, processes and/or services	Likelihood	Timing of threat

e.g., threats: Introduction and/or poor control of invasive species



A list of threats developed by the **International Union for the Conservation of Nature (IUCN)** and the **Conservation Measures Partnership (CMP)**

http://www.iucn.org/about/work/programmes/species/red_list/resources/technical_documents/new_classification_schemes/

These categories may be a useful starting point for identifying threats to ecological character of a Protected Area.

Step 5 Identify Monitoring Needs and Indicators for Management Effectiveness

Through monitoring of executive progress and effectiveness of wetland management activities, managers can assess the impacts of management actions on wetland ecosystem, review and update management plan.

Management activities	Excepted objectives	Implementation	Whether objectives has been achieved	Reason

Wetland restoration

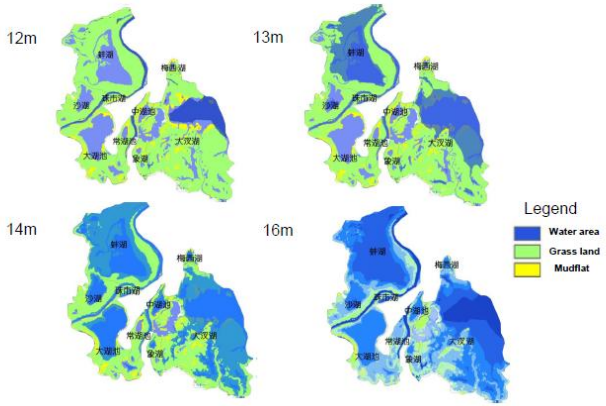
review of the extent of expected scenarios realized……

Step 6 Develop Action Plan for Monitoring Indicators

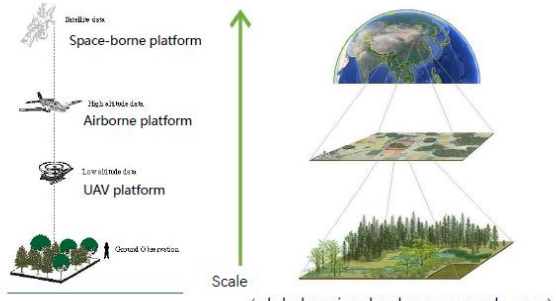
In this section, we should select monitoring methods, indentify monitoring frequency, and priority of monitoring activities as showing in the following table:

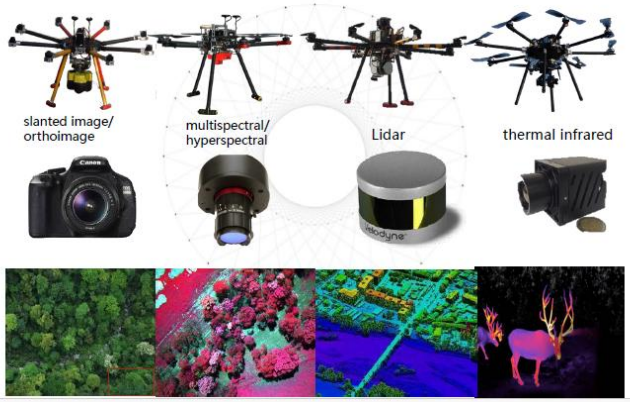
Indicators	Methods	Monitoring frequency	Source of funding	Priority

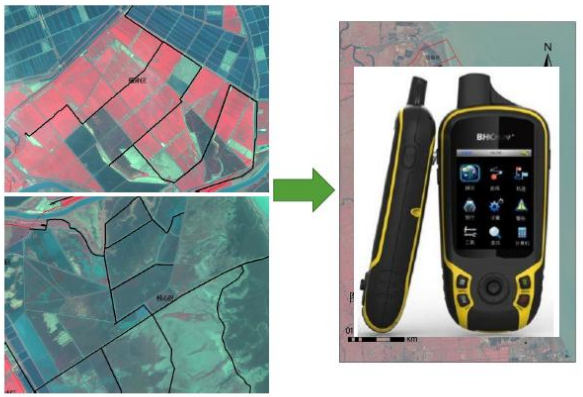
Monitor Change of wetland landscape by remote sensing technology



RS can provide biodiversity information of multiple spatial scale and time scale




slanted image/
orthoimage
multispectral/
hyperspectral
Lidar
thermal infrared

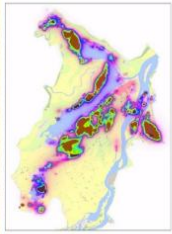



Plant survey
Sampling of benthos


Acoustic recorder





Step 7 Implementation of Monitoring Action Plan

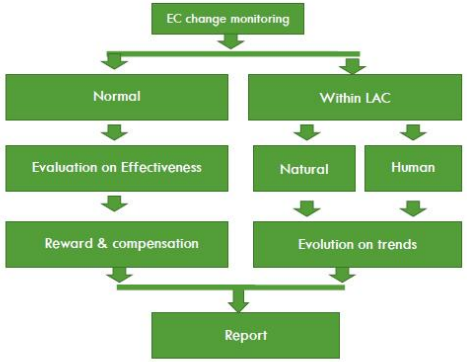
Monitoring action plan should be implemented with contracting parties, the task arrangement should be recorded by management bureau.

Monitoring activities	Executor	Reporting frequency	Contact

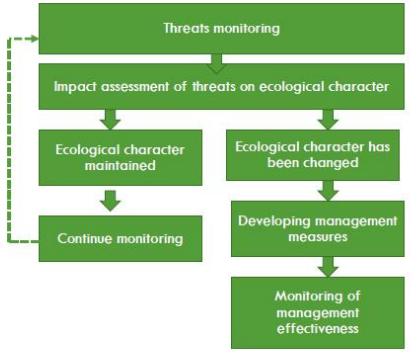
Step 8 Collection and Submission of Monitoring Data

The executors of monitoring activities should submission data to the Bureau.

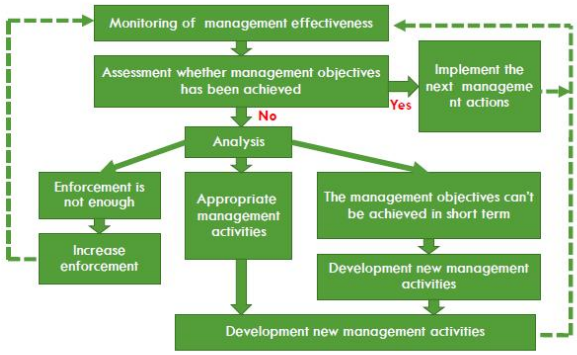
Step 9 Analysis, Reports and Applications of Monitoring Data



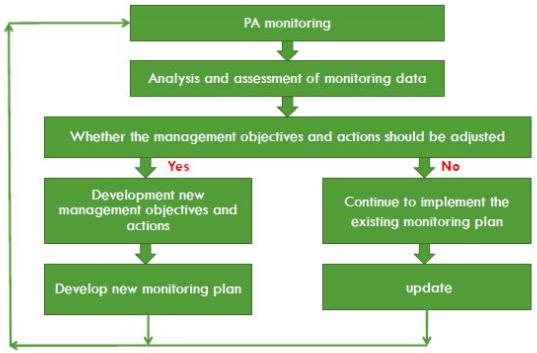
Step 9 Analysis, Reports and Applications of Monitoring Data



Step 9 Analysis, Reports and Applications of Monitoring Data



Step 10 Update of monitoring plan



How much mangroves increased in China actually?

14th Meeting of the Conference of the Contracting Parties to the Ramsar Convention on Wetlands

"Wetlands Action for People and Nature"

Wuhan, China, and Geneva, Switzerland 5-13 November 2022

COP14 2022

Resolution XIV.19

Proposal to establish an International Mangrove Centre (a Ramsar Regional Initiative)

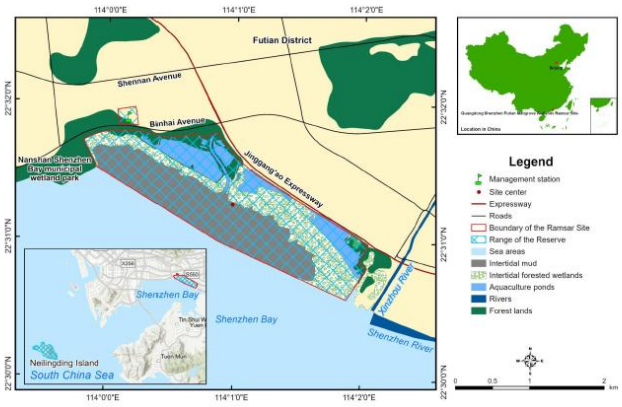
Background session in draft Resolution, a case of increasing / net gain of mangroves in China:

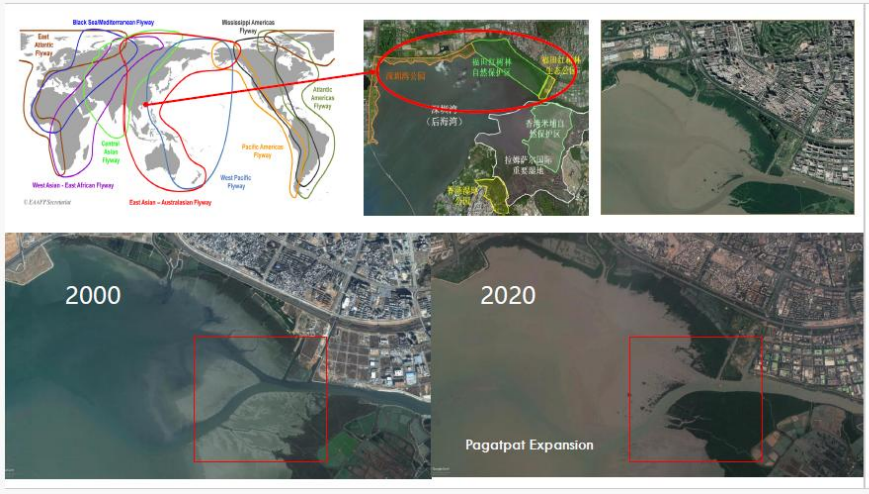
7000 ha in the past 20 years - Data by NFGA
5000 ha in the past 20 years – Data by MNR

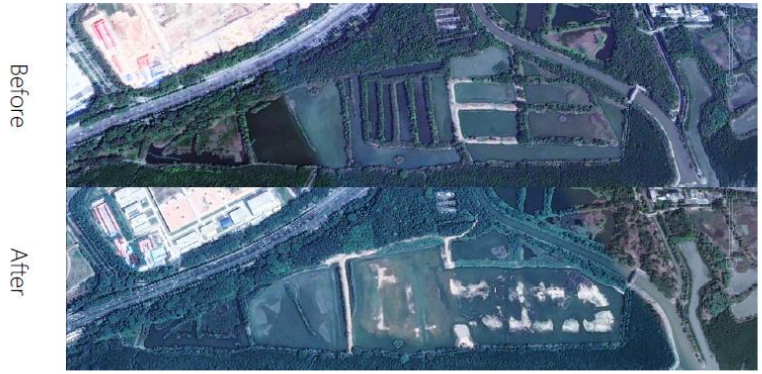
Where are the missing 2000 ha?

Guangdong Shenzhen Futian Mangrove Wetlands Ramsar Site

(Total area 367.64 ha)




Black Sea/Mediterranean Flyway
Mississippi Americas Flyway
East Atlantic Flyway
Atlantic Americas Flyway
Central Asian Flyway
Pacific Americas Flyway
West Asian - East African Flyway
West Pacific Flyway
East Asian – Australasian Flyway
2000
2020
Pagatpat Expansion


Before
After


2022
Pagatpat removed

Group discussion on challenges and priorities

1. Select a shared challenge in your region 5 min
2. Describe the issue + list 3 major Components, Processes, ESs, drivers of changes 15 min
3. Draw a map of conceptual model + optional box conceptual model 15 min
4. Identify/Think of 1 Critical Ec and priority10 min
5. 3-4 Group reports 2 min each:
   - 1 Challenge
   - 1 map
   - 1 critical EC
   - 1 Priority

ANNEX 4 : PARTICIPANTS' PRESENTATION SLIDES

CHINA PRESENTATION

Monitoring and Evaluation of Mangroves under the Integrated Forest and Grassland Monitoring System

202X

Academy of Forest and Grassland Inventory and Planning, National Forestry and Grassland Administrition

Zhang Xiaoyun

目 录

CONTENTS

01 林草综合监测 Foerest and Grassland Integrated Monitoring System

Background

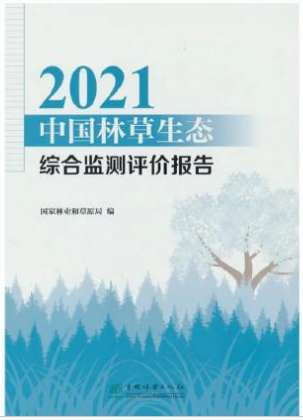
Since 2018, with the advancement of national institutional reform, and the promulgation of new forestry, grassland, and wetland protection laws, it has become an urgent task to achieve integrated monitoring of forest resources with grasslands, wetlands, deserts, and other types of resources. The National Forestry and Grassland Administration has organized key technical personnel to make technical solutions for integrated survey and monitoring of forest, grassland, wetland, and desert resources, and proposed the concept of integrated forest and grassland monitoring, which was implemented in 2021.

Achievements

An integrated monitoring system has been established, covering ecological conditions such as forest, grassland, wetland, desert resources.

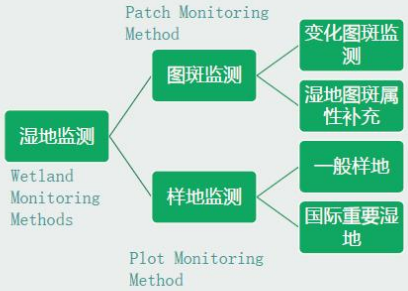
The first national integrated forest and grassland ecological monitoring and evaluation work has been completed in all 31 provinces (autonomous regions and municipalities)

the "2021 China Integrated Forest and Grassland Ecological Monitoring and Evaluation Report" has been released, marking an important milestone in the development of forestry surveys and monitoring.



02 监测内容和评价方法 Monitoring Content and Evaluation Methods

湿地监测方法



Wetland Monitoring Methods

Patch Monitoring Method

Wetland patches focus on area, and are provided with complete attribute information, including management levels, protection forms, vegetation types and areas, and threats. Changes in administrative and management boundaries, land use and vegetation cover types, natural attributes, and management attributes are monitored.

Plot Monitoring Method

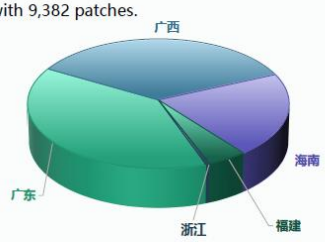
Wetland patches in each province are sampled with a precision of no less than 90%, resulting in about 10,330 wetland plots nationwide. A spatially balanced sampling method is used to locate the plots.

红树林面积和图斑 Mangrove Area and Patches

据国土变更调查数据统计，2021年全国红树林面积27370.53公顷，9382个图斑。

According to the national land change survey data, in 2021, the national mangrove area was 27,370.53 hectares, with 9,382 patches.

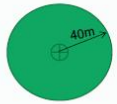
省份	图斑数量	面积（hm²）
浙江省	43	123.86
福建省	490	1276.65
广东省	4872	10624.84
广西	2360	9617.47
海南省	1614	5727.68
合计	9379	27370.53



样地抽样方法 Sampling Method

- The mangrove wetland patches in each province are taken as the sampling population, and the number of mangrove plots in each province is calculated according to a sampling precision of no less than 90%, with a total of 254 national mangrove plots.
- A spatially balanced sampling method is used to locate the plots. The plot area is 0.5 hectares, with a shape of a circle with a radius of 40 meters.

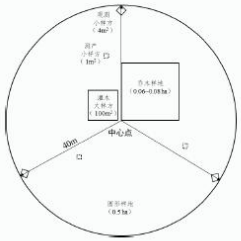
省份	图斑数量	面积	样地数量
浙江省	43	123.86	27
福建省	490	1276.65	39
广东省	4872	10624.84	55
广西	2360	9617.47	59
海南省	1614	5727.68	74
合计	9379	27370.53	254



样地调查Plot Survey

The plot design consists of a 0.5 hm² circular plot (radius 40m), a square/rectangular/circular arbor plot with an area of 0.06–0.08 hm², three 40m-long transects, a 100 m² large shrub plot, three 4 m² observation subplots (2m×2m), and three 1 m² yield subplots.

For wetland types with uneven vegetation distribution, the plot location can be selected based on typical vegetation distribution.



样地监测内容

- 地貌
- 海拔
- 土壤类型
- 植被群系和覆盖面积
- 溶解氧
- 土壤含水量
- 积水状况
- 水源保障情况
- 受威胁状况
- 利用方式
- 植物种类
- 外来入侵植物
- 植被生物量

Survey date,
Surveyor,
Plot number,
Plot area (m^2),
Wetland type,
Soil type,
Vegetation type,
Vegetation area,
Vegetation community,
Dissolved oxygen,
Soil moisture content,
Water source security,
Threats,
Invasive species,
Utilization,
Number of species
Vegetation biomass

调查日期			调查人	
样地号			样地面积（m^2）	
湿地类型				
实际纵坐标（m）			实际横坐标（m）	
样地是否移动			样地移动原因	
地貌			海拔（m）	
土壤类型				
植被类型			植被面积	
植被群系1			覆盖面积	
植被群系2			覆盖面积	
植被群系3			覆盖面积	
溶解氧	位置	上游来水	中部	下游出水
	坐标			
	含量（mg/L）			
	测定时间			
土壤含水率	测点位置坐标			
	10cm			
	30cm			
	60cm			
积水状况			水源保障情况	
受威胁状况				
利用方式				
植物种类				种数： 种
序号	名称	序号	名称	

赋值统计方法Scoring and Statistics Methods

溶解氧平均值分级赋值
Dissolved Oxygen Scoring

溶解氧Ó	平均溶解氧Ó	三处溶解氧数值平均
	溶解氧赋值$O_{赋值}$（参照地表水质标准）	Ó≥7.5，赋值57.5＞Ó≥6，赋值46＞Ó≥5，赋值35＞Ó≥3，赋值23＞Ó≥2，赋值12＞Ó，赋值0
	沿海滩涂和红树林溶解氧赋值（参照海水水质标准）	Ó≥6，赋值56＞Ó≥5，赋值45＞Ó≥4，赋值34＞Ó≥3，赋值23＞Ó，赋值1

植物多度赋值
Plant Abundance Scoring

植物种数F	植物多度F赋值	F≥20，赋值520＞F≥15，赋值415＞F≥10，赋值310＞F≥5，赋值25＞F，赋值1
	沿海滩涂和红树林生物多样性F赋值	F≥5，赋值55＞F≥2，赋值4F=1，赋值31＞F，赋值2

植被生物量计算方法Biomass Calculation Methods

红海榄	M=Wi+Ws+Wr Wi=0.055(D)$^{1.687}$ Ws=0.085(D^2 H)$^{0.891}$ Wr=0.295D$^{1.575}$
海榄	
榄李	
木榄	
白骨壤	M=Wi+Ws+Wr Wi=0.005D$^{2.429}$ Ws= 0.00002 (D^2 H)^2+0.034 (D^{2}H)+0.0547 Wr=0.042D$^{2.137}$
海榄雌	
拉关木	M=Wi+Ws+Wr Wi=0.019(Dc)^2−0.189Dc+1.629 Ws=0.185(Dc^2 H)$^{0.702}$ Wr=0.039Dc$^{2.288}$
无瓣海桑	M=Wi+Ws+Wr Wi=0.003Dc$^{2.556}$ Ws=0.028(Dc^2 H)$^{0.981}$ Wr=0.013Dc$^{2.685}$
海桑	
秋茄	M=Wi+Ws+Wr Wi= 0.018(D)$^{1.567}$ Ws=0.08 (D^2 H)$^{0.797}$ Wr=0.066D$^{1.847}$
桐花树	
海莲	
海漆	
海桐	

D:基径,地面高度5cm处的树干直径。单位：cm
Dc：胸径。单位：cm
H:植株高度。单位：m

赋值统计方法Scoring and Statistics Methods

	样地指标	新增计算指标	数值处理
Water source security	水源状况H	水源满足程度赋值	优=5良=4中=3差=1
Dissolved oxygen	溶解氧Ó	平均溶解氧Ó	三处溶解氧数值平均
		溶解氧赋值	Ó≥7.5，赋值5；7.5>Ó≥6，赋值4；6>Ó≥5，赋值3；5>Ó≥3，赋值2；3>Ó≥2，赋值1；2>Ó，赋值0
Soil moisture content	土壤含水量S	加权平均土壤含水量S	$S=S_{10}\times10\%+S_{30}\times40\%+S_{60}\times50\%$
		土壤含水量赋值	S≥40或常年积水，赋值5；40>S≥20，赋值4；20>S≥15，赋值3；15>S≥10，赋值2；10>S，赋值1
Number of species	植物种数F	植物多度F赋值	F≥20，赋值520>F≥15，赋值415>F≥10，赋值310>F≥5，赋值25>F，赋值1
Invasive species	外来入侵植物I –	外来入侵物种面积占植被面积比例	I≥80，赋值0；80>I≥60，赋值1；60>I≥40，赋值2；40>I≥20，赋值3；20>I>0，赋值4；I=0，赋值5
Threats	威胁情况T	威胁情况T赋值	安全=5轻度=4中度=3重度=1

评价方法 Evaluation Methods-Indicator Weighting

The weights of various indicators are determined using the Analytic Hierarchy Process (AHP) based on the opinions of more than 500 wetland experts, managers, survey and monitoring personnel, and grassroots protection personnel collected through questionnaires.

生态状况指标权重确定
Indicator Weighting

样地指标	新增计算指标	权重
水源状况H	水源满足程度赋值	0.2864
溶解氧Ō	平均溶解氧Ō	0.0906
	溶解氧赋值	
土壤含水量S	加权平均土壤含水量S	0.0515
	土壤含水量赋值	
植物种数F	植物多度F赋值	0.1747
威胁情况T	威胁情况T赋值	0.3968

湿地健康状况评价 Wetland Healthy Evaluation

湿地健康

$$WHI = 100 * \sum_{i=1}^{n} A_i Y_i$$

*WHI*为湿地生态健康指数，Wetland Health Index

Ai为归一化后的指标指数，Score

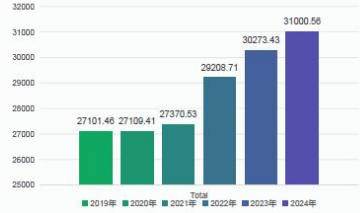
Yi为三级指标层次总排序所得到的权重值,Weight

湿地生态健康等级 Level	指数区间 Index interval	湿地生态系统特征 Wetland Ecosystem Profile
优	*WHI*≥4	湿地水源充足，水质较好，湿地生物多样性高，湿地植被完好，无外来入侵生物，受威胁状况小、高度原真，湿地生态系统完整性好、稳定性高。
良	3.5≤*WHI*<4	湿地水源稳定，水质一般，湿地生物多样性较高，湿地植被较好，基本无外来入侵生物，受威胁状况较小、原真性好，湿地生态系统相对完整、稳定。
中	3≤*WHI*<3.5	湿地水源减少，水质中等，湿地生物多样性一般，湿地植被退化，外来入侵中等，受威胁状况中等，湿地生态系统完整性和稳定性一般、生态功能一般。
差	*WHI*<3	湿地水源连年持续减少，水质较差，湿地生物多样性低，湿地植被退化明显，外来入侵严重、受威胁状况严重，湿地生态系统完整性和稳定性低。

03 监测结果与分析

红树林面积Mangrove Area

Provences	2019年	2020年	2021年	2022年	2023年	2024年
浙江省	118.23	118.19	123.86	337.48	351.76	343.91
福建省	1212.15	1211.69	1276.65	1309.67	1499.32	1781.45
广东省	10651.83	10618.39	10624.84	10992.38	11448.38	11643.71
广西	9421.04	9475.73	9617.47	10404.17	10621.87	10798.54
海南省	5697.73	5685.41	5727.68	6165.01	6350.69	6432.95
Total	27101.46	27109.41	27370.53	29208.71	30273.43	31000.56



湿地健康状况评价结果

Healthy Evaluation Result of Wetlands

	植物多样性	水质	威胁	水源保障情况	土壤含水量	生态状况评价
北京市	1.25	3.94	4.63	4.31	4.50	3.90
天津市	2.16	3.82	4.92	4.44	3.86	4.15
河北省	1.93	4.23	4.27	4.12	4.18	3.82
山西省	2.22	3.22	3.27	3.63	4.77	3.29
内蒙古自治区	1.95	4.15	4.13	3.92	2.96	3.63
辽宁省	1.84	4.65	4.35	4.76	4.51	4.07
吉林省	1.01	2.06	4.48	4.28	3.77	2.56
黑龙江省	1.71	3.35	4.62	4.10	4.62	3.85
上海市	2.04	4.32	2.31	4.66	4.62	3.64
江苏省	2.08	3.94	4.20	4.34	3.72	3.82
浙江省	2.43	4.03	3.73	4.19	4.77	3.73
安徽省	1.19	3.12	4.46	4.38	4.26	3.74
福建省	2.02	4.24	4.50	4.57	4.48	4.06
江西省	1.81	3.91	4.17	4.69	4.19	3.89
山东省	2.19	4.07	4.65	3.88	4.51	4.02
河南省	2.96	4.12	4.08	4.11	4.30	3.91
湖北省	3.24	4.21	4.03	4.47	4.42	4.07
湖南省	1.42	3.34	4.51	4.63	3.80	3.86
广东省	2.06	4.30	4.27	4.70	4.88	4.08
广西壮族自治区	2.97	4.52	4.09	4.84	4.04	4.14
海南省	2.08	4.10	4.00	4.60	4.46	4.19
重庆市	3.67	3.87	2.89	4.85	3.57	4.11
四川省	3.03	3.24	2.75	3.56	4.70	3.57
贵州省	4.13	4.88	2.97	4.79	4.28	4.33
云南省	2.38	3.89	2.62	4.24	3.59	3.61
西藏自治区	1.20	1.81	2.66	2.99	3.18	3.13
陕西省	1.25	3.72	4.07	3.76	3.17	3.41
甘肃省	1.81	4.27	2.76	3.07	3.21	3.24
青海省	1.82	2.70	4.08	3.87	4.29	3.46
宁夏回族自治区	1.20	3.34	4.07	4.20	4.56	3.56
新疆维吾尔自治区	1.04	4.23	3.88	3.53	3.41	3.29
全国	1.68	3.23	4.07	3.93	3.82	3.52

红树林生态状况评价结果 Evaluation Result of Mangroves

省份	面积(公顷)	样地数量	植物多样性	溶解氧	威胁	水源保障情况	土壤含水量	生态状况评价
浙江省	123.86	27	3.19	2.07	3.93	4.89	4.85	3.95
福建省	1276.65	39	2.95	4.41	4.26	4.23	4.49	4.05
广东省	10624.84	54	3.41	3.63	4.59	4.54	4.94	4.30
广西壮族自治区	9617.47	59	4.20	4.00	3.88	5.00	4.81	4.32
海南省	5727.68	73	3.10	3.07	4.74	4.37	4.75	4.20
全国	27370.5	252	3.60	3.67	4.35	4.65	4.83	4.27

植被生物量和碳储量计算结果 Biomass and Carbon Storage Calculation

省份	面积(公顷)	单位面积生物量（kg/m²）	总生物量（吨）	碳储量（万吨）
浙江省	123.86	15.17	18789.56	0.91
福建省	1276.65	1.33	16943.19	0.82
广东省	10624.84	6.55	695995.06	33.76
广西壮族自治区	9617.47	6.48	623045.22	30.22
海南省	5727.68	4.78	273785.21	13.28
全国	27370.5		1628558.24	78.99

04 存在问题与改进措施

Issues and Improvement

问题分析

- ◆ 目前，红树林湿地的监测内容与其它类湿地的监测内容和评价模型一样，没有针对红树林的自身特点制定监测指标和评价模型。
- ◆ The current monitoring content and evaluation model for mangrove wetlands are the same as for other wetlands, without considering the unique characteristics of mangroves.
- ◆ 监测指标和结果年度间变化不明显，年度变化情况反映不敏感。
- ◆ Annual changes in monitoring indicators and results are not sensitive enough.

改进措施Improvement Measures

- Sampling Method Improvement

Consider using a typical sampling method for mangroves, given the detailed distribution and species information from previous surveys.

- Monitoring Content and Model Improvement

Develop a monitoring indicator system and evaluation model tailored to mangroves to better reflect their quality and health status.

- Technology Application

Use drone technology to monitor mangrove biomass, improving the efficiency and accuracy of monitoring.

Thanks

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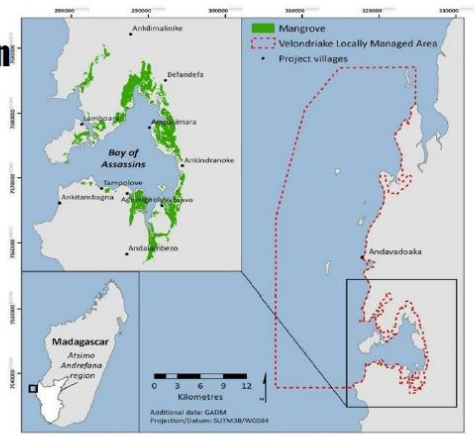
MADAGASCAR PRESENTATION

Preservation & restauration
1 300 Ha



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Bōndy AFRICA
A JOINT VENTURE BETWEEN BŌNDY & VNV

Ma Honko project

A ground-breaking step toward mangrove restoration and coastal community empowerment in Madagascar

COMMUNITY-BASED AND ASSISTED NATURAL MANGROVE RESTORATION – IRODO – BAY MADAGASCAR

FORESTS 4 FUTURE

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CHALLENGES ADDRESSED IN IRODO BAY

FORESTS 4 FUTURE

- Increase of the pressure from the local coastal population: small-scale conversion to agriculture, over-exploitation of forest products (timber, firewood, etc.), erosion and sedimentation due to upstream agriculture and deforestation.
- Poor hydrological conditions of many degraded mangrove ecosystems which significantly hinder the growth of young propagules : reduced or limited connectivity of the degraded mangrove ecosystems to the sea preventing tidal currents to reach and allow seeding recruitment

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OBJECTIVES COMMUNITY-BASED AND ASSISTED NATURAL MANGROVE RESTORATION

- The main objective is **to restore degraded mangrove ecosystems further inland** that have limited or reduced connectivity with the sea.

- The specific objectives are :
  - Built tidal water channels to **improve hydrological and soil conditions** as well as **seedling transport for better settlement** and growth of propagules
  - Improve the living conditions for the local population and developing their livelihood

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COMMUNITY BASED IDENTIFICATION AND VALIDATION OF THE RESTORATION SITE

- To promote adherence of the local community to the process, the identification and validation of the restoration site was carried out jointly with them and the regional forest service

- The process is leading by the local community who is the best advisers for restoration site choice (the historical, environmental and topographic context, …) and to ensure the sustainability of the restoration sites.

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PREPARATORY MEETING, MOBILIZATION OF THE COMMUNITY AND IMPLEMENTATION

- Prior Community meetings to raise awareness about the importance of mangrove restoration: their future benefits must be discussed in an understandable and participatory way (food security and income regeneration, biodiversity, cyclone)
- Inform local community of the principles of the restoration method and the steps involved for a suitable design of the channel system in the area (depth, angle of channel site, length, starting point, …)

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THE MAIN TECHNICAL CRITERIA FOR IDENTIFYING SITES

From a technical point of view, the following criteria are crucial:

- Existing degraded mangrove area
- Existing flood zone during low tides
- Soil type (muddy or sandy-muddy) and neutral pH;
- Water salinity must be brackish.

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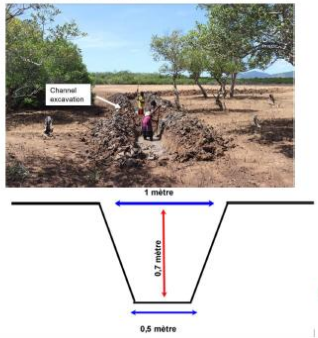
APPROACH

- Community mobilization using the HIMO approach (cash for work)
- Digging canals from the sea into degraded mangrove areas



RESULT

- 50 members of the local community were mobilized to dig the channel
- An area of 40 ha of degraded mangroves was identified
- A channel system with a total length of 2,5 km was dug to promote the natural recolonization in the degraded areas

OBSERVATION AND MONITORING OF RESTORED MANGROVE SITES

Four types of action are considered :

- Observation missions by the local community that will consist in assessing if the recruitment of seedlings (propagules) takes place, defining the growth level (height) and evaluating the possible damage caused by the surrounding herds (especially by zebu herds) or climatic hazards;
- Mission to monitor the state of the water channels to see if the banks are still stable and discharge (flow-through) is possible, especially during high water tides
- First estimate of the level of success, e.g. approximate area of seedling settlement
- Long-term monitoring (biomass and biodiversity) using drone and satellite imagery

IMPACT

The mangrove ecosystem

- Modification of soil structure in degraded areas with the availability of water
- Gradual recolonization of natural regeneration of mangrove forests in the degraded area
- Very high success rate of mangrove plantations by the local community
- Enhanced of the biodiversity : new crab holes identified in the site

IMPACT COMMUNITY-BASED AND ASSISTED NATURAL MANGROVE RESTORATION

Socio-economic :

- ❑ Strengthens of the community cohesion and collaboration.
- ❑ Improved livelihoods conditions : communities are starting to collect crabs and mollusks from the restored site;

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LESSONS LEARNED

FORESTS 4 FUTURE

- ❑ **Participative identification of restoration zones** to chose the methodology and appropriate restoration technology
- ❑ **Participative and inclusive approach for the implementation of the restoration activities** (cash for work)
- ❑ **Nursery establishment** important for improving the plantation survival rate
- ❑ **Monitoring post restoration by the community** to facilitate the assessment
- ❑ **Patrolling surveillance and awareness:** periodic activity to avoid pressures in the mangroves

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Thank you for your attention

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MADAGASCAR

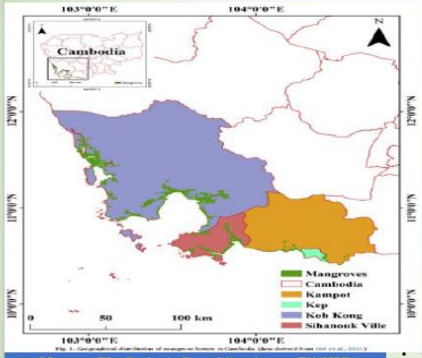
CAMBODIA PRESENTATION

I. Cambodia's Background

Area	:	181 035 km²
Population	:	~ 17 million (2024)
Coastline	:	435 km
Coastal Province	:	4 Provinces (Koh Kong, Preh Sihanouk, Kampot, Kep)
Coastal population	:	~ 7% of the total population)
Total Protected Area	:	73 areas, cover around 40% of the country's territory)
Coastal protected Area	:	8 areas

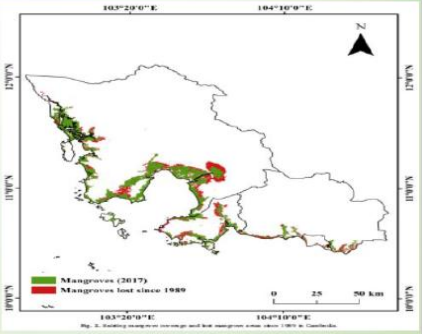
- 3 National parks (Kep, BoKor, Botomsakor)
- 2 Marine National parks (Ream, Koh Rong)
- 2 Multiple use Area (DongPeng, Kbal Chay)
- 1 Wildlife Sanctuaries (Peam Krosob)

II. Overview of mangrove in Cambodia



Mangrove Distribution in Coastal Area (source; FiA 2010)

Province	Mangrove (ha)
Koh Kong	62,000
Sihanoukville	13,500
Kampot	1,900
Kep	1,005
Total	78,405



- Cambodia has around 85, 100 ha of mangrove (Bann,2003)
- According to FiA, mangrove in 2010 remain 78, 405ha
- Cambodia has 78 km² mangroves left, mainly in Koh Kong
- Approximately 12 % of mangrove forest was lost from 1993 to 2011
- Cause of mangrove lost: Shrimp farming, charcoal production, salt farming, Tourist sector, infrastructure development and unsustainable use.
- Cambodia recent reduction of mangrove loss: Reforestation of mangrove species, banned of charcoal production, deactivation of non-profitable aquaculture ponds.

III. Conservation efforts (1/5)

III.1 Policy and Legislation Framework

Objectives:

1. To become a carbon neutral country by 2050 and to promote the preservation of ecosystem, the protection of biodiversity and the conservation of natural protected areas.
2. To intensify tree planting movement
3. Improving protected area management
4. Enhancing local communities' livelihood
5. To protect, conserve and manage both ecological and socio-economic system to ensure the long-term sustainability of coastal ecosystems of mangroves as a flagship species and other coastal resources and benefits of the coastal resources-dependent dwellers in Cambodia.

III. Conservation efforts (2/5)

III.2 Conservation practices

- Community-Based Conservation in coastal areas;
  Community Protected Area (CPA)= 17
  Community Fisheries (CFi)= 41
- Improve and expand mangrove nursery in coastal area
- Take action to arrest the perpetrators who cut down mangrove forest
- Provide legitimate tenure right

Protected Areas system, spatial planning and zoning

Mangrove Conservation

Disseminate the benefits of mangrove forests to local communities (Training, workshop, people to people)

Sustainable Farming Practice: working with local community to do farming.

Experimental Farming: Planting mangrove trees 5ha in Koh Smao village, to show people the benefit of having mangrove forests to balance the environment and biodiversity.

Reducing Logging in the Mangrove forest: install manure-powered biogas on 12 local farm

III. Conservation efforts (3/5)

III.3 Restoration practice

1. **Restoration Approach:**
   - Follow Guidelines for Mangrove Restoration
   - Experimental multi-species of mangrove plantation
   - Re-plantation of multi-species of mangrove
   - Monitoring the growth and survival of planted mangrove
2. **Several NGOs, Agencies, and communities have been involved in mangrove restoration such as;**
   - Culture and Environment Preservation Association (CEPA), Wetlands International ,The Participatory Management of Mangrove Resource (PMMR), IUCN, Mangrove for the Future (MFF), ActionAid, BCC Project, CCA4CSII Project, Coastal Zone Management project of DANIDA
3. **Private Sectors involvement:**
   - British Chevening Alumni Association of Cambodia, Vital Company, Panasonic company, Heineken Cambodia, ATALIAN Cambodia

III. Conservation efforts (4/5)

III.4 Community Involvement

- Acknowledged the benefit of mangrove ecosystem for their daily life
- Annual mangrove planting
- Patrolling activities to safeguard mangrove cut down or other illegal activities
- Livelihood diversification
- Communities-based ecotourism (Trapeang Sangke, Peam krosaop, Boeng kachhang , koh salao and koh kapi CPAs)
- Participate in workshop or training to gain more knowledge about mangrove and share their respective practical experiences.

Patrolling

Training, workshop

Local community farming

Peam Krosaop

Trapean Sangke

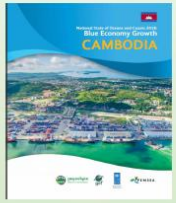
Reducing Logging in the Mangrove forest: install manure-powered biogas

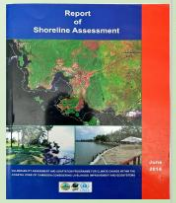
III. Conservation efforts (5/5)

III.5 Monitoring and Assessment

There are some reports on Cambodia's environmental status for coastal areas, such as:

- 5th Environmental status report
- Biodiversity, Climate Change Vulnerability and Adaptation Needs Assessment of Kep Province
- Mangrove Biodiversity Survey Report (Peam Krasop wildlife sanctuary and Koh Kapik Ramsar site
- Coastal Mangroves. Rehabilitation and Management
- Cambodia Forest Cover 2018
- 6th National Report to the Convention on Biological Diversity
- National State of Ocean and Coasts 2018: Blue Economy Growth, Cambodia
- Report of Shoreline Assessment.





A Snapshot of recorded biodiversity in Koh Kapik Ramsar Site, one of the coastal protected areas in Cambodia (1/2)

Muñoz et al., 2024

1. **Flora**
   - 64 species of mangroves recorded in the Koh Kapik Ramsar site
2. **Fauna**
   - 41 bird species
   - 25 species of mammals
   - 74 larval and juvenile taxa belonging to 53 genera, 31 families, and 15 orders

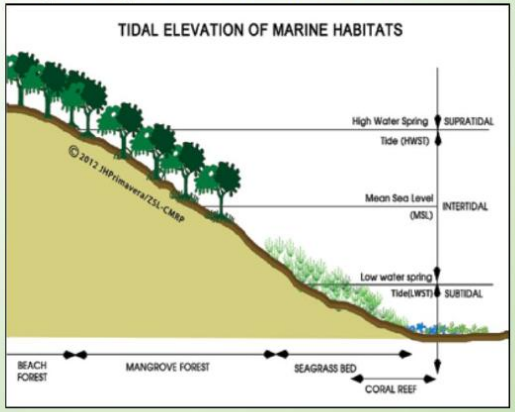
A Snapshot of recorded biodiversity in Koh Kapik Ramsar Site, one of the coastal protected areas in Cambodia (2/2)

Based Practices of Mangrove Restoration in Cambodia

Planning Planting Mangrove. Determine zones

Seed or Seedlings Options?

- Doing nothing (protection/boat exclusion)
- Assist General Regeneration (ANR)
- Translocation (wildlings)
- Seeds (lower water)
- *Seedlings* (high waters)



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Spacing

- *BCCP: 1 x 1 m => 2 x 1½ m from 10,000 plants/ha to 3,300 plants/ha*
- ***Example**: High density of 15,030 Rhizophora apiculata trees / ha was found in 5 year-old stands decreasing sharply to 9,810 in 8 year-old stands, proving stocking was too high (suggest >1.2 x 1.2 m). Data from Malaysia*
- Vietnam (spacing) 2 x 3 and 2 x 3 m

Recommended:

- 2 x 1½ in fragile semi-deep area waters / safe areas
- 3 x 3 m
- 2 x 2½ m in shallow in enrichment areas (EP)

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Photo 1 In the parent mangrove occurrences of wildings are plenty. At times difficult to access them and secure soil ball to be dug up with the wilding. Photo by GIC BCCP team 2017

Photo 1 Mangrove wildings are earthballed (= carefully dug up and removed with soil) to prevent root damage. Then transferred to polythene bags to retain the soil. Without the soil the mortality increases tremendously. Photos from Philippines (PTFCF 2014).

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Mangrove Nursery – Boeng Kachaeng

Photo 1 Seed bed raising Rhizophora seedlings in the same mangrove nursery as above. Note the light shade provided by Maleleuca trees.. Roots develop much faster than stem and foilage. Photo by MoE's silviculturist to BCCP, Mr. Both

Mangrove Nursery for seedling raising

Photo 1 BCCP open air mangrove nursery in Boeng Kachhang near Koh Kong town 2016. Seed beds are inundated twice a day during the 1-2 moths required for the propagules to develop into plantable seedlings. Photo by MoE's silviculturist to BCCP, Mr. Both

Mangrove Nursery – nylon net shaded

Photo 1 Preparing seedbeds and polythene pots in mangrove field nursery in Koh Kong. The seedlings are arranged in temporary belts lined out by strings to guide direction. Pots are placed directly on the ground and roots can penetrate into the muddy soil below the pots.

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Emptying the Nursery – out-planting seedlings!

Photo 1 Seedlings being transplanted manually from mangrove nursery to field for planting. The seedlings are bulked and tied in bundles of 12-24 pots; placed on a sledge or wooden board and pulled by a string to reduce the burden of carrying them as they are heavy. Photos from year 2015-16 from mangrove nursery in Koh Kong by MoE's silviculturist to BCCP, Mr. Both

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Photo 1 Sowing of seed o "propagules" resemble. planting seedlings. Here ir Koh Kong, the sowing takes place at low tide when there is a dry spe. during rains. Photo by MoE's silviculturist to BCCP, Mr. Both

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Photo 1 Accomplished plantation of Rhizophora seedlings 1.5 x 2 m in Boeng Krataeng 2018. Note the support-sticks tied to the seedlings for stabilising them and avoid that they topple or tilt. Photo by MoE's silviculturist to BCCP, Mr. Both

Deep waters in Andoung Teuk….

Photo 1 Exploited, degraded mangrove in lower Andoung Teuk, Koh Kong province. An area in the foreground has been rehabilitated by BCCP. Remaining area has become to deep for planting due to water has deepened due to disappearing soil from increasing currents in the area (erosion below water surface). Photo by BCCP forestry team Khiev Samnang and author Anders Pedersen year 2017

Alternative Mangrove Species for piloting..?

Bruguiera decandra

A mangrove tree of family Rhizophoraceae. "decandra" means "ten male", referring to the flower having ten stamens.

Small tree up to 15 metres (50 ft) tall with a trunk diameter of up to 30 cm (12 in). Its bark is pale brown. The flowers are white. The ovoid to conical fruits measure up to 1.8 cm (0.7 in) long. It grows naturally in India, Bangladesh, Burma, Thailand, Malaysia, and Cambodia. Its habitat is mangrove swamps and tidal creeks.

Bruguiera sexangula Synonym *Bruguiera eriopetala*

Bruguiera sexangula, commonly called the upriver orange mangrove, is a mangrove shrub or tree usually growing up to 15 m, occasionally 30 m, in height.

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IV. Challenges

- Land Encroachment
- Deforestation and Conversion
- Climate Change Impacts
- Limited Funding and Resources
- Limited Capacity for Restoration at the sub-national level
- Insufficient coordination among relevant institutions/stakeholders

V. Way Forward

- Strengthen legal and institutional frameworks
- Promote community-based management
- Expand and enhance restoration efforts
- Strengthen monitoring, research, and knowledge sharing
- Mobilize sustainable financing
  - blue carbon financing, e.g., REDD+
  - Encourage Public-Private Partnerships
  - Apply for grants e.g., Green Climate Fund, GEF, and more.
- Promote nature-based solutions
- Communication, education, participation, and awareness