Aquaculture Health Research Survey

March 2026

Report of the global consultation on aquaculture research priorities: Amphibians Section

World Organisation for Animal Health

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Executive summary

The 2025 Global Consultation on Aquaculture Health Research, jointly conducted by WOAH and the STAR IDAZ International Research Consortium (IRC), aimed to define global research priorities across major aquaculture groups. Amphibians received markedly fewer responses than finfish, molluscs or crustaceans, with only five experts completing this section. This low participation reflects the early stage of amphibian aquaculture, yet it still provides a preliminary appraisal of research needs for a sector that is rapidly expanding. Even with limited input, the findings highlight early gaps that should be addressed to support sustainable development.

Priority Diseases

Experts identified a small but significant group of pathogens of concern, including *Batrachochytrium dendrobatidis*, *Batrachochytrium salamandrivorans*, ranaviruses, opportunistic bacterial infections, nutritional diseases and several unexplained mortality events. These observations shed light on possible health threats, but the scarcity of responses restricted the depth of analysis and illustrated how little is known about amphibian disease dynamics.

Diagnostics Research Priorities

Responses indicated the importance of affordable, reliable and accessible tools, including those suitable for low-resource settings. Strengthening diagnostic foundations — through better case definitions, improved understanding of host–pathogen–environment relationships and clarification of vectors — was highlighted as essential. In the longer term, harmonised and validated diagnostic standards will be needed to support global application.

Prophylactic Research Priorities

Similar patterns emerged for prophylactics. Immediate needs focus on practical disease-prevention tools, improved water quality management and alternatives to antimicrobials such as pre- and probiotics. Over the medium to long term, more innovative strategies — microbiome-based, immunological and ecological — will be required, supported by improved understanding of amphibian immunology.

Therapeutics Research Priorities

Therapeutic needs ranged from short-term outbreak management in wild and captive populations to the development of antimicrobial-free alternatives. Experts also stressed the need to better understand how treatments interact with environmental conditions and antimicrobial resistance.

Control Strategy Research Priorities

Control strategy priorities included strengthening risk-mitigating trade policies, refining priority pathogen lists, identifying vectors and carriers, and reinforcing surveillance, biosecurity and integrated monitoring. In the longer term, enhanced epidemiological frameworks and environmental indicators for high-risk aquatic environments will be crucial for early detection and risk-based control.

Conclusion

Although these priorities provide useful early direction, the consultation also highlighted substantial limitations: in several key areas, experts explicitly stated that available knowledge was insufficient to answer questions in detail. This scarcity of information reflects major global gaps in amphibian health expertise and confirms that the priorities identified here should be viewed as preliminary. Amphibian aquaculture is expanding quickly, yet scientific and diagnostic capacity has not kept pace. Addressing these early gaps — through investment in foundational research, expertise development and strengthened surveillance — will be essential to guide the sector toward sustainable and resilient growth.

Introduction

This document forms part of a series of focused reports developed following the *Global Consultation on Aquaculture Health Research (2025)*, co-organised by the **World Organisation for Animal Health (WOAH)** and the **STAR IDAZ International Research Consortium (IRC)**. The consultation was launched in January 2025 to support Activity 4.5 of **WOAH's Aquatic Animal Health Strategy**, which calls for strengthening coordinated research, identifying global gaps, and guiding investment priorities for aquatic animal health.

The consultation covered four major aquaculture groups — finfish, molluscs, crustaceans, and amphibians — and invited experts worldwide to provide detailed insights into diagnostics, epidemiology, prophylactics, therapeutics, and control strategies for each sector. The next page includes an infographic summarising the overall Aquaculture Health Research Survey, offering a visual overview of the consultation's global participation, expert diversity, and methodological scope. The full methodology, respondent background, and cross-cutting findings can be found in the previously published report 'Aquaculture Health Research Survey: Finfish Section', available on the WOAH publication portal and STAR IDAZ IRC website.

Compared with the other species groups, the Amphibians section received significantly fewer responses, with only a small number of experts opting to complete this part of the questionnaire. This limited participation likely reflects the fact that amphibian aquaculture is a relatively new but rapidly expanding industry, concentrated in specific regions and still developing its technical and scientific foundations. As a consequence, the global community of amphibian health specialists remains small. At the same time, this emerging sector faces increasing disease risks associated with intensification, global trade, and environmental change — underscoring the urgent need to develop expertise before the sector expands further, and offering a unique opportunity to avoid repeating some of the mistakes seen historically in other aquaculture sectors.

This short report summarises the research needs identified by the amphibian experts who participated in the consultation. While the dataset is more limited than for finfish, molluscs, or crustaceans, the insights provided are nevertheless valuable for recognising early gaps, guiding preparedness, and supporting the development of a proactive research agenda for amphibian aquaculture health.

The findings presented here focus exclusively on the amphibian-specific responses and should be interpreted alongside the broader cross-species analysis provided in the main consultation report. Together, these documents aim to support national authorities and funding bodies in planning targeted research and capacity-building efforts to ensure sustainable and resilient growth of this emerging sector.

World Organisation for Animal Health

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Global aquaculture survey

440 invitations distributed globally

187 countries engaged

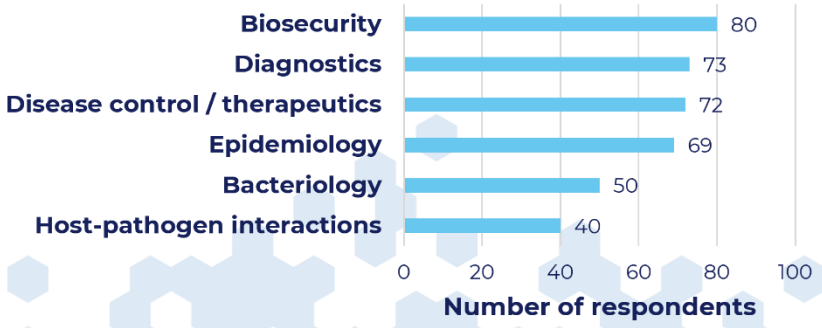
184 responses received from **89** countries

43% overall response rate

51 m 21 s average completion time

The survey had **global reach** with responses received from experts across the Americas, Europe, Africa & the Middle East, and Asia & Australasia

Respondents identified that they had **diverse expertise** across a range of topics relevant to aquaculture

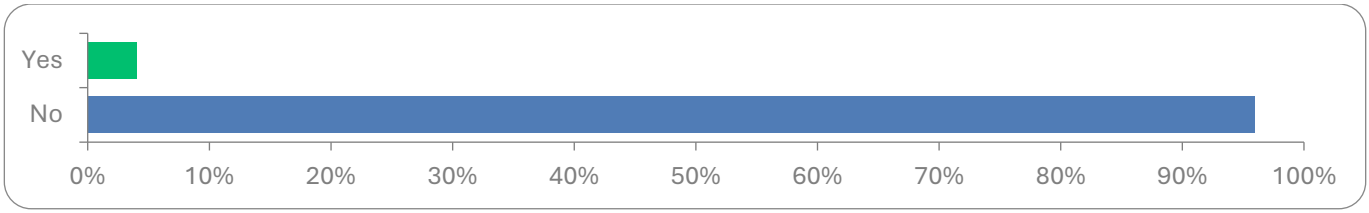


Other areas of expertise cited include:

- Virology
- Vaccine development
- Welfare
- Parasitology
- Immunology

Section: Amphibians

In total, only 5 experts elected to complete the Amphibians section of the global consultation for advancing aquaculture research. This very limited response reflects the small and emerging nature of the amphibian aquaculture sector and the comparatively low number of specialists currently working in this field. Further information on respondent profiles is available in the *Expert background* section of the main report, accessible via the WOAH publication portal and STAR IDAZ IRC website.



Although five experts initially indicated their willingness to contribute to the Amphibian section, only a few responses were provided per questions. The small number of responses limits the analysis, thus the findings below represent a limited but valuable snapshot of current expert perspectives on amphibian health research needs.

Experts highlighted a narrow but critical set of priority pathogens:

- *Batrachochytrium dendrobatidis*
- *Batrachochytrium salamandrivorans*
- Ranavirus
- Unidentified diseases
- Opportunistic bacterial infections
- Nutritional diseases

The survey focused on amphibians and did not specifically seek input on reptiles. However, comments indicated that crocodiles in some regions form an integral part of aquaculture and are often farmed (for meat or skins) within the same ecosystems — and sometimes in close proximity — to other aquaculture operations. Crocodile pox, caused by a virus in the family Poxviridae, was mentioned as pathogen of interest. The bacterial pathogens affecting crocodiles are often similar to those found in fish (e.g., Group B Streptococcus (GBS)), and comparable treatments are commonly used. There is a need to determine whether distinct strains or species differences exist, and to assess their capacity to cause disease in other aquatic animals. This knowledge is essential for developing appropriate control measures that align with One Health principles.

***Note:** Additional bacterial pathogens of relevance for amphibian health*
Although not mentioned explicitly by survey respondents, scientific literature indicates that several bacterial pathogens are relevant to amphibian health and should be considered in future research prioritisation. Streptococcus agalactiae or Group B Streptococcus (GBS) is a bacterial species of interest in frogs, as reported by the FAO in a risk profile of GBS sequence type (ST)283 (serotype III) and reported repeatedly in the scientific literature[1]. Other sequence

[1] FAO. *Risk profile: Streptococcus agalactiae sequence type 283 in aquatic food production.* Food and Agriculture Organization of the United Nations; 2021. Available at: https://www.fao.org/3/cb5063en/cb5063en.pdf

types of GBS that can affect fish may also affect frogs, notably ST7 (serotype Ia) and ST260 and related types (serotype Ib). Of concern, there are anecdotal reports of streptococcosis in frogs being treated with antimicrobials, including vancomycin, a drug that is reserved for human use only according to WHO[2].

In addition, Elizabethkingia spp., notably Elizabethkingia miricola[3] and Elizabethkingia meningoseptica[4], are increasingly reported as pathogenic bacteria in amphibians, particularly frogs, with highly virulent strains associated with severe disease outbreaks and high mortality.

Several opportunistic bacterial pathogens have also been documented in amphibians, including Aeromonas hydrophila[5], a well-recognised cause of septicaemia and "red-leg syndrome", as well as bacteria commonly detected in aquatic environments and aquatic products such as Citrobacter freundii[6], Acinetobacter spp.[7], and Edwardsiella spp.[8] These pathogens are often associated with stress, compromised husbandry, or environmental degradation and raise additional concerns related to AMR and pathogen transmission within aquatic ecosystems. The limited number of responses suggests a potential gap in aquatic animal health expertise, which in turn may lead to unsupervised or unregulated use of antimicrobials of human health concern.

Diagnostic research needs

Timeframe	*Identified Research Needs*
Short-Term (1–5 years)	• Development of cheap, reliable diagnostic tools accessible globally. • Diagnostics kits adapted to low-resource environments and for field use. • Improve diagnostic case definitions. • Clarify environment–host–pathogen relationships. • Determine the roles of different species as vectors.
Medium–Long Term (5–15 years)	• Develop and validate laboratory diagnostic standards for global use.

Prophylactics

Timeframe	Identified Research Needs

[2] World Health Organization. *WHO AWaRe classification of antibiotics.* WHO; 2023. Available at: https://www.who.int/publications/i/item/WHO-MHP-HPS-EML-2023.04

[3] Lei X, et al. *Elizabethkingia miricola infection in cultured frogs.* Aquaculture. 2019;512: 734331. Available at: https://doi.org/10.3389/fcimb.2023.1094050

[4] Xie, Z.Y., Zhou, Y.C., Wang, S.F., *et al*. (2009). First isolation and identification of *Elizabethkingia meningoseptica* from cultured tiger frog (*Rana tigerina rugulosa*). *Veterinary Microbiology*, **138**(1–2), 140–144. Available at: https://doi.org/10.1016/j.vetmic.2009.02.011

[5] Pessier AP, Mendelson JR. *A Manual for Control of Infectious Diseases in Amphibian Survival Assurance Colonies.* IUCN/SSC Conservation Breeding Specialist Group; 2017. Available at: Risk assessment and recommended disease screening

[6] Jeong, Su-Bhin and Sohn, Min-Young and Son, Ha-Jeong and Ji, Chae-Yeong and Kim, In-Gu and Kang, Gyoungsik and Park, Chan-Il, Case Reports of Citrobacter freundii Infections in Captive Freshwater Species in South Korea. Available at: http://dx.doi.org/10.2139/ssrn.5705212

[7] Guo, L., Jin, X., Yang, D., Wei, L., Chen, J., Lin, Z. & Ma, L. (2025). Identification and characterization of *Serratia nematophila* and *Acinetobacter guillouiae* from putrid-skin disease lesions in farmed Chinese spiny frog (*Quasipaa spinosa*). *Microbiology Spectrum*, **13**(2), e02096-24 Available at: https://doi.org/10.1128/spectrum.02096-24

[8] Mohanty BR, Sahoo PK. *Edwardsiellosis in fish: a brief review.* Journal of Biosciences. 2007;32: 1331–1344. Available at: https://link.springer.com/article/10.1007/s12038-007-0143-8

Short-Term (1–5 years)	• Need for cheap and reliable prophylactic tools to reduce disease spread. • Define animal welfare indicators • Study pre-probiotics or other alternative to antimicrobials • Improve water quality management
Medium–Long Term (5–15 years)	• Development of innovative prophylactic strategies (e.g. microbiome-based, immunological, ecological approaches). • Improve understanding of immunology • Tools to control diseases in both wild and captivity

It was commented that prophylactics is an expanding segment of aquaculture, and as a high-value industry, it has already established its own standards. However, the interactions with — and impacts of — environmental change, along with the continued expansion of aquaculture, require further understanding to ensure that both industries are safeguarded.

Therapeutics

Timeframe	Identified Research Needs
Short-Term (1–5 years)	• Immediate strategies to treat outbreaks in captive and wild amphibian populations. • Identification of key infection sources to guide treatment application. • Develop alternative to antimicrobials.
Medium–Long Term (5–15 years)	• Understanding interactions between therapeutics, environment and AMR dynamics.

Control strategies

Timeframe	Identified Research Needs
Short-Term (1–5 years)	• Assess and refine trade policies to reduce disease risks associated with the movement of animals and products. • Develop and update priority pathogen lists to guide targeted control measures. • Identify potential vectors and carriers involved in disease transmission. • Strengthen global monitoring and surveillance to enable early detection and rapid response. • Advance integrated surveillance approaches combining multiple data sources and sectors. • Evaluate and improve biosecurity control measures across production systems. • Investigate the roles of aquatic species in antimicrobial resistance (AMR) to inform mitigation strategies.
Medium–Long Term (5–15 years)	• Advance biosecurity control approaches to ensure long-term, robust prevention of disease spread. • Strengthen epidemiological frameworks and HACCP-based systems to better understand and manage the spread and occurrence of diseases and aquatic AMR. • Develop and validate environmental indicators, particularly for waters at high risk of pollution, to support early detection and risk-based control strategies.