TRAINING WORKSHOP FOR YOUNG CRANE RESEARCHERS IN NORTH-EAST ASIA

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Overview

Cranes are among the most iconic yet threatened bird species in East Asia. These species depend on increasingly vulnerable wetlands and grasslands, which are under growing pressure from development, climate change, and habitat loss and degradation. Ensuring the long-term survival of cranes requires not only urgent conservation measures today, but also the development of a new generation of skilled researchers and conservation professionals to lead sustained efforts into the future.

In 2006, the first training course for young crane researchers in the North-East Asian Crane Site Network was organized at Izumi Crane Park, Japan. This event was significant effort to start structured regional capacity building for crane conservation. Until then, research and monitoring efforts across the network had been fragmented, with limited opportunities for young scientists to receive specialized training or to exchange knowledge across borders. Bringing together early-career researchers from multiple countries fostered collaboration, built technical skills in crane monitoring and habitat management, and strengthened the long-term human capacity needed to sustain conservation efforts in North-East Asia. Moreover, Izumi Crane Park, being one of the world's most famous wintering sites for cranes, served as an ideal living classroom, providing participants with both practical field experience and exposure to successful conservation models. Importantly, many of the young professionals who attended this first workshop have since become today's leaders in crane research and conservation across the region, demonstrating the lasting legacy and multiplier effect of this initiative. This initiative laid the foundation for a new generation of crane specialists who could contribute not only to local site management but also to coordinated, international efforts to conserve migratory cranes and their habitats in North-East Asia.

Image 1. Participants of the training workshop for young crane researchers in the North-East Asian Crane Site Network, Izumi Crane Park, Japan

The Training Workshop for Young Crane Researchers in North-East Asia, held in Mongolia this year, was designed to build on the legacy of the first training course organized in 2006. Its purpose was to bring together emerging researchers and conservation practitioners from across the region to strengthen technical capacity in crane research and conservation. Through a carefully structured program combining lectures, field-based exercises, and interactive discussions, participants gained practical skills in crane monitoring, habitat assessment, data analysis, and conservation planning.

Beyond technical training, the workshop also placed strong emphasis on fostering international collaboration and professional networking among early-career experts committed to safeguarding cranes and their habitats along the East Asian Flyway. In doing so, it created a unique platform for regional exchange, peer learning, and the development of long-term partnership foundations that are essential for advancing coordinated conservation efforts across national boundaries in North-East Asia.

Objectives

By investing in the next generation of conservation professionals, the workshop contributes to the long-term protection of cranes and the ecosystems they present. It also lays the foundation for future leadership and science-based conservation across North-East Asia.

The workshop objectives were to:

- Build the technical skills of young researchers and conservationists in crane-related research and monitoring
- Promote science-based approaches to species and ecosystem protection
- Encourage cross-border collaboration among countries along the East Asian Flyway
- Support leadership development in crane and wetland conservation
- Facilitate peer learning and knowledge exchange across the region

Trainers

The trainers were selected for their outstanding track records in crane research and conservation across Asia. They are internationally recognized experts whose significant contributions have advanced both scientific understanding and practical conservation of cranes in the region.

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Participants

The training workshop brought together 26 participants, including 16 trainees, 5 trainers, and 5 facilitating members. There were 11 men and 15 women, reflecting a strong gender balance. All trainees identified themselves as being at an early stage in their careers.

Image 2. Participants of the training workshop for young crane researchers in the North-East Asia held in July 2025 in Mongolia

Participants represented five countries in the North-East Asia region: Mongolia, Russian Federation, People's Republic of China, Republic of Korea, and Japan (see Fig. 1).

Facilitating members came from the United Nations ESCAP, the Wildlife Science and Conservation Center, and the International Crane Foundation. At the conclusion of the program, all trainees were awarded certificates of participation. A detailed list of participants is provided in Annex 1.

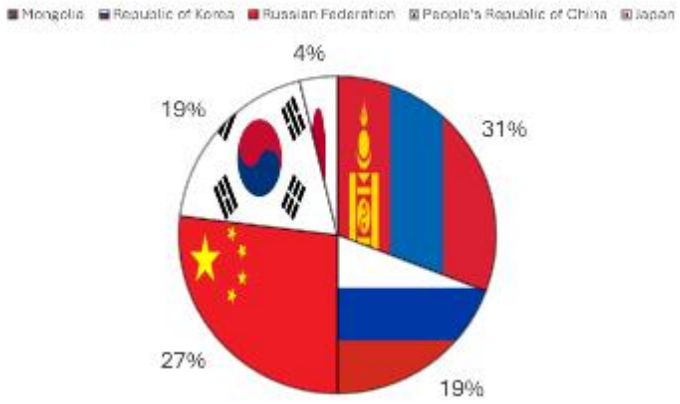

Image 2. Countries represented in the workshop

The detailed agenda of the three-day workshop is provided in Annex 2. While the workshop generally followed the planned agenda, the schedule experienced minor delays due to unforeseen weather conditions and extended in-house discussions. Nevertheless, all participants actively took part in every session, including field activities.

The workshop commenced with opening remarks by Mr. Ganbold Baasanjav, Head of the ESCAP East and North-East Asia Office (delivered via video message), and Ms. Yu Qian, East Asia Program Director at the International Crane Foundation. Welcoming remarks were also offered by Mr. Nyambayar Batbayar, Director of the Wildlife Science and Conservation Center of Mongolia (WSCC). Following the opening session, Ms. Mijin Lee introduced the NEASPEC Migratory Birds Project, setting the stage for the workshop's technical sessions of the program.

The technical sessions were led by three main trainers: Dr. Nyambayar Batbayar, Dr. Elena Ilyashenko, and Dr. Jia Yifei, with additional training support from Dr. Elena Mudrik and Ms. Nandintsetseg Nyam-Osor.

Image 3. Trainers on the workshop

Key discussion topics

Overview of crane research and conservation

Cranes occur on every continent except South America and Antarctica. Of the 15 recognized species, 11 are classified as threatened or vulnerable due to the rapid loss or degradation of their natural habitats, climate change, and many other reasons. Conservation interest grew after the founding of the International Crane Foundation in 1973, which fostered global research and collaboration. The IUCN's first major assessment, Cranes: Status Survey and Conservation Action Plan (Meine & Archibald, 1996), became a key reference, later updated by the Crane Conservation Strategy (Mirande & Harris, 2019).

In Asia, crane conservationists are highly active, working from the Siberian tundra to the wetlands of India and China on habitat protection, community engagement, flyway agreements, and long-term monitoring. Over the past two decades, these efforts have made significant contributions to global crane conservation. To secure the future of cranes in the region, it is essential to train a new generation of young researchers and conservationists who can sustain and expand ongoing efforts.

Flyway level conservation work

In Asia, migratory cranes traverse countries with diverse cultures, traditions, religions, and levels of economic development, as well as differing attitudes toward conservation. Yet across their flyways, these charismatic and iconic birds serve as powerful flagship species, inspiring efforts to protect nature and biodiversity.

Effective crane conservation requires a coordinated flyway-level approach, supported by a clear understanding of the challenges that may hinder international agreements and on-the-ground protection. Key obstacles include weak coordination, insufficient capacity building and financial support, political instability, frequent changes in government personnel, language barriers, and uneven levels of conservation activity linked to economic disparities. These issues can create friction between countries and limit conservation outcomes.

At the same time, important opportunities exist to strengthen international cooperation through improved policy alignment, the development of joint programs and projects, and the mobilization of innovative financing mechanisms. Harnessing these opportunities can greatly enhance the effectiveness and sustainability of crane conservation efforts across the region. Good examples of crane conservation at the flyway level can be the UNEP/GEF Siberian Crane Wetland Project administered by the International Crane Foundation (Harris, 2009) and its successor project for Siberian Cranes in East Asia supported by the Disney Conservation Fund from 2015-2024.

Making effective environmental education programs

In North-East Asia, cranes have for millennia occupied a prominent place in mythology and religious traditions. They have symbolized longevity, happiness, good luck, long life, and marital bliss, appearing in paintings, tapestry, and other decorative arts.

Environmental education has proven to be one of the most powerful tools for supporting crane research and conservation. Communities, teachers, and students who participate in environmental events often become advocates for the protection of cranes and their habitats. Modern crane conservation programs increasingly address socio-economic issues, helping people view cranes as allies rather than threats. Consequently, expanding environmental

education activities across the region is essential to foster broader public awareness, engagement, and long-term support for crane conservation.

Ecotourism

Ecotourism may play a vital role in crane conservation by generating sustainable funding for habitat protection, monitoring, and anti-poaching activities. It creates economic incentives for local communities to safeguard cranes and their wetlands, while also raising awareness and educating visitors about the species and their ecological importance. Additionally, involving local people in ecotourism fosters long-term stewardship and supports conservation research and citizen science initiatives.

Quantifying the diet and feeding habitats of cranes

Understanding crane diets and how food availability shifts under climate change is essential for their conservation. However, the feeding ecology of many species remains poorly studied, underscoring the need for more focused research.

Quantifying diets and feeding habitats helps explain how food resources influence population trends, why certain species alter their foraging strategies, and how such changes affect long-term population sustainability. Assessing food availability is also critical for planning and implementing reintroduction programs.

Most cranes are generalist and opportunistic feeders, consuming a wide range of plant and animal foods. Their diet and foraging behavior vary with morphology, habitat type, and season, making feeding ecology highly species- and context-dependent. As a result, methods for studying crane diets and feeding habitats must be adapted to each species, habitat, and seasonal condition.

Climate change implications on cranes and wetland habitat conservation

Global climate change, combined with human activities, is a major driver of wetland loss and degradation, altering habitats for cranes and other waterbirds and causing population declines and shifts in distribution. Land-use change, particularly wetland conversion to farmland, further disrupts diets, migration patterns, distribution, and reproductive success by changing vegetation structure. Although cranes can adjust their diet, movement, and breeding strategies, such adaptations are often insufficient to offset the impacts of habitat loss.

Wetland preservation, improved management, and protection should be key areas for crane conservation in North-East Asia. Because the natural wetlands in the region are highly threatened by land use change and global warming.

Usage of remote sensing images in habitat assessment and mapping

Remote sensing and open-source GIS tools provide critical capacity for ecological research, particularly for habitat mapping and assessment in remote areas like the Mongolian steppe. In this training session, participants were introduced to the fundamentals of satellite image interpretation, especially using Landsat 9 imagery, and trained in QGIS for spatial analysis. This included practical exercises on downloading data from the USGS EarthExplorer, computing vegetation indices such as NDVI, and overlaying GPS tracking data of migratory birds to assess habitat use.

The combination of Landsat satellite imagery and GPS data allows researchers to evaluate seasonal habitat changes, wetland conditions, and grazing pressure. These methods support cross-border ecological monitoring and conservation planning and are particularly valuable for collaborative studies of migratory species such as cranes.

For cranes and geese along the East Asian–Australasian Flyway, ecological adaptability and habitat connectivity are critical to conserving endangered species and ensuring effective habitat management. Recent advances in satellite tracking, high-resolution imaging, stable isotope analysis, and unmanned aerial vehicles (UAVs) now provide unprecedented tools for studying migration and habitat use. Training in these methods has strengthened the capacity of young crane researchers and conservationists in East Asia, aligning with the goals of the Kunming–Montreal Global Biodiversity Framework. Ultimately, these advances provide essential evidence to guide conservation action along the flyway and inform broader wetland protection strategies.

Use of genetics tool in crane conservation

Molecular genetic approach is an important tool of the conservation genetics - a multidisciplinary subfield of population genetics which goals to prevent species from extinction. The use of molecular genetic methods allows us to evaluate the levels of genetic diversity and inbreeding, spatial genetic differentiation and phylogeography, demographic history, hybridization, adaptability, sex ratio, relatedness, kinship and other important characteristics and processes in populations of the endangered and vulnerable species. Most crane species in North-East Asia are rare and protected, but genetic monitoring of their populations is also lacking for most of them. Thus, genetic diversity and differentiation of the White-naped, Demoiselle and Eurasian cranes have been fragmentarily studied in Russia, whereas gene pool of the Red-crowned crane has been well investigated in the island population in Japan, but purely in the other mainland countries. The Hooded crane is the least studied crane species worldwide, including genetic aspects. Thus, there is no comprehensive knowledge of the genetic structure of these species across their entire ranges. Since North-East Asian cranes are migrants and their flyways connect several countries, it is extremely important to study genetic processes in all parts of the species ranges, both in the center and on the periphery, as well as in the breeding and wintering grounds. During the Training Workshop, participants learned about the types of biological material, methods of sampling, molecular genetic tools and examples of their application for studying the gene pools of Asian crane species.

Main recommendations

Crane research and conservation with a focus on Northeast Asia are as follows:

1. Consolidate efforts on crane conservation on the basis of the activities of existing working groups such as the North-East Asia Crane Working Group, Flint Crane Working Group of Eurasia, International Red-crowned Crane Network, International White-naped and Hooded Crane Network, Korean Crane Network, as well as ICF Asia Programme’s activities in the region.
2. Pay attention to regular monitoring of crane populations and their breeding, migratory and wintering habitats in North-East Asia for the determination of current trends, prevalent threats and measures for their mitigation.
3. Provide joint complex research in cooperation with specialists of other biological disciplines and pay attention to issues that can be applied for the conservation of cranes and their habitats at international, national and flyway levels.

4. Use modern techniques of communication and participate in webinars, training, and workshops for information exchange and coordination of activity in crane research and conservation.
5. We recommend the use of molecular genetic approach for conservation of the rare crane species in North-East Asia, which requires collecting biological material and developing species-specific molecular genetic markers, which are currently absent for most crane species in this region. For such markers as microsatellites and SNPs (Single Nucleotide Polymorphisms) we also suggest to elaborate panels for use in many crane species that would allow to obtain universal tool for measuring and inter-species comparison of various genetic diversity parameters. Such marker panels should be developed and introduced at international level for application in joint research projects.

Strengthening flyway-level crane conservation:

1. **Enhance coordination and partnerships**: Strengthen centralized coordination among countries, establish robust international partnerships and projects, and foster closer cooperation between national governments, NGOs, and scientific organizations to improve conservation effectiveness along flyways.
2. **Increase regular exchange of information**: Promote systematic sharing of research findings, monitoring data, and best practices across countries and institutions to ensure informed decision-making and harmonized conservation actions. One of the important discussions were about improving the coordinated efforts on color banding and marking of cranes in Asia.
3. **Strengthen capacity-building initiatives**: Invest in similar training programs, workshops, and mentorship opportunities for early-career researchers, site managers, and conservation practitioners. During the discussion there were suggestions that the next training workshop be hosted in China, given that the country supports the highest number of crane species in Asia and has implemented many successful conservation projects that could serve as valuable learning models.
4. **Establish sustainable financing mechanisms**: Develop long-term, reliable funding strategies to support both international and national crane conservation activities, drawing on diverse sources such as international organizations, government allocations, and innovative financing schemes. High priorities should be given to early career crane researchers and conservationists to encourage them to stay on cranes issues in Asia.
5. **Expand the use of international tools and frameworks**: Broaden the application of multilateral agreements such as the Ramsar Convention, the Convention on Biological Diversity, the Convention on Migratory Species, the East Asian–Australasian Flyway Partnership, and the Central Asian Flyway, as well as bilateral agreements on migratory birds. These frameworks offer powerful tools for aligning policies, mobilizing resources, and advancing conservation goals, while also engaging and educating new generations of conservationists to safeguard cranes and their habitats.

Environmental education events and programs:

1. Use cranes as symbols of nature and wetland conservation campaigns. Explain how protecting crane habitats helps protect other animals and plants and their habitats.
2. Create information centers, organize festivals, holidays, summer environmental camps, seminars and other education events dedicated to cranes and their habitats.
3. Involve students and local people in the organization of education events as well as in crane studies. Use the results of crane studies in local schools when teaching biology. Prepare teaching aids and other materials about cranes for children and adults.

4. Ensure events are well-organized to create a good impression among participants, which will lead to better attitudes towards cranes and their habitats. Organize events on a regular basis.
5. When preparing programs for the conservation of cranes, pay special attention to the participation of local people. Help the local people create small businesses (souvenirs, homestays, food), so that part of the income from this small business goes to support the livelihood of the local population.
6. Exchange information about successful education events and programs as well as about lessons learned from unsuccessful efforts
7. Establish connections between government and public organizations and international cooperation in the protection of cranes
8. Develop replicable models for environmental education activities that can be adopted on a wider basis (upscaled) within and across countries along flyways with limited additional effort

Recommendations on ecological tourism

1. Make sure that ecotourism will contribute to crane conservation and environmental education
2. Establish cooperation with tourism companies for which environmental education and nature conservation are the main goals
3. Prepare routes that avoid negative impacts of tourists on cranes and their habitats. Exclude the use of vehicles and drones near the overnight roosting sites of cranes.
4. Create infrastructure that will allow tourists to see cranes without disturbing them (hides, screened paths).
5. Prepare information materials about cranes in tourist areas.
6. Train tour guides to provide high-quality interpretive services to tourists and to observe cranes in their habitats

Recommendations on climate mitigation

1. ***Protect and restore wetlands***. Safeguard key wetlands used for breeding, staging, and wintering by cranes. Restoration should include improving water management, reviving native vegetation, and reducing pollution from agriculture and industry. Healthy wetlands also provide climate benefits by storing carbon and buffering against extreme weather events.
2. ***Maintain habitat connectivity***. Cranes depend on a network of sites along their migratory routes. Protecting corridors between these sites and integrating crane habitats into land-use and climate adaptation plans are essential to ensure that populations can move and adapt under changing conditions.
3. ***Integrate climate-smart approaches***. Conservation should directly address climate challenges by restoring wetlands for carbon sequestration and climate resilience, and by ensuring renewable energy projects (wind farms, power lines) are designed to minimize risks to cranes and other waterbirds.
4. **Community support for wetland conservation.** Community involvement is essential for sustainable wetland conservation. Participatory management empowers local people to take part in monitoring, restoration, and decision-making, building ownership and long-term commitment. Providing livelihood alternatives such as ecotourism, handicrafts, or climate-smart agriculture reduces pressure on wetlands while creating new income streams. Clear benefit-sharing mechanisms ensure that conservation delivers visible and fair returns to local households, strengthening both community resilience and support for wetland protection.

What is next?

After extensive discussions, participants agreed on several recommendations to improve future training workshops. First, while the program primarily targets young researchers and conservationists already employed, China faces a decline in crane specialists due to challenges in publishing scientific papers. To address this, it is recommended that future sessions also recruit senior doctoral students and staff from key protected areas to encourage their engagement in fieldwork.

Second, building on the training, a long-term joint working group could be established under frameworks such as the East Asian–Australasian Flyway Partnership (EAAFP) and the Crane Working Group. This would consolidate training outcomes, promote regional collaboration, and strengthen crane conservation efforts, similar to the role previously played by the International Crane Foundation.

Third, slight adjustments to the training schedule could improve effectiveness, for example, placing lectures after initial fieldwork. This would allow participants to become familiar with one another in the field before moving into lectures and discussions. Adding extra days for field work would allow participants to obtain more hands-on training. This year, field part of the training was effected by rains.

Field Activities

Crane Enterprise Program

Participants visited the Crane Enterprise Program training workshop, which is a successful conservation initiative implemented in the Khurkh-Khuiten Nature Reserve. The enterprise empowers local women by providing them with skills to diversify their income, in return for their commitment to protecting and raising awareness about crane species. Proceeds from the sale of handmade wool products go directly to the local artisans.

Crane capturing

As part of the field activities, participants successfully captured and banded an adult Eurasian Crane (*Grus grus*). This hands-on experience allowed trainees to observe and engage in professional bird handling techniques, data collection, and banding procedures, contributing to ongoing monitoring and research efforts in the region.

Birdwatching and Sightseeing

Each morning of the workshop began with field excursions for birdwatching, providing participants with the opportunity to observe a wide range of bird species, including nearly all crane species found within the Khurkh and Khuiten Nature Reserve. These early outings enriched the participants' understanding of local biodiversity and crane behavior in their natural habitat. At the conclusion of the workshop, participants also enjoyed a local sightseeing tour, offering a cultural perspective on the region and its conservation landscape.

Habitat monitoring

Participants visited one of the key habitats monitoring sites within the Khurkh and Khuiten Nature Reserve, where an eddy covariance station is installed. This site is part of ongoing efforts to monitor and restore the peatland ecosystem. During the visit, participants gained firsthand insight into the ecological importance of peatlands, particularly their role in carbon storage, water regulation, and supporting biodiversity.

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References

Akiyama T., Momose K., Onuma M., Matsumoto F., Masuda R. Low genetic variation of Red-crowned cranes on Hokkaido Island, Japan, over the hundred years // Zoological Science. 2017. V. 34. № 3. P. 211-216. https://doi.org/10.2108/zs160194

Batbayar, N., et al. (2021). Satellite tracking of White-naped Cranes reveals key staging and wintering areas. Bird Conservation International, 31(1), 92–108.

Chen Q., Lin H., Zheng C., Mudrik E.A., Kashentseva T.A., Cheng Y., Wang Z., Zhou H., Zhou H., Wang W., Liu, Y. Understanding the past to preserve the future: Genomic insights into the conservation management of a critically endangered waterbird // Molecular Ecology. 2025. V. 34. № 2. e17606. https://doi.org/10.1111/mec.17606

Congalton, R. G., & Green, K. (2019). *Assessing the Accuracy of Remotely Sensed Data: Principles and Practices*. CRC Press.

ESA. (2023). Sentinel-2 User Handbook. https://sentinels.copernicus.eu

Frankham R., Ballou J.D., Briscoe D.A. Introduction to Conservation Genetics. Cambridge University Press, New York. 2002. 617pp.

Guo, J., Liang, W., Zhou, Y., Jia, Y., Yang, H., Sun, L., Chen, Q., Fu, T., Ren, S., Jiang, W., Lei, G., Wen, L., 2025. A case study from a critical stopover site in the East Asian-Australasian Flyway provides lessons for optimal high-tide roost management to support shorebird conservation. Biological Conservation 302, 110985. https://doi.org/10.1016/j.biocon.2025.110985

Harris J. 2009. Save flyways for the Siberian Crane. A flyway approach conserves some of Asia's most beautiful wetlands and waterbirds. International Crane foundation.

Jia, Y., Jiao, S., Zhang, Y., Zhou, Y., Lei, G., Liu, G., 2013. Diet Shift and Its Impact on Foraging Behavior of Siberian Crane (Grus Leucogeranus) in Poyang Lake. PLoS ONE 8, e65843. https://doi.org/10.1371/journal.pone.0065843

Jia, Y., Liu, Y., Jiao, S., Guo, J., Lu, C., Zhou, Y., Wang, Y., Lei, G., Wen, L., Mo, X., 2021. Shifting of the Migration Route of White-Naped Crane (Antigone vipio) Due to Wetland Loss in China. Remote Sensing 13, 2984. https://doi.org/10.3390/rs13152984

Kennedy, R. E., et al. (2014). Bringing an ecological view of change to Landsat-based remote sensing. Frontiers in Ecology and the Environment, 12(6), 339–346. https://doi.org/10.1890/130066U.S. Geological Survey. (2023). EarthExplorer User Guide. https://earthexplorer.usgs.gov/

Lei, J., Jia, Y., Wang, Y., Lei, G., Lu, C., Saintilan, N., Wen, L., 2019a. Behavioural plasticity and trophic niche shift: How wintering geese respond to habitat alteration. Freshwater Biology 64, 1183–1195. https://doi.org/10.1111/fwb.13294

Lei, J., Jia, Y., Zuo, A., Zeng, Q., Shi, L., Zhou, Y., Zhang, H., Lu, C., Lei, G., Wen, L., 2019b. Bird Satellite Tracking Revealed Critical Protection Gaps in East Asian–Australasian Flyway. IJERPH 16, 1147. https://doi.org/10.3390/ijerph16071147

Liang, W., Lei, J., Ren, B., Cao, R., Yang, Z., Wu, N., Jia, Y., 2022. The Impacts of a Large Water Transfer Project on a Waterbird Community in the Receiving Dam: A Case Study of Miyun Reservoir, China. Remote Sensing 14, 417. https://doi.org/10.3390/rs14020417

Liu, Y., Wu, L., Guo, J., Jiao, S., Ren, S., Lu, C., Wang, Y., Jia, Y., Lei, G., Wen, L., Su, L., 2022. Habitat selection and food choice of White-naped Cranes (Grus vipio) at stopover sites based on satellite tracking and stable isotope analysis. Avian Research 13, 100060. https://doi.org/10.1016/j.avrs.2022.100060

Meine CD, Archibald GW, editors. 1996. The Cranes: Status Survey and Conservation Action Plan. IUCN, Gland, Switzerland, and Cambridge, U.K. 294 pp.

Mirande CM, Harris JT, editors. 2019. Crane Conservation Strategy. Baraboo, Wisconsin, USA: International Crane Foundation. 454 pp.

Mudrik E.A., Goroshko O.A., Surmach S.G., Kashentseva T.A., Nechaeva A.V., Smirenski S.M., Politov D.V. Gene pool homogeneity of western and eastern populations of the White-naped crane Antigone vipio in different flyways // Russian Journal of Genetics. 2022. V. 58. № 5. P. 566–575. https://doi.org/10.1134/S1022795422050064

Mudrik E.A., Ilyashenko E.I., Kazimirov P.A., Kondrakova K.D., Archimaeva T.P., Bazarov L.D., Goroshko O.A., Dorzhiev Ts.Z., Kuksin A.N., Postelnykh K.A., Shurkina V.V., Ilyashenko V.Yu., Shatokhina A.V., Politov D.V. Mitochondrial DNA data allow distinguishing the subpopulations in the widespread Demoiselle crane (Anthropoides virgo) // Vavilov Journal of Genetics and Selection. V. 29. № 4. P. 568-577. https://doi.org/10.18699/vjgb-25-60

Mudrik E.A., Ilyashenko, E.I., Ilyashenko, V.Y. Postelnykh K.A., Kashentseva T.A., Korepov M.V., Goroshko O.A., Nechaeva A.V., Politov D.V. Genetic diversity and differentiation of the widespread migratory Demoiselle Crane, Grus virgo, on the northern edge of the species' distribution // Journal of Ornithology. 2022. V. 163. № 1. P. 291–299. https://doi.org/10.1007/s10336-021-01919-4

Mudrik E.A., Kashentseva T.A., Postelnykh K.A., Politov D.V Genetic monitoring of captive breeding and reintroduction of the Russian endemic species, Siberian Crane (Leucogeranus leucogeranus, Gruidae) // Biology Bulletin. 2023. V. 50. №. 8. P. 275–281 https://doi.org/10.1134/S1062359023080162

Mudrik E.A., Politov D.V. Molecular genetic approaches in the study and conservation of population gene pools of cranes (Gruidae, Aves) // Biology Bulletin Reviews. 2022. V. 12. Suppl. 1. P. S46–S54. https://doi.org/10.1134/S2079086422070088

NASA Landsat Science. (2023). https://landsat.gsfc.nasa.gov

Nowald G, Fanke J, and Hansbauer MM. 2018. Linking Crane Life History and Feeding Ecology with Natural Habitats and Agricultural Lands // Cranes and Agriculture: A Global Guide for Sharing the Landscape. Austin, J.E., Morrison, K.L., Harris, J.T., editors. Baraboo, Wisconsin, USA: International Crane Foundation. p. 18-34

Patterson-Abrolat, C., Ilyashenko, E.I. and Morrison, K.L. 2018. Strategies to Manage the Crane-Agriculture Interface Using Partnerships, Ecotourism and Educational Opportunities // Cranes and Agriculture: A Global Guide for Sharing the Landscape. Austin, J.E., Morrison, K.L., Harris, J.T., editors. Baraboo, Wisconsin, USA: International Crane Foundation. p. 157-179.

QGIS Development Team. (2023). QGIS Geographic Information System. Open Source Geospatial Foundation Project. http://qgis.org

Roy, D. P., et al. (2014). Landsat-8: Science and product vision for terrestrial global change research. Remote Sensing of Environment, 145, 154–172. https://doi.org/10.1016/j.rse.2014.02.001

Smirenski SM, Harris J, Smirenski EM., editors. 2001. Guide on Crane Study for North-East Asia Crane Site Network. Moscow, 69 pp.

Tkach K., Watson M. Publication and use of genetic tools in conservation management applications—A systematic review // Journal of Applied Ecology. 2023. V. 60. № P. 1-15. https://doi.org/10.1111/1365-2664.14433

Tucker, C. J. (1979). Red and photographic infrared linear combinations for monitoring vegetation. Remote Sensing of Environment, 8(2), 127–150. https://doi.org/10.1016/0034-4257(79)90013-0

Wang, Y., Jia, Y., Guan, L., Lu, C., Lei, G., Wen, L., Liu, G., 2013. Optimising hydrological conditions to sustain wintering waterbird populations in P oyang L ake N ational N atural R eserve: implications for dam operations. Freshwater Biology 58, 2366–2379. https://doi.org/10.1111/fwb.12216

Wulder, M. A., et al. (2019). Current status of Landsat program, science, and applications. Remote Sensing of Environment, 225, 127–147. https://doi.org/10.1016/j.rse.2019.02.015

Zhang, L., & Weng, Q. (2016). An investigation of forest disturbance using remote sensing and GIS: A case study in China. *Environmental Monitoring and Assessment*, 188(2), 115.

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Appendix 2: Training workshop agenda

DAY 1 (5 July, Saturday)	
Departure from UB at 08:00 Lunch will be on the road Dinner at the Reserve	
Day 2 (6 July, Sunday) Fundamentals of crane research & population monitoring	
08:30 - 09:00	Registration
09:00 - 09:15	Opening session • Opening remarks: Mr. Ganbold Baasanjav, Head of ESCAP East and North-East Aisa office (video) • Welcoming remarks: Mr. Nyambayar Batbayar, Wildlife Science and Conservation Center of Mongolia (WSCC) • Group photo
09:15 – 10:30	**Session 1. Overview of the Crane Research and Conservation** • Global and Northeast Asia overview of crane research and conservation • Introduction to population status and numbers of cranes in breeding areas (Mongolia, Russian Federation, China) • Introduction to population status and numbers of cranes in wintering areas (China, Republic of Korea, Japan) Q&A and Discussion
10:30 – 11:00	Break
11:00 – 12:00	**Session 2. Climate change and habitat degradation** • Understanding climate change impact on cranes and wetlands – what crane projects can do to mitigate impacts • Agriculture expansion in NE Asia, potential effects and benefits to cranes and their habitats Q&A and Discussion
12:00 – 13:30	Lunch
13:30 – 15:00	**Session 3. Habitat assessment, monitoring, and restoring** • Assessing wetland habitat conditions and planning for long-term monitoring • Improving crane habitat and wetland restoration techniques • Quantifying diet and feeding habitat of cranes Q&A and Discussion
15:00 – 15:30	Break
15:30 – 17:30	**Session 4. Drone usage, capture and marking, AI sampling** • Using drones for crane population monitoring • Crane capture, sampling, and marking techniques, safety considerations • HPAI and disease surveillance in cranes and waterbirds Q&A and Discussion
18:00 – 19:30	Welcome dinner & networking
DAY 3 (7 July, Monday) CEPA, Community work, communications, and cooperation	
09:00 – 10:10	**Session 5. CEPA and community works** • Making effective environmental education programs • Conducting questionnaire surveys and considerations • Community based conservation, case studies Q&A and Discussion
10:10 – 10:30	Break
10:30 – 12:00	**Session 6. Protected areas and flyway level approach**

	• Protected areas' role in crane conservation • Flyway level conservation work: needs and challenges Open discussion: Challenges in crane conservation in NEAsia
12:00 – 13:30	Lunch
13:30 – 17:00	**Field activities: Capturing and color banding cranes**
18:00 – 19:30	Dinner
DAY 4 (8 July, Tuesday) Data analysis and programming applications	
09:00 – 10:30	**Session 7. Remote sensing application** • Usage of remote sensing images in habitat assessment and mapping • Application of Google Earth Engine Q&A and Discussion
10:30 – 10:50	Break
10:50 – 12:00	**Session 8. GIS and QGIS** • Application of GIS and QGIS • Data analysis in R Q&A and Discussion
12:00 – 13:30	Lunch
13:30 – 17:00	**Field activities** • Sampling diet and habitat data collection • Visit to the Khurkh Bird Banding Station • Joint crane and birdwatching
17:45 – 19:00	**Closing session** Wrap-up, certification ceremony & closing remarks Farewell dinner and party
DAY 5 (9 July, Wednesday)	
Departure from the Reserve at 10:00 Lunch on the road Arrival at UB at around 19:00-20:00	