

Zoology beyond boundaries: Advances and perspectives from the 27th Annual Academic Conference of the China Zoological Society

Lan Zhao,^{1,2,3,4} Yin Qi,^{1,2,3,4} Junhua Hu,^{1,2,3,4,*} and Jia-Tang Li^{1,2,3,4,*}

¹China-Croatia 'Belt and Road' Joint Laboratory on Biodiversity and Ecosystem Services, Chengdu Institute of Biology (CIB), CAS, Chengdu 610213, China

²Mountain Ecological Restoration and Biodiversity Conservation Key Laboratory of Sichuan Province, CIB, CAS, Chengdu 610213, China

³Key Laboratory of National Forestry and Grassland Administration on Biodiversity Conservation on the Qinghai-Xizang Plateau, CIB, CAS, Chengdu 610213, China

⁴University of Chinese Academy of Sciences, Beijing 100049, China

*Correspondence: hujh@cib.ac.cn (J.H.); lijt@cib.ac.cn (J.-T.L.)

Received: August 25, 2026; Accepted: September 10, 2026; Published Online: September 11, 2026; <https://doi.org/10.59717/j.xinn-life.2026.100254>

© 2026 The Author(s). This is an open access article under the CC BY license (<https://creativecommons.org/licenses/by/4.0/>).

Citation: Zhao L., Qi Y., Hu J., et al. (2026). Zoology beyond boundaries: Advances and perspectives from the 27th Annual Academic Conference of the China Zoological Society. *The Innovation Life* 4:100254.

MAINTEXT

From August 22 to 25, 2026, the China Zoological Society (CZS) convened its 27th Annual Academic Conference at the Chengdu Airport International Conference Centre in Sichuan Province. Chaired by Academician Fuwen Wei, the congress brought together more than 1,000 zoologists, developmental biologists, geneticists, ecologists, and conservation practitioners from across China.

Embodying a pioneering and innovative spirit, the conference served as an intellectual forum for emerging theories, mechanisms, and technologies. It explored animal life across biological scales—from genes and cells to species, communities, and ecosystems—and featured ten plenary lectures, fourteen thematic symposia, and over 300 oral and poster presentations (Figure 1). In addition to the 11 academic sessions, the conference hosted three career-development sessions. The 5th Chimelong Awardees & Young Elite Scientists sessions showcased rising leaders who presented outstanding achievements and notable contributions across synthetic embryology, marine mammal adaptations, and invasive amphibian risk assessments. The "She Power – Women Scientists Forum" highlighted women's pivotal contributions across subdisciplines—from evolutionary systematics and stem-cell platforms to bat ecology and forest restoration—illuminating their unique intellectual perspectives for resolving complex biological questions. The PhD student forum exhibited the creativity and vitality of emerging scholars, providing strong impetus for the development of the field.

By leveraging the distinct expertise of the China Zoological Society, these forums brought together researchers from diverse fields including molecular biology, medicine and macroecology, as well as from technological areas such as precision instrumentation and biomanufacturing. Such broad participation enriched zoological research with fresh perspectives while deepening its integration with genomics, physiology, synthetic biology, ecology, global change science, and artificial intelligence. The resulting synergy was reflected in research thrusts around four thematic pillars—microscopic, macroscopic, extreme environments, and cross-disciplinary integration—that collectively push the boundaries of our understanding of animals. This endeavor will expand the frontiers of life sciences and strengthen China's zoological research in service of national priorities and human well-being.

Life's gestation: Deciphering the molecular grammar of animal development

At the ultra-micro scale, developmental biologists are deciphering the regulatory networks that orchestrate cell fate, tissue patterning, and organogenesis. A landmark discovery from the opening plenary revealed that the maternal factor *huluwa* initiates vertebrate body-axis formation by shielding β -catenin from degradation, demonstrating how a single molecular switch can serve as a blueprint for embryonic architecture.¹ Additional pioneering works, including studies on retinal degeneration, primate gestation, and 3D in vitro implantation models, have traced pathogenic cascades from gene to phenotype, providing theoretical foundations and experimental platforms for tackling developmental disorders such as visual impairment and birth defects, and bridging basic biology with clinical translation. Technological breakthroughs have further accelerated advances in the field: haploid embryonic stem cell (semi-cloning) approaches, together with artificial-embryo and digital-embryo models, are opening new avenues for studying human development in vitro and in silico, allowing developmental processes to be examined with high spatiotemporal resolution while mitigating ethical constraints.

These studies centered on cell-fate determination and spanning multiple taxa—from vertebrates (fish, mammals, reptiles) to protists. They integrated molecular identification, metabolic reprogramming, genetic screening, and multi-omics, along with functional validation to elucidate the molecular decision-making mechanisms underlying gametogenesis, embryonic development, organ remodeling, and functional maintenance in contexts spanning development, reproduction, thermoregulation, aging, and disease. These advances deepen our mechanistic understanding of the origins of health and disease. Building on this foundation, researchers have proposed a revolutionary paradigm—from gene editing to cell editing—a conceptual and operational pathway poised to capture the next wave of innovation and propel microscopic animal research toward transformative breakthroughs.²

Biodiversity across scales: From lineages to landscapes and deep time

Animal biodiversity is now understood as a dynamic, multidimensional system encompassing genetic, phylogenetic, functional, and community diversity, promoting a redefinition of the species pool through a phylogenetic framework. Charting its historical, current, and future dynamics remains a core zoological pursuit. As highlighted by plenary speakers, macro-ecosystem-science provides a conceptual framework linking organismal diversity to planetary biogeochemical cycles under rapid environmental change. Large-scale multi-omics technologies have greatly expanded the temporal and spatial scope of zoological research, enabling exploration of key evolutionary innovations and developmental traits—exemplified by studies on snake origins, limb loss, venom bioprospecting, and related drug resource development.³ Furthermore, the Protist 10,000 Genomes Project (P10K) has facilitated research into the diversity and mechanisms of protozoan symbiotic systems. Capitalising on genetic resources including the Bird 10,000 Genomes Project (B10K), primate and lizard genome projects, researchers integrated paleoenvironmental reconstructions to characterise global vertebrate diversity. For focal clades including birds, amphibians, crustaceans, algivorous protists, and obligate parasitic flies, investigators have disentangled diversity patterns, evolutionary trajectories, and their underlying drivers.

In addition, methodological advances, including telomere-to-telomere assemblies and lightweight, long-lasting automated tracking technology, provide a panoramic atlas of animal genetic and behavioral diversity. At community and landscape scales, thematic presentations highlighted symbiosis-driven interactions (ciliate-protist-microbe partnerships, parasite-host coevolution in lizards) and geographic processes (island biogeography, bird-mediated dispersal, and forest-restoration effects on biodiversity). Forward-looking sea-level rise assessments, ecosystems surveys across China and climate projections are rendering macroecology increasingly predictive and actionable for conservation planning. These advances are strengthening our capacity to forecast changes and develop proactive management strategies in response to accelerating global environmental change.

Edge of survival: Adaptation across extreme environments

How animals persist beyond previous survival thresholds under environmental extremes and anthropogenic stress remains as a central challenge in zoology. Conference reports outlined a unified systems-level framework spanning genomic, cellular, physiological, and behavioral responses, with multi-omics integration across individuals, populations, and microbiomes. A plenary lecture traces the evolutionary innovations in gravity sensing and

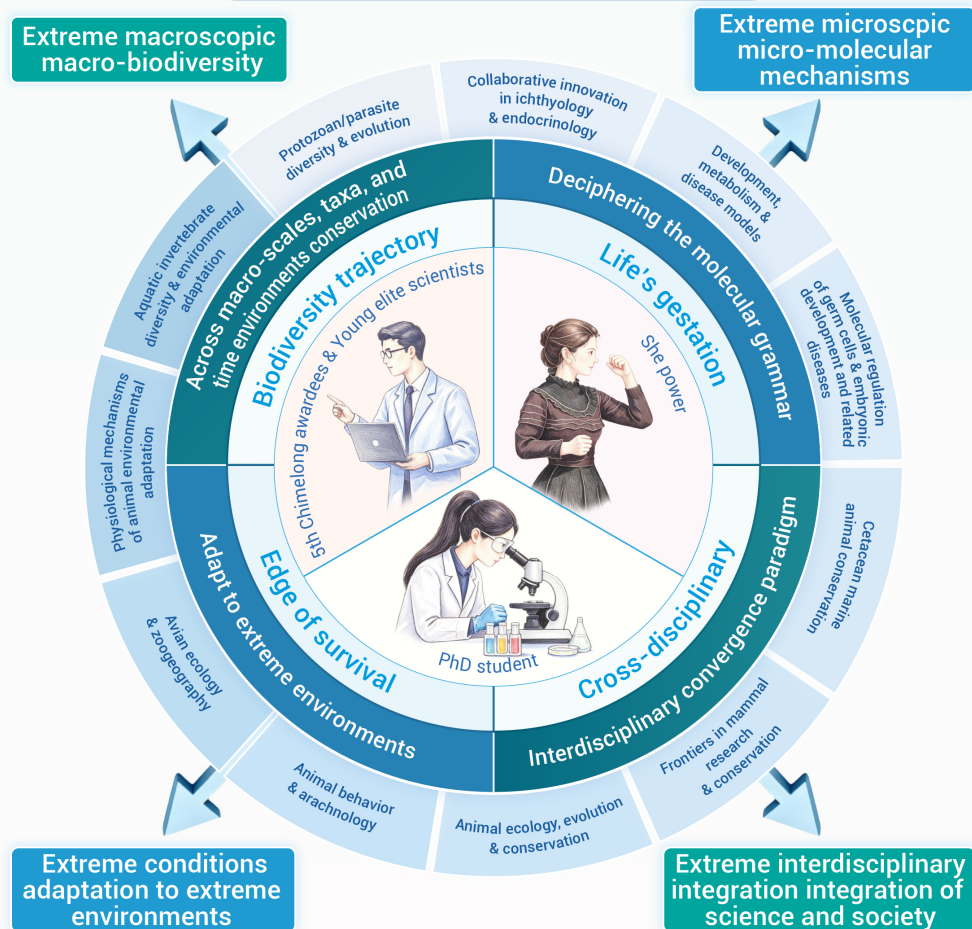


Figure 1. Schematic overview of the 27th Annual Academic Conference of the China Zoological Society The conference science agenda comprises 11 academic sessions covering four research frontiers: micro-molecular mechanisms, macro-biodiversity, adaptation to extreme environments, and integration of science and society. It also includes three career development sessions: "Presentation from the 5th Chimelong Awardees & Young Elite Scientists", "She Power – Women Scientists Forum", and "PhD Student Forum".

research on gibbon vocal communication has revealed parallels with human music and language origins, offering fresh perspectives on human–nature connections. Concurrently, genetic dissection of livestock production traits is helping build more sustainable food systems. Grounded in these mechanistic insights, emerging technologies are transforming conservation practice: machine learning decodes canine behavior and enables individual recognition; 6G-enabled citizen science expands public participation in ecological monitoring; large-scale educational installations merge marine conservation with cultural tourism, especially for aquatic mammals. Critically, threat identification has expanded across taxa and systems—from parasitic infections in fish and emerging viruses in crustaceans, to roadkill mortality and protected-area limitations for primates, to food-web disruptions under global change and challenges facing wild equids and migratory seals. Conservation now transcends geographic boundaries, and resource utilization is overcoming bottlenecks in growth and reproduction. Safeguarding the shared biosphere and our common future

balance regulation that enabled the vertebrate water-to-land transition. This pivotal expansion of survival boundaries opened terrestrial ecosystems. Another highlighted how physiological flexibility and gut microbiomes synergistically sustain survival on the Qinghai-Xizang Plateau, elucidating host–microbe co-adaptation under chronic hypoxia and cold.

Diverse adaptive strategies across taxa were comprehensively documented. At the genomic level, polyploidy in fish and frogs, alongside population-level shifts, metabolic reprogramming, and chromosomal homeostasis in rodents and insects, drives hypoxia tolerance. Physiologically, desert rodents exhibit finely tuned energy–water trade-offs during prolonged drought, while TRPA1 channel evolution underpins thermal adaptation across vertebrates. At the morphological level, male-specific coloration in desert lizards reflects the interplay between sexual selection and environmental signaling. Ecologically, plateau uplift drives range expansion and sex differentiation in molluscs, and gut microbiomes are causally linked to host fitness. At broader scales, metagenomic mining uncovers host–microbe networks, cadmium disrupts amphibian metamorphic skin remodeling, and oysters demonstrate regulatory plasticity. Moreover, anthropogenic stressors including urbanization and heavy metal pollution elicit multi-level adaptive responses, ranging from gene transcription and metabolism to behavioral adjustments in communication and reproductive strategies.

Beyond boundaries: Integrating science, technology, and society

As invaluable resources for human well-being, wild animals face unprecedented threats from habitat fragmentation and loss, climate change, and emerging diseases. Conservation science has evolved beyond biology into a trans-societal endeavour embracing citizen science, policy, and public engagement. This conference showcased research-practice breakthroughs grounded in the Chinese wisdom of "Unity of Nature and Man" (UNM),⁴ advancing integrated management to tackle mounting biodiversity crises and pursue harmonious coexistence and a shared future for all life on Earth.

Recognizing the evolutionary and behavioral foundations of animal life,

requires bridging disciplines with society, and integrating diverse expertise, technological innovation and public engagement into a holistic, sustainable strategy.

Collectively, the congress charted an integrated trajectory from the origins and diversification of life to adaptive strategies, human health, and sustainability. It marked a pivotal moment in the transition of China's zoology from following established agendas to shaping the field across multiple frontiers. As the CZS strengthens cross-disciplinary integration and advances research frontiers, it also addresses persistent challenges in theoretical understanding, methodological frameworks, and foundational data.⁵ The congress thus highlighted zoology's shift toward a technology-driven paradigm, while China's expanding international presence reflects its emerging role in global zoological research. Through open collaboration and sustained innovation, China's zoology will contribute original solutions, concrete actions, and a shared vision for the sustainable conservation of global biodiversity and a harmonious future for nature and humanity.

REFERENCES

- Yan L., Chen J., Zhu X., et al. (2018). Maternal *Huluwa* dictates the embryonic body axis through β -catenin in vertebrates. *Science* **362**:eaat1045. DOI:10.1126/science.aat1045
- Deng Y., Xiong J., Huang K., et al. (2026). From gene editing to cell editing: An emerging technology for synthetic biology. *Innov. Life* **4**:100225. DOI:10.59717/j.xinn-life.2026.100225
- Peng C., Wu D.-D., Ren J.-L., et al. (2023). Large-scale snake genome analyses provide insights into vertebrate development. *Cell* **186**:2959–2976.e2922. DOI:10.1016/j.cell.2023.05.030
- Huang G., Ping X., Xu W., et al. (2021). Wildlife conservation and management in China: Achievements, challenges and perspectives. *Nat. Sci. Rev.* **8**:nwab042. DOI:10.1093/nsr/nwab042
- Li C., Ma Y., Jiang Z., et al. (2026). Data issues hinder further success in China's biodiversity conservation. *Nat. Rev. Biodivers.* **2**:71–73. DOI:10.1038/s44358-025-00122-0

FUNDING AND ACKNOWLEDGMENTS

This work was supported by National Natural Science Foundation of China (No. 32271737 and No. 32571939). The funder had no role in study design, data collection and analysis, decision to publish or preparation of the manuscript.

AUTHOR CONTRIBUTIONS

All authors contributed to the manuscript and approved the final version.

DECLARATION OF INTERESTS

The authors declare no competing interests.