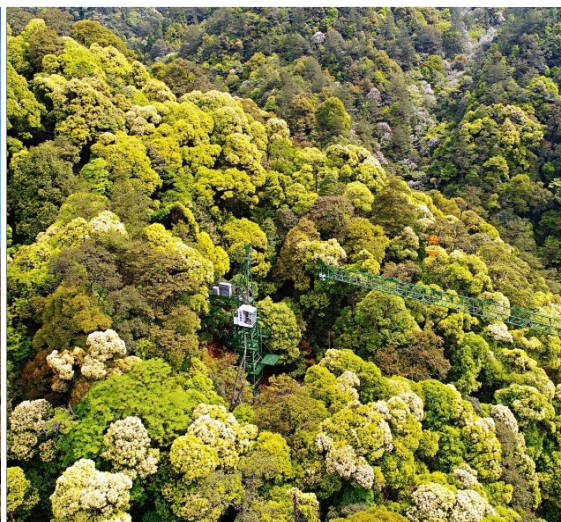
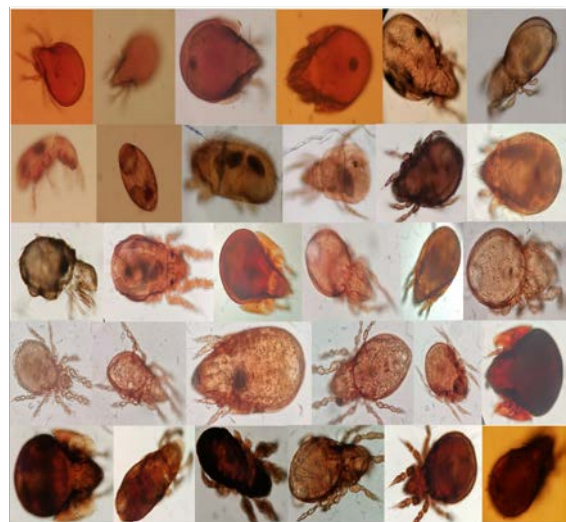




5TH WORLD CONGRESS OF BIOSPHERE RESERVES



Progress of Networked Biodiversity Monitoring in China

FENG Xiaojuan

2025-09-24



1. Overview

2. Networked Monitoring

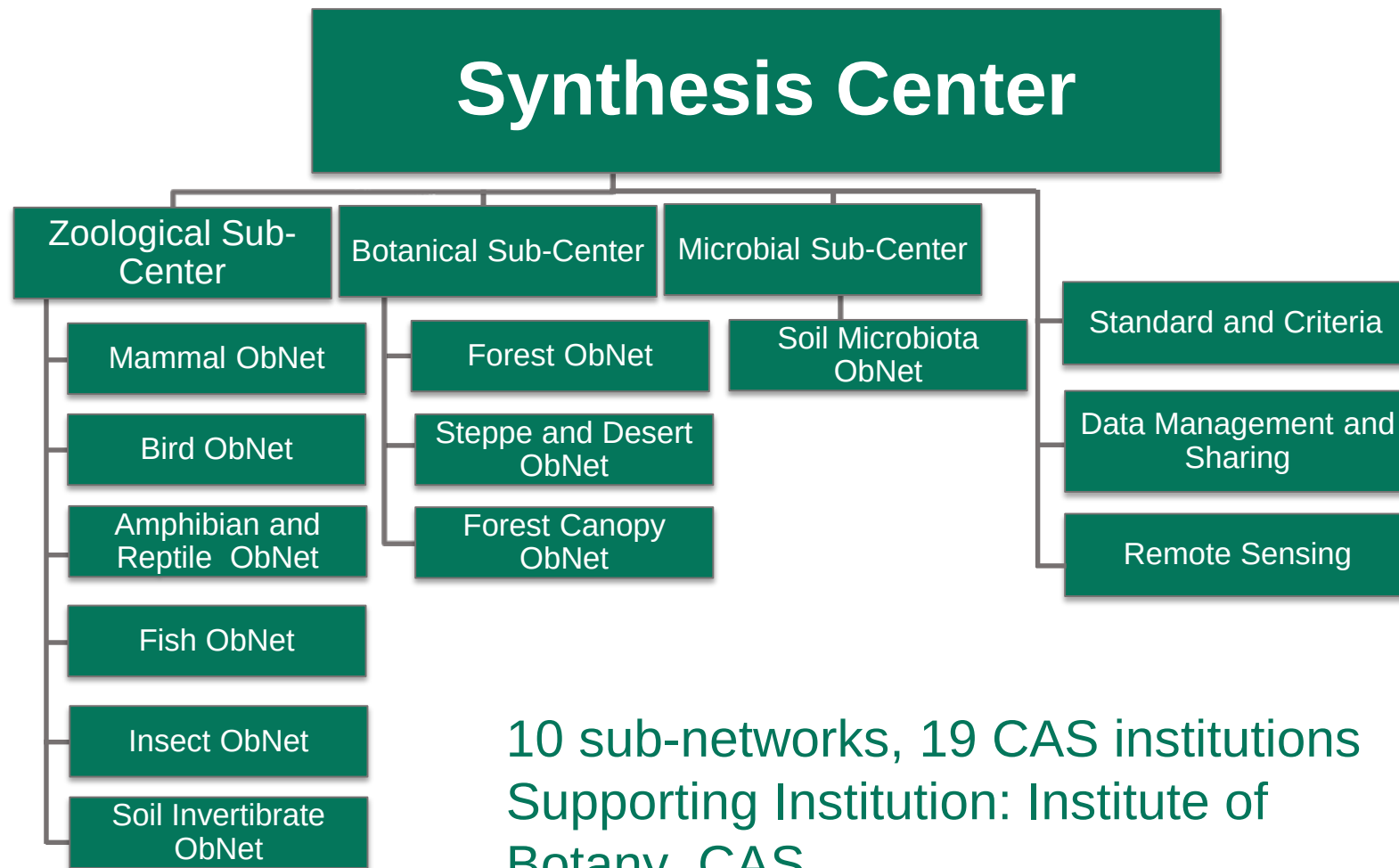
3. Scientific discoveries

4. Visibility

Overview



» Sino BON: Framework



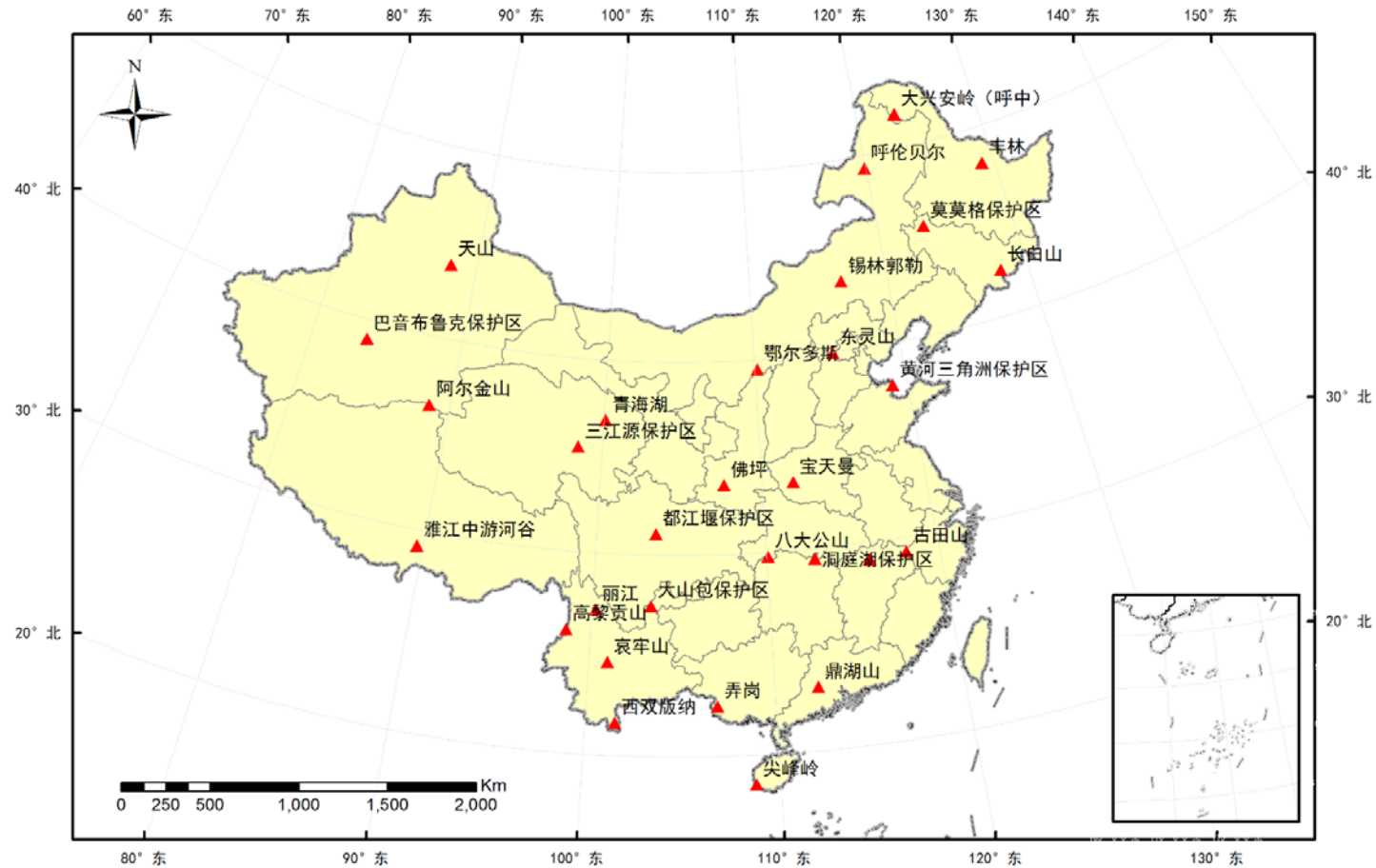
10 sub-networks, 19 CAS institutions
Supporting Institution: Institute of Botany, CAS



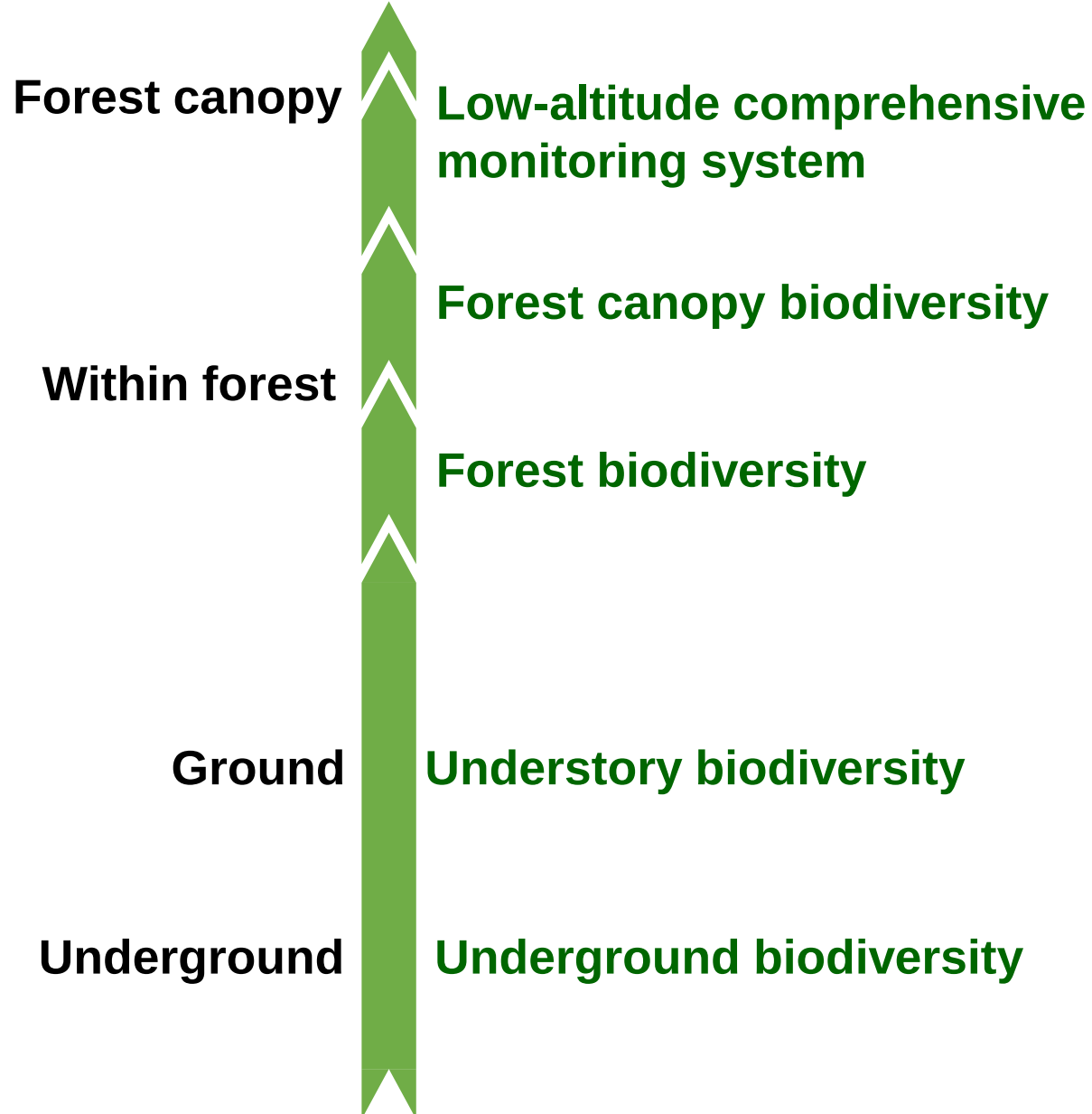
» Sino BON: Layout



- ❑ Guided layout scheme: field monitoring station & sub-networks
- ❑ Represents biodiversity characteristics in China



» Sino BON: Synthenic platform



Crane



Near-surface remote sensing



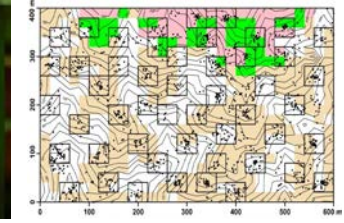
Seedlings



Phenology



Tree growth



Amphibian and Reptile



Birds



Animals



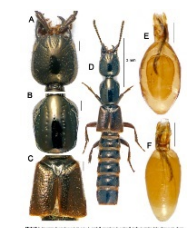
Soil Invertebrates



Soil Microbes



Insects



» Sino BON: Monitoring methods



Crane
(Forest canopy)



Satellite tracking
(Birds)



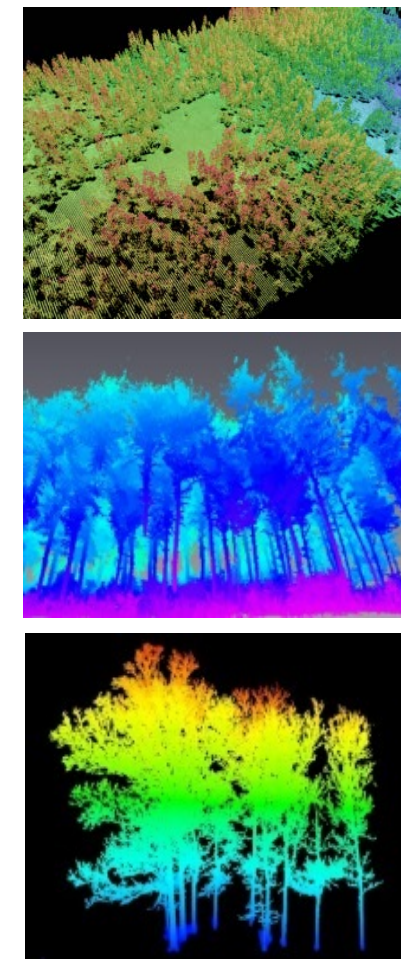
Infrared camera
(Animals)



Radio Frequency Identification
(Amphibian & Reptile)



LiDAR
(Vegetation)



» Sino BON: Synthesis Center

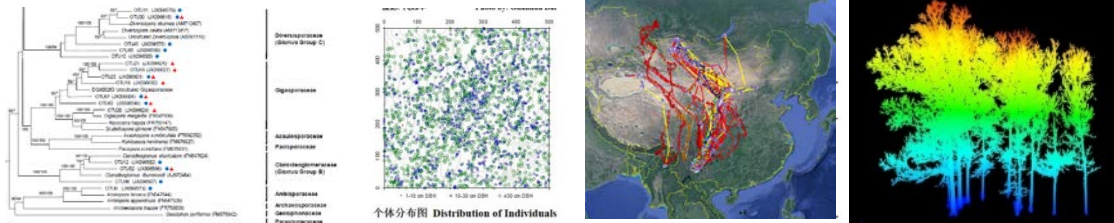


Standard Data

Sino BON

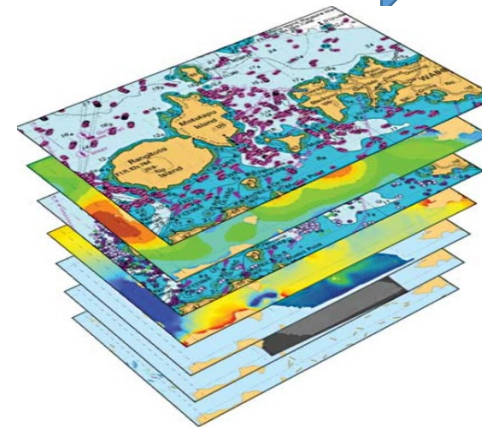


Microbial gene(DNA analysis)
Plant distribution (Field observation)
Animal distribution/migration (Camera/Satellite tracking)
Landscape data (LiDAR)



Analysis

Data & tools



Biodiversity and ecological layers based on standards

Data integration

Tools, models & workflow

Outputs

- Scientific discoveries
- Services

Decision makers

Resources managers

International treaties & programmes

Conversation organizations

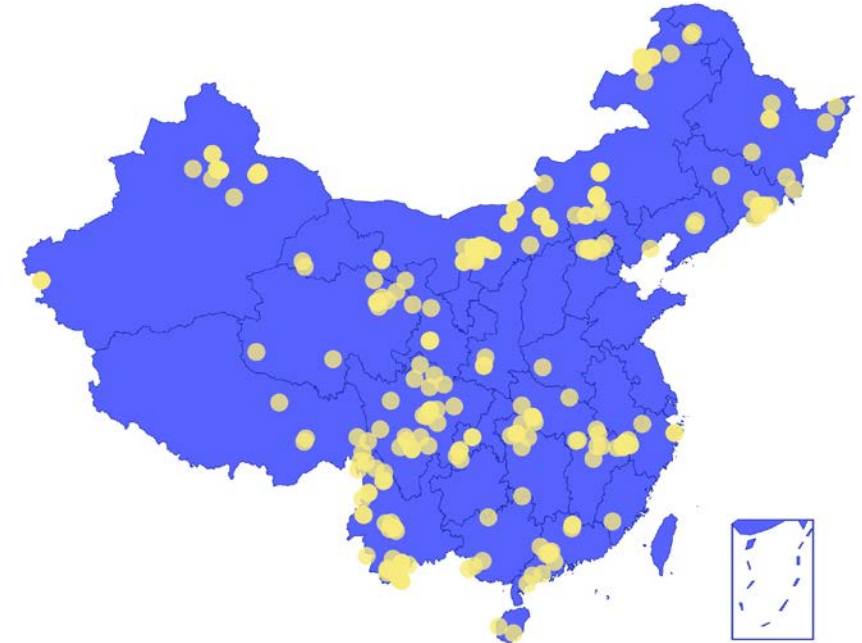
» Sino BON: Synthesis Center



- Establishes an all-in-one system for aggregating data resources from all biological groups, processing and analyzing data products, and providing data services. It has integrated **549** metadata, with a total record count of **10.03** million



<https://www.plantplus.cn/sinobon/>



Geographical distribution of monitoring data

Networked Monitoring

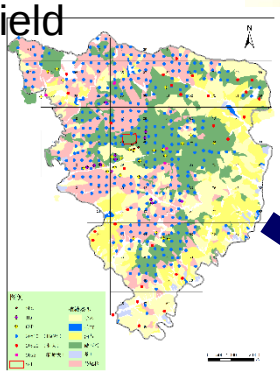


Networked Monitoring

- Developing a comprehensive model for long-term, multi-trophic biodiversity monitoring

Mammals

Infrared camera arrays, GPS locators, mobile devices for field image data collection



Soil Invertebrates

Micro-environment Monitoring Platform

Steppe and Desert & CForBio

Birds

Satellite trackers & Infrared camera arrays

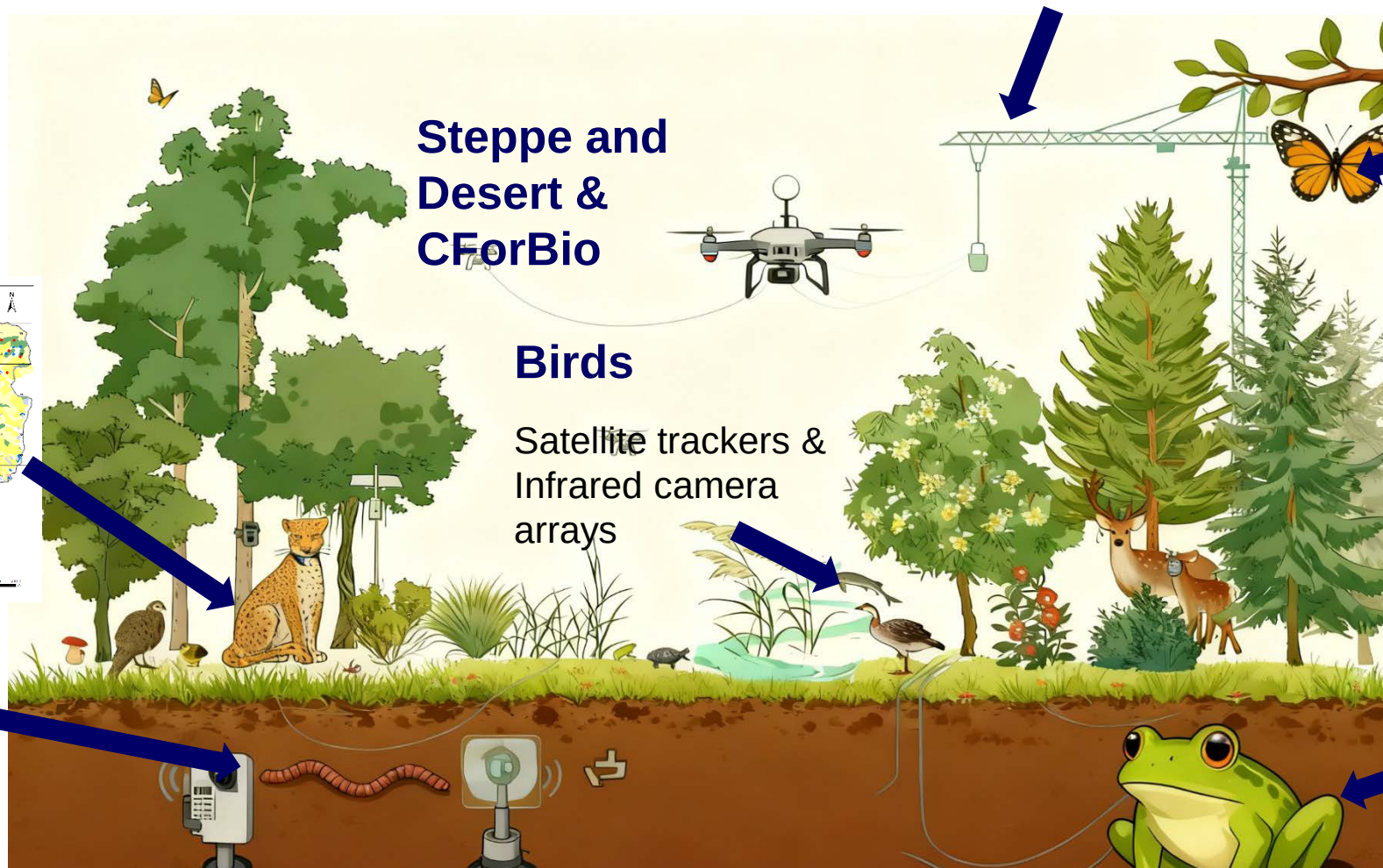
Eight cranes in typical forests

Insects

Nesting tubes, Insect 4D real-time monitoring system, Malaise trap

Amphibians and Reptiles

Automatic acoustic recorder, Full-spectrum radio telemetry tracking system, 4G-enabled full-spectrum radio telemetry system



Networked Monitoring



- ❑ Compiled the *Technical Specifications for Biodiversity Observation for National Field Research Stations*
- ❑ Series of *Biodiversity Monitoring Protocol Handbooks*
 - Forest plant diversity monitoring protocol handbook
 - Steppe and desert plant diversity monitoring protocol handbook
 - Mammal diversity monitoring protocol handbook
 - Soil microbiota diversity monitoring protocol handbook
 - Soil invertebrate diversity monitoring protocol handbook

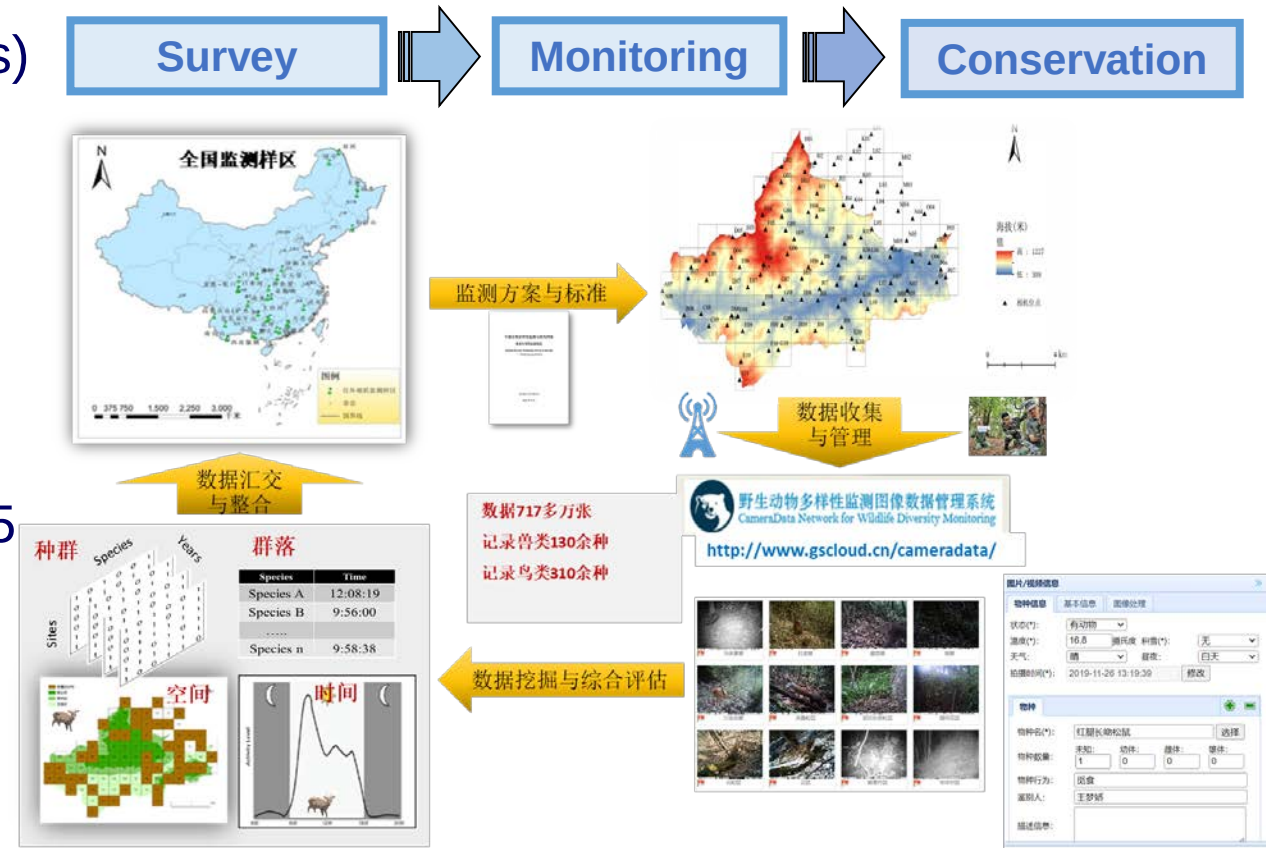


➤ Sino BON: Mammal ObNet



❑ The application of infrared camera promotes the national level mammal monitoring network

- In 30 representative forests (natural reserves)
- Kilometer grid method
- Infrared camera arrays, GPS, and mobile devices for field image data
- The first CameraData Network for Wildlife Diversity Monitoring, with 22,618 sites & 8.95 million photos

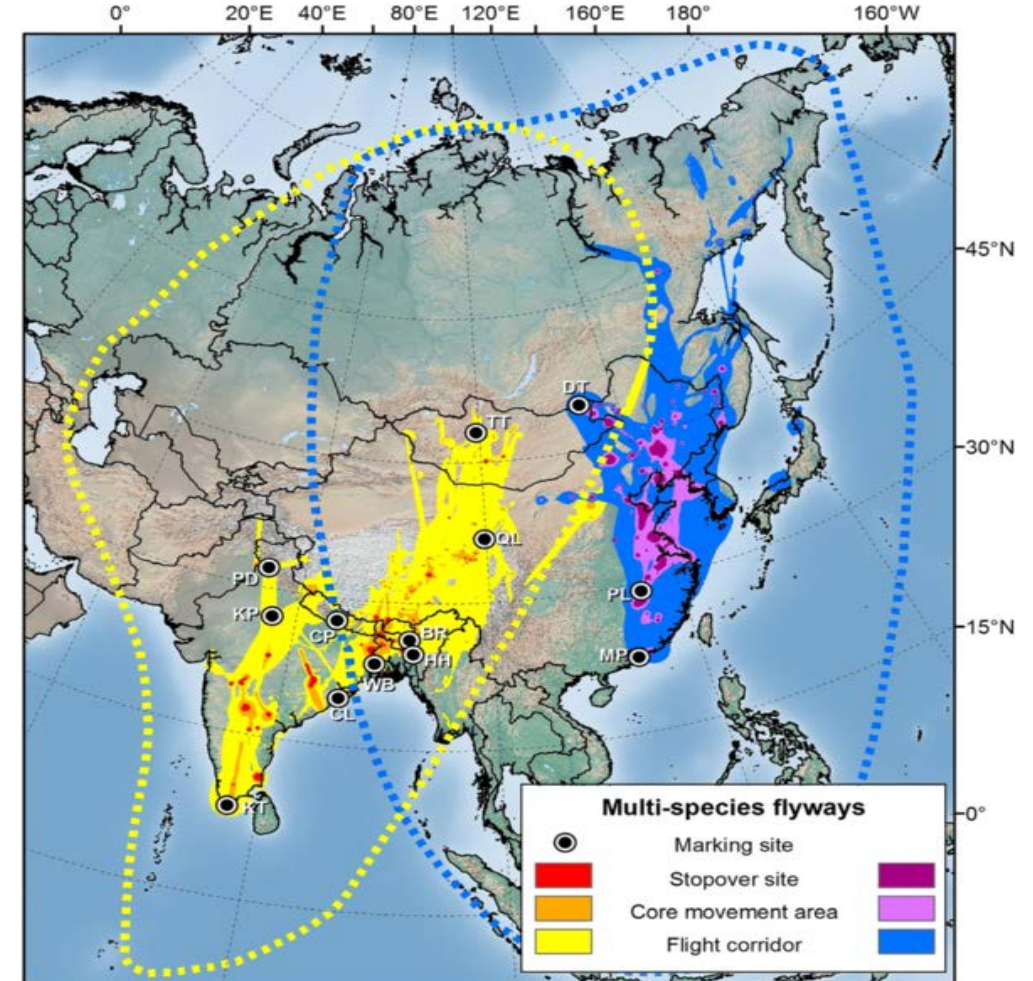


» Sino BON: Bird ObNet



□ The application of satellite tracking promotes bird migration monitoring and research

- East Asia-Australasia, the globally most threatened migration route, with 16 international monitoring sites and 38 domestic monitoring sites
- Tracking the migration of 63 bird species of 2,569 individuals
- Over 4 billion migration data records
- Establishing the most comprehensive database for the East Asia-Australasia migration route



Monitoring data from globally significant migration routes

» Sino BON: Amphibian and Reptile ObNet



□ The first large-scale radio tracking of amphibians and reptiles in China

- Radio frequency identification, automatic sound recorder, radio tracking
- Long-term monitoring at the individual, population, and community levels of amphibians and reptiles

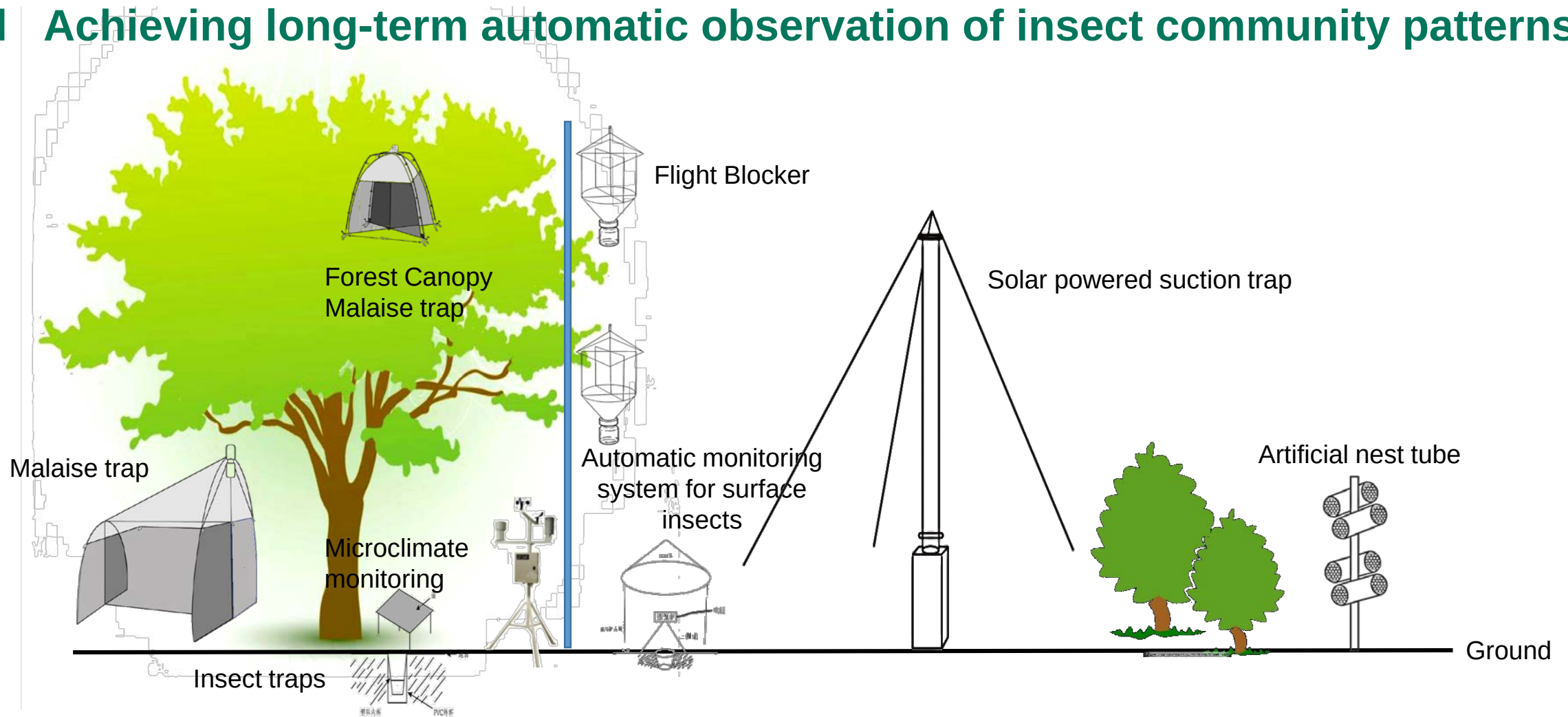


Reptile (*Liangshantriton taliangensis*)
Radio tracking

» Sino BON: Insect ObNet



- ❑ Establishing an integrated and long-term insect species diversity monitoring system
- ❑ Achieving long-term automatic observation of insect community patterns



□ The first nationwide monitoring network of inland water fish

- In 8 river basins, e.g. Yangtze River, Yellow River, Lancang River, etc.
- Fish finder and sonar detection for fish monitoring
- The first national database of inland water fish diversity, with over 10,000 fish samples & 6,000 fish data records



» Sino BON: Soil Invertebrate ObNet



❑ Establishing a monitoring network covering all typical ecosystems in representative regions across China

- In cold-temperate, temperate, warm-temperate, sub-tropical, tropical, high and cold area, and arid area oasis
- Monitoring macrofauna (earthworms), mesofauna (mites & springtails), and microfauna (nematodes)
- Collecting over 150,000 soil invertebrate specimens, and identifying more than 1,100 species

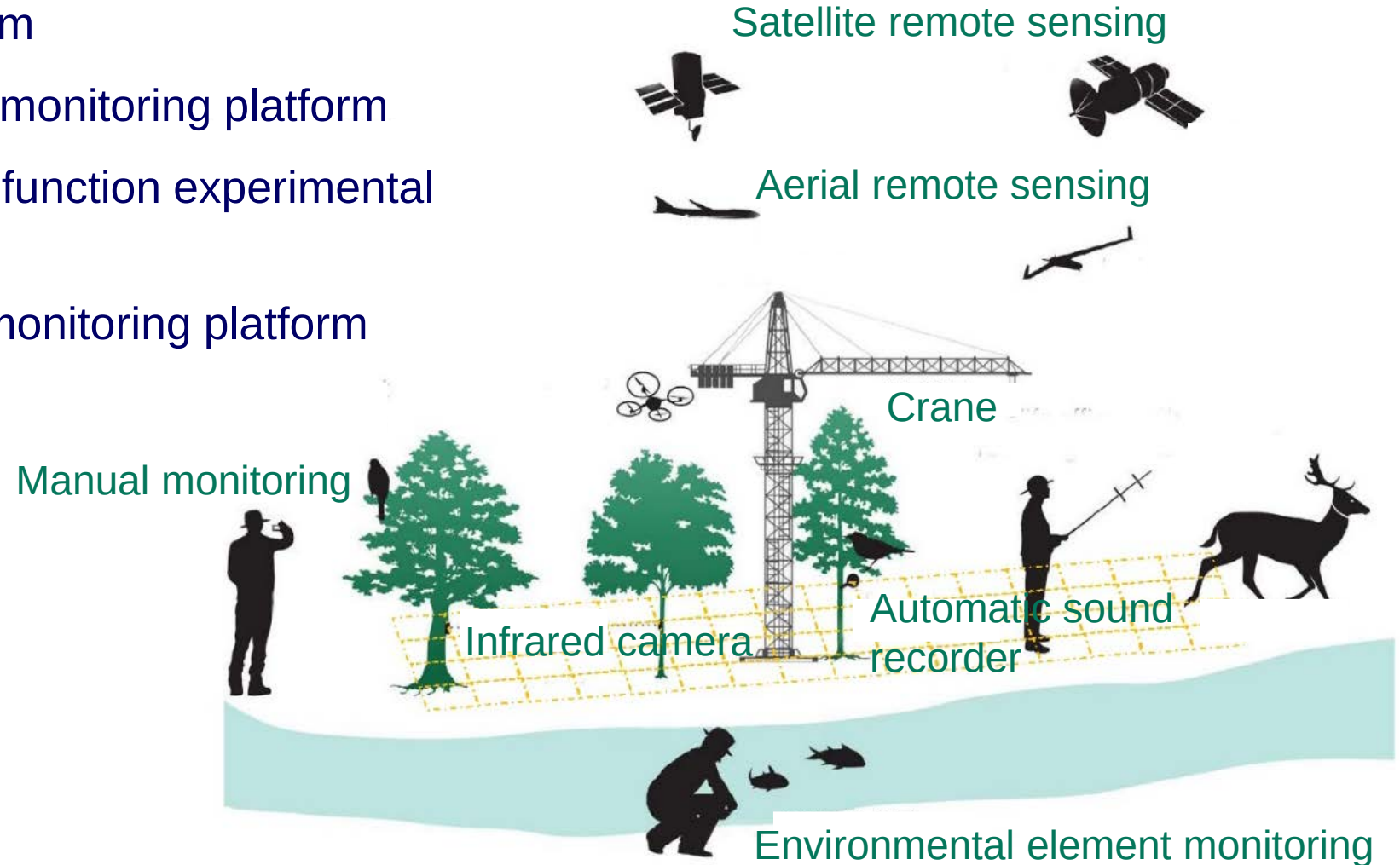


Soil invertebrate monitoring in farmland
in sub-tropical zone

» Sino BON: Forest ObNet (CForBio)

□ Space-air-field integrated biodiversity monitoring system

- Forest dynamics plot platform
- Grid based animal diversity monitoring platform
- Biodiversity and ecosystem function experimental platform
- Forest canopy biodiversity monitoring platform

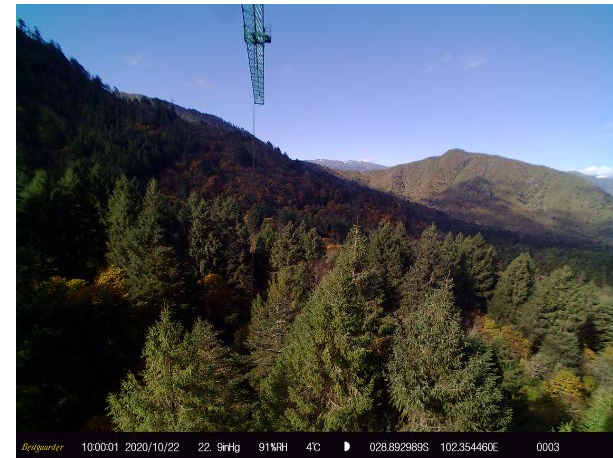


» Sino BON: Forest Canopy ObNet

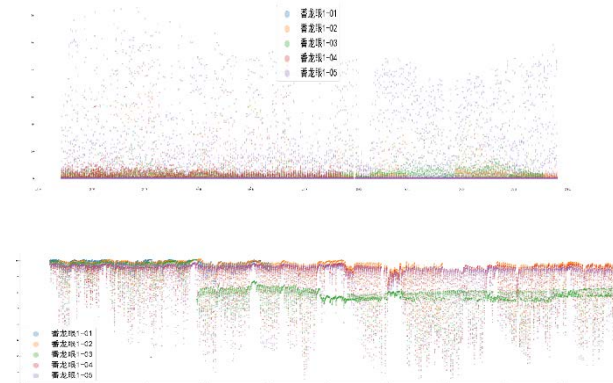


□ World-class platform for canopy biological monitoring

- Total of 8 cranes in typical temperate to tropical forests, i.e., Qianjiangyuan, Dinghu Mountain, etc.



Forest canopy
biology monitoring



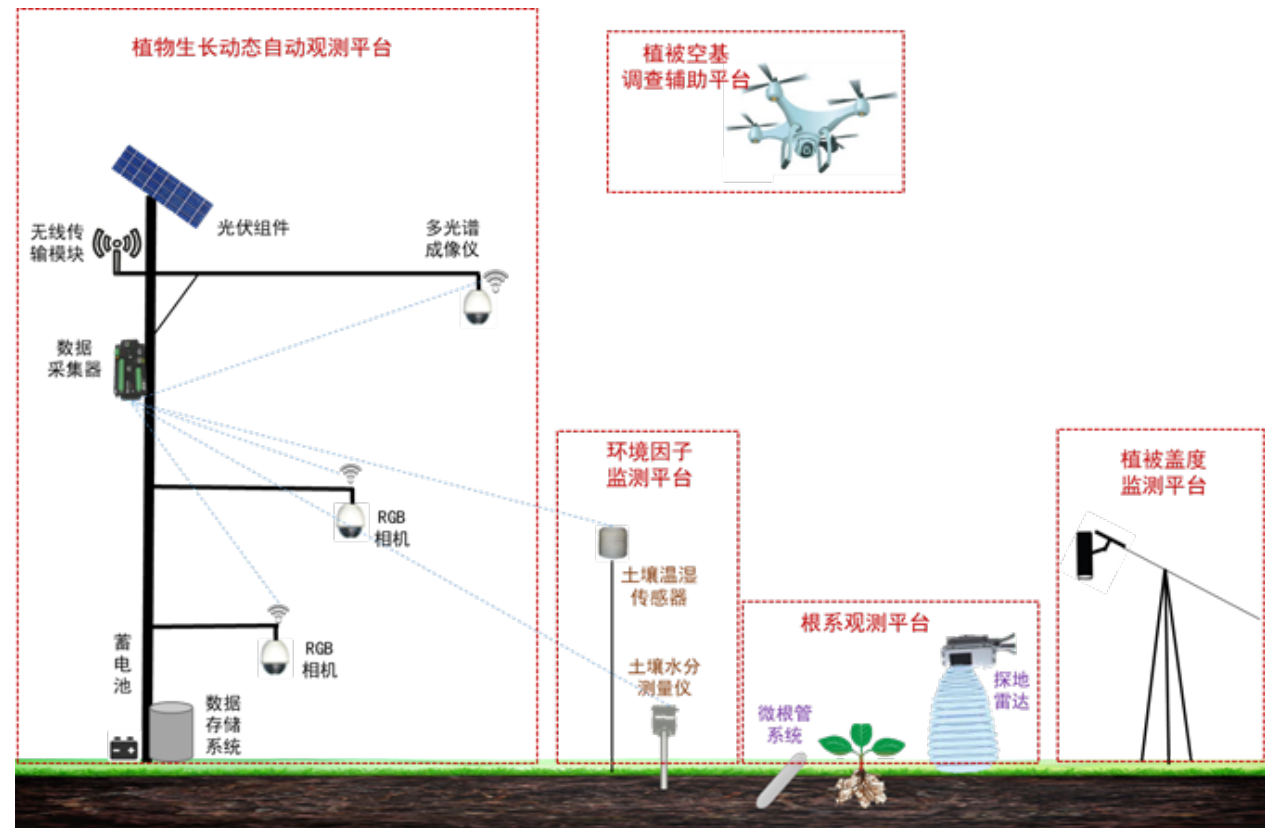
Forest canopy Micro-
climate monitoring

» Sino BON: Steppe and Desert ObNet



□ Long-term monitoring of the diversity changes in grassland and desert

- Establish permanent plots representing specific plant communities in areas with distinct vegetation alliances
- Achieving long-term automatic monitoring at species/community level by the establishment of new platforms for observing plant growth, vegetation cover, and root systems

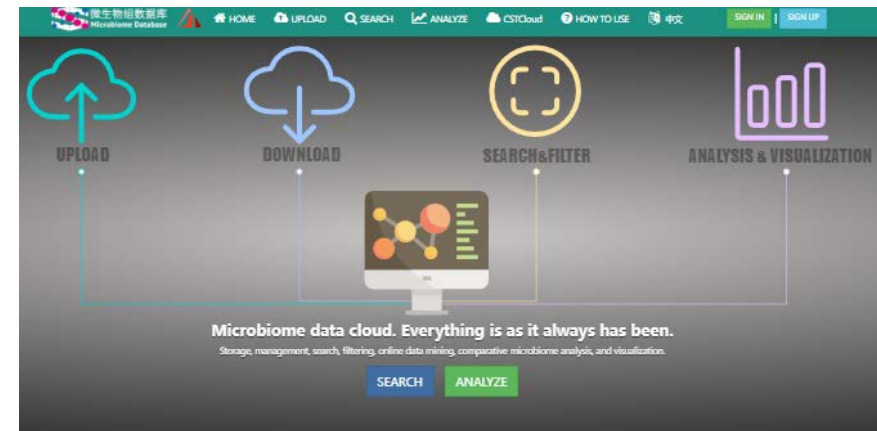


» Sino BON: Soil Microbiota ObNet



□ Monitoring spatial and temporal dynamics of soil microbial communities and functional genes in various ecosystems, including bacteria, archaea, fungi, and lichens

- High-throughput sequencing (Hiseq, Miseq), quantitative PCR, and bioinformatics analysis
- Macrofungi, soil bacteria, archaea, fungi, functional gene
- The Microbiome Database, with 17,542 samples, 3,791 functional genes, and ect.



Our unique database provide dozens of microbiome dataset resources:

Try our advanced search engine

Project 16S rRNA SEARCH

Example keywords: Forest Wetland Shrub

Database Summary

 PROJECTS 122	 SAMPLES 17542	 16S rRNA 9519	 18S rRNA 559
 ITS 3583	 FUNC. GENES 3791	 METAGENOME 90	 METATRSCRIPTOME 0

Scientific discoveries



» Scientific discoveries

Science, 2015

Revealed the main causes of Falco peregrine migration routes and the key genes for its long-distance migration

Science, 2019

Revealed plant-fungi interactions regulating the coexistence of species in subtropical forests

Nature, 2021

Established a monitoring system for wild pandas, and systematically revealing its adaptation behaviors

Nature, 2025

Explained the latitudinal gradient of forest plant diversity has led to a new perspective on the co-evolution of mycorrhizal types and dispersal modes in maintaining forest biodiversity

*Nature Ecology &
Evolution*

*Nature
Communications*

Science Advances

PNAS

Current Biology

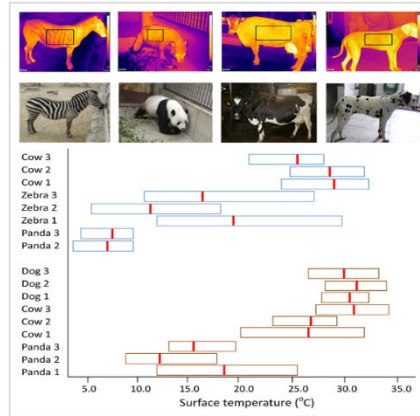
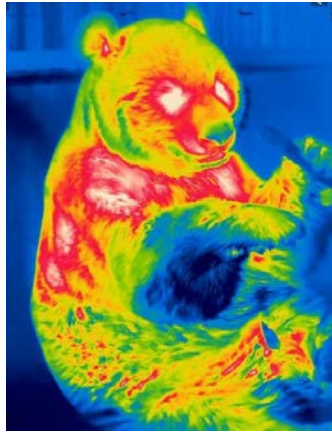
TREE

AREES

Current Biology

➤➤ Mammal monitoring and research

- Established a monitoring system for wild pandas, and systematically revealing its adaptation behaviors



A
DAY #1 Temperature = 3°C



horse manure accumulation

DAY #3 Temperature = -4°C

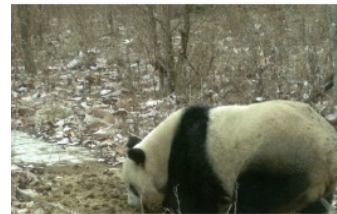


B
MHR behavior



Sniffing
Rolling
Rubbing
Smearing

DAY #7 Temperature = 0°C



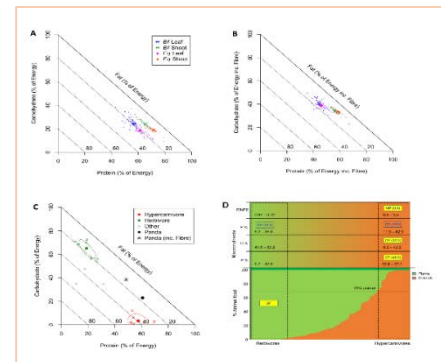
panda visting



rolling



Duration ~8 min



Revealing the molecular mechanisms of MHR behavior

Science, 2015; Current Biology, 2019; PNAS, 2020

» Movement ecology



- Revealed the main causes of *Falco peregrine* migration routes and the key genes for its long-distance migration



Data sets

56 *Falco peregrines*

12-year monitoring data by satellite tracking

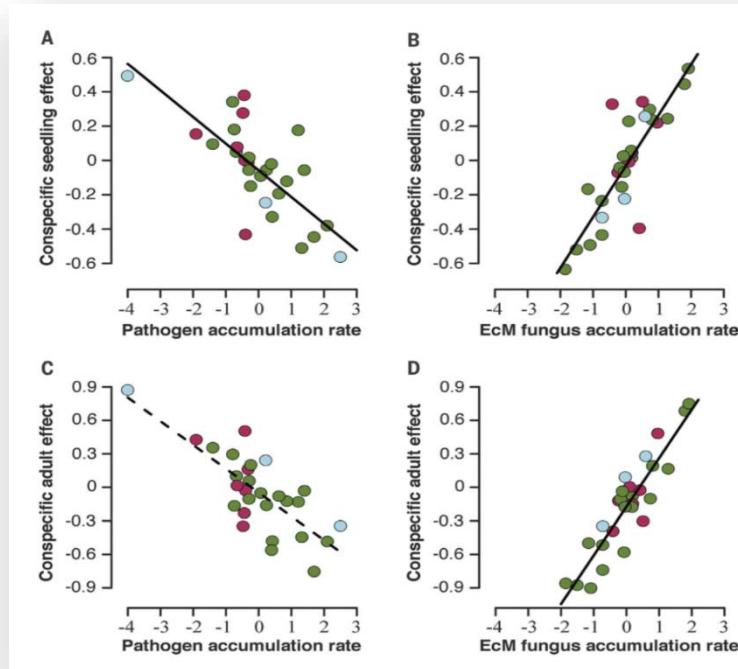
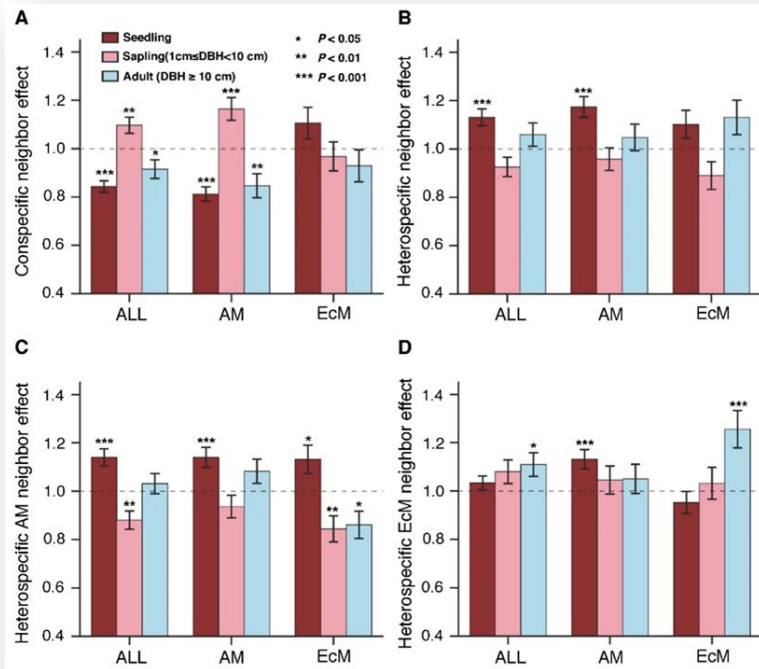
Falco peregrines Population genomic information

Nature, 2021 (Cover story)

Forest plant diversity maintenance mechanisms



Revealed plant-fungi interactions regulating the coexistence of species in subtropical forests



Data sets

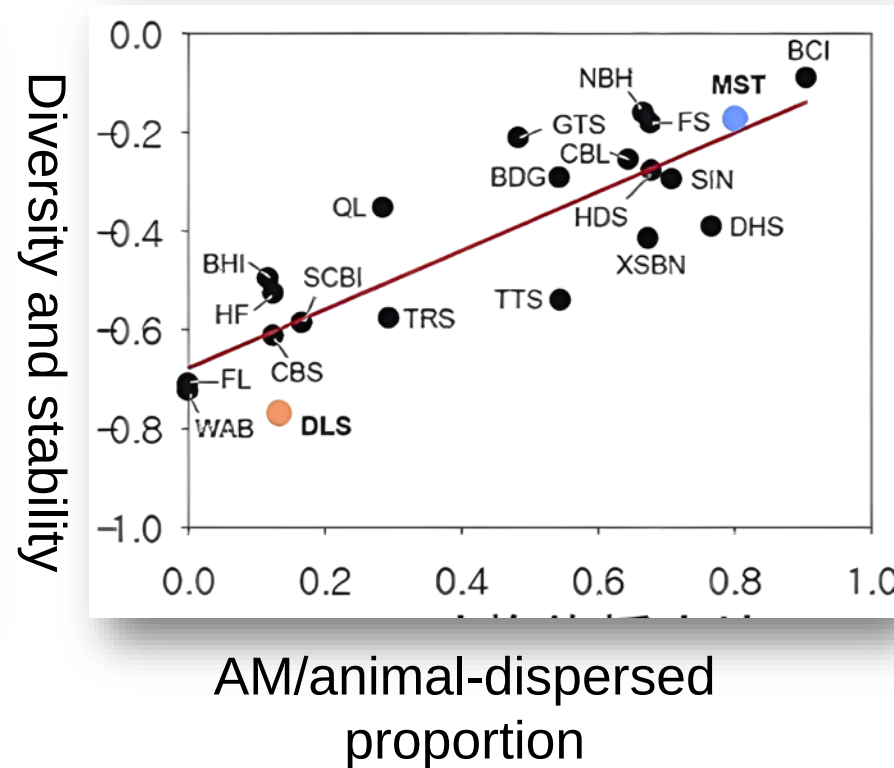
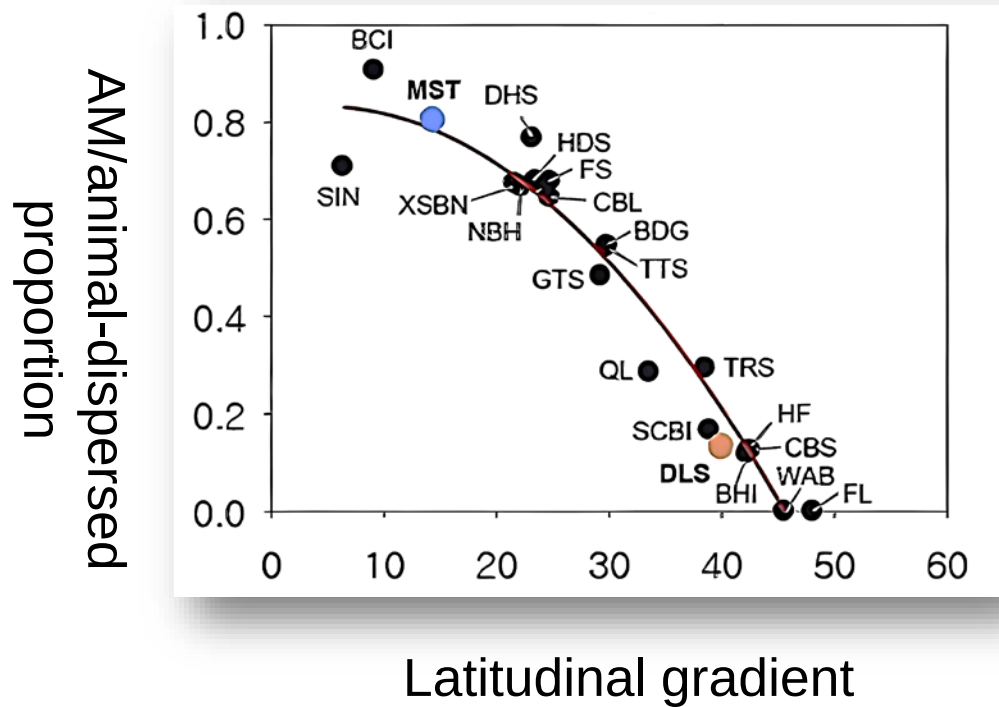
9-year continuous monitoring data on seedlings

332 individual rhizosphere fungal communities

Conspecific negative density dependence (CNDD) is constrained by both ectomycorrhizal fungi and pathogenic fungi, a new species coexistence mechanism

» Forest plant diversity maintenance mechanisms

- Explaining the latitudinal gradient of forest plant diversity has led to a new perspective on the co-evolution of mycorrhizal types and dispersal modes in maintaining forest biodiversity



Data sets

Twenty-one large forest dynamic plots

Visibility



» Scientific supporting for policy makers

- Long-term monitoring of fish provides a data foundation and scientific basis for policies such as the "***Ten-Year Fishing Ban in the Yangtze River***" and the "***Ecological Protection of the Chishui River***"
- The outcomes of the fishing ban in the Chishui River basin provide a reference for assessing the effectiveness of the ***Ten-Year Fishing Ban in the Yangtze River***



Scientific supporting for policy makers



- ❑ Infrared camera technology has facilitated the **nationwide intelligent monitoring system for large animals**, helping establish **Chebaling National Nature Reserve as a scientific monitoring demonstration site** and supporting the planning and management of multiple nature reserves

Monitoring Technical Specifications and Standards



Integrated Application of Critical Monitoring Technologies



Database Platforms

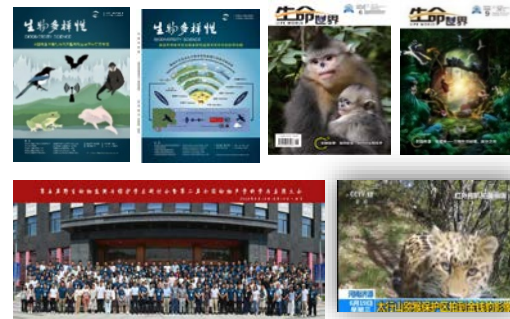


Intelligent Management of Scientific Big Data

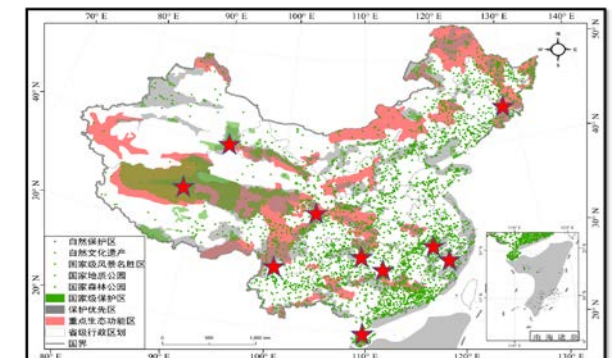
Big Data and New Technologies Drive Scientific Progress



Enhances Social Impact



Serving Critical National Needs



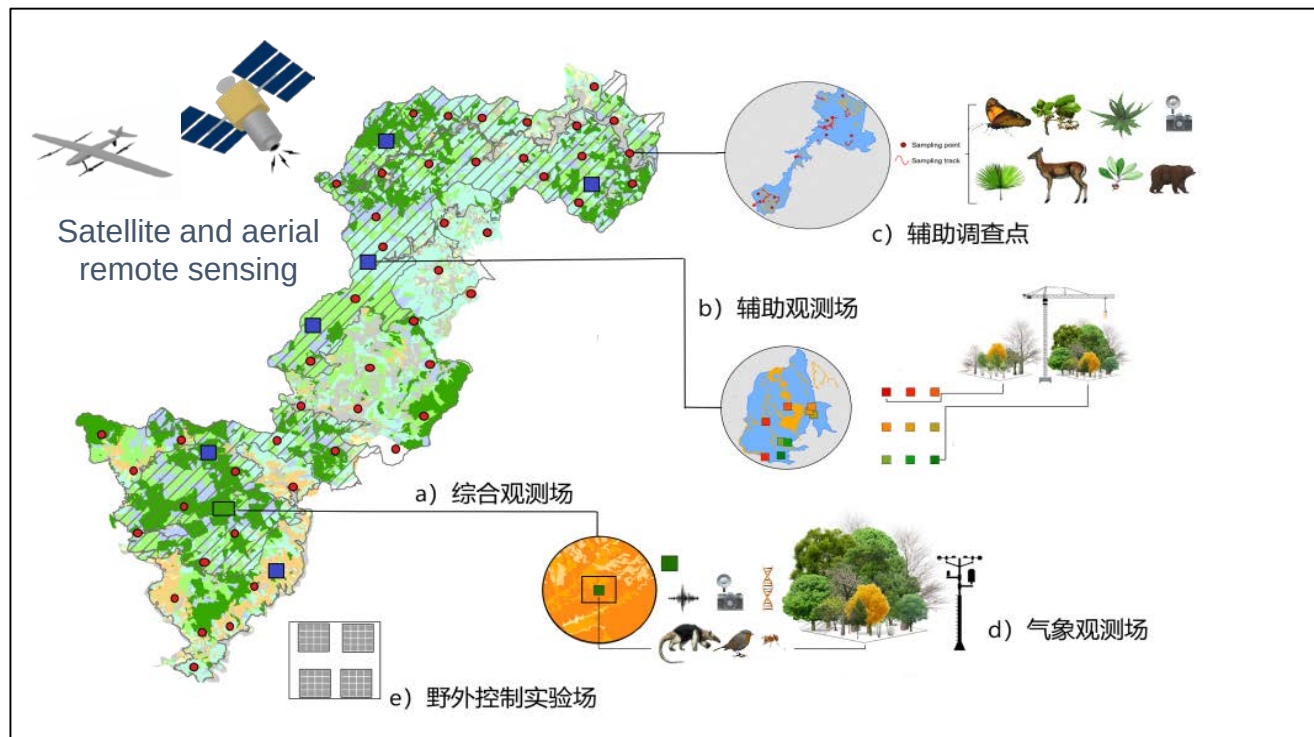
Scientific supporting for policy makers



- The integrated sky-air-ground biodiversity monitoring system in Qianjiangyuan National Park plays an exemplary and guiding role in the construction and development of national parks
- The case study on coordinated multi-objective conservation priority area planning has been selected for inclusion in the Big Earth Data in Support of the Sustainable Development Goals (2024) report



SDG Case Study

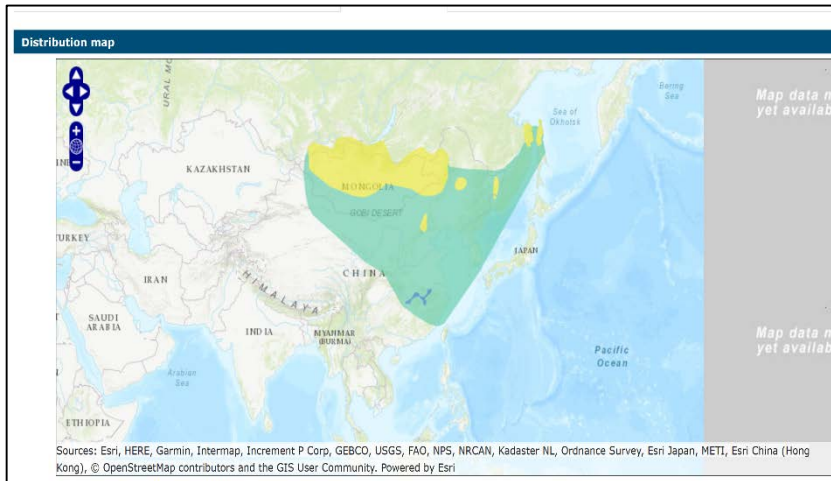


Integrated sky-air-ground biodiversity monitoring system

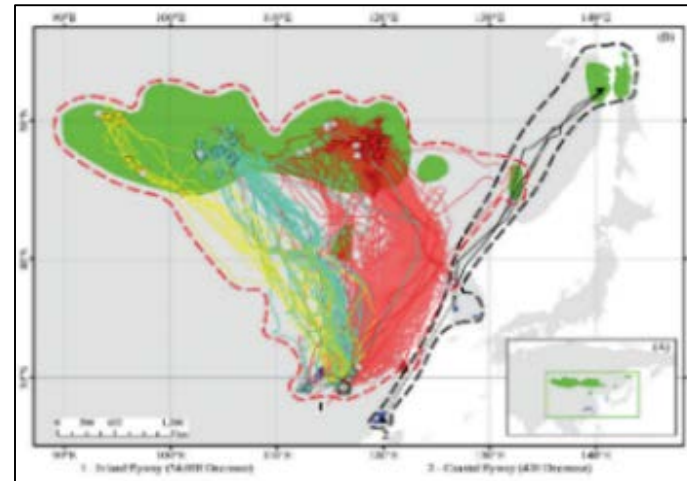
Scientific supporting for policy makers

□ A series of research findings on the population dynamics and migration route structures of birds in China have been adopted by "Wetlands International"

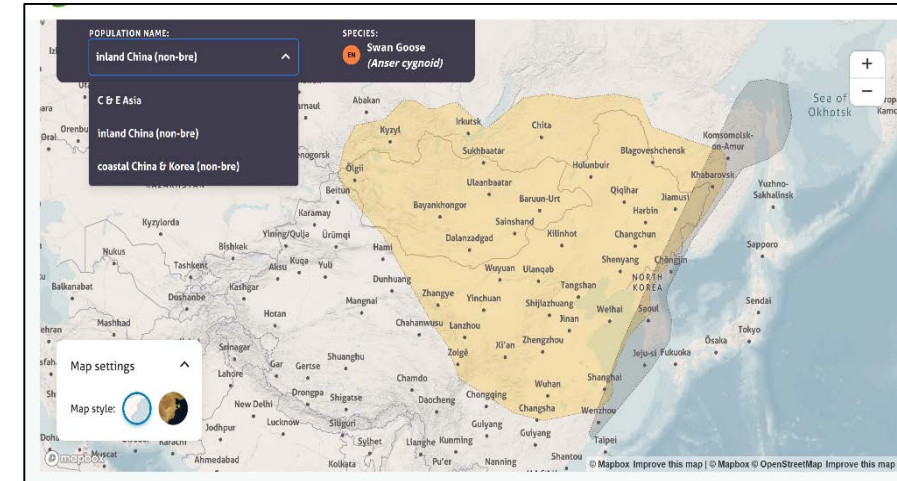
The origin distribution map of the Swan Goose from Birflife



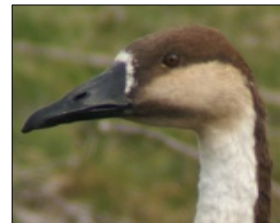
Swan Goose is divided into two distinct populations was discovered



Distribution map of the Swan Goose populations



Case study: Distribution map of the Swan Goose



References

- R1823 - Damba, I., Fang, L., Yi, K., Zhang, J., Batbayar, N., You, J., Moon, O., Jin, S., Liu, B., Liu, G., Xu, W., Hu, B., Liu, S., Park, J., Kim, H., Koyama, K., Natsagdorj, T., Davaasuren, B., Lee, H., Goroshko, O., Zhu, Q., Ge, L., Cao, L., & Fox, A. (2020). Flyway structure, breeding, migration and wintering distributions of the globally threatened Swan Goose *Anser cygnoides* in East Asia. *Wildfowl*, 0, 97-123. Retrieved from <https://wildfowl.wwt.org.uk/index.php/wildfowl/article/view/2739>

CBD related activities

- ❑ Sino BON researchers delivered a keynote speech at the "Ecological Civilization Forum", proposing enhancing biodiversity conservation and sustainable utilization
- ❑ Participating Exhibition of Biodiversity Achievements of the Chinese Academy of Sciences and its Press Conference



Ecological Civilization Forum



Exhibition

Capacity building



International conferences

- The 8th International Canopy Science Conference
- The First International Symposium on Lianas
- The 10th International Symposium on Figs and Fig Wasps

National conferences

- The First National Conference on Animal Acoustics Science and Applications
- The 5th Academic Symposium on Wildlife Monitoring and Conservation
- The 6th National Conference on Biodiversity Monitoring



Media reports



- The monitoring outcomes have garnered attention and coverage from a range of domestic, international, and local media outlets, including **CCTV, Xinhua News Agency, People's Daily, Guangming Daily, and Science and Technology Daily, etc..**



THANK YOU

