

ETHICAL CONSIDERATION FOR WILDLIFE RESEARCH IN BANGLADESH

Maria Tabasoom Pingki¹, Md. Sakhawat Hossain¹, Mahmudul Hasan^{2,3}, S. N. Bilasi³, and Mohammad Matiur Rahman^{1*}

Department of Fisheries Biology and Genetics, Faculty of Fisheries, Bangladesh Agricultural University, Mymensingh 2202, Bangladesh

ABSTRACT: In Bangladesh, Wildlife research is essential to biodiversity protection, ecological surveillance, and sustainable resource management. It does, however, bring up important ethical issues, such as cultural sensitivity, legal compliance, human-wildlife relationships, and animal welfare. This study investigates the current ethical frameworks governing wildlife research in Bangladesh, assesses the main obstacles faced by field researchers, and analyses the extent to which international ethical standards have been incorporated into local practices. Risk of habitat destruction, ethical ramifications of capturing, tagging, and handling wild animals, and possible confrontations with indigenous groups and stakeholders are all highlighted and discussed. The review also examines current laws and regulations, institutional review procedures, and the role of national and international guidelines in guaranteeing ethical research practices. Critical evaluations are conducted of research gaps, ethical oversight inconsistencies, and the necessity of context-specific protocols. The review concludes with a list of recommendations for improving ethical governance in wildlife research, which include community involvement, ethics training, capacity building, and the creation of a national ethical framework for wildlife research that is adapted to the socioecological context of Bangladesh.

Key words: Animal, Species, Principles, Biodiversity, Conservation.

INTRODUCTION

Bangladesh, a small South Asian country located at the heart of the Indo-Myanmar global biodiversity hotspot (Myers *et al.*, 2000; Rahman *et al.*, 2019), is renowned for its exceptional biodiversity. Connecting the Indian and Malay subregions, it is home to a rich diversity of wildlife species (IUCN, 2015). The eastern Bandarban-Khagrachari region, in particular, is recognized as a biodiversity hotspot due to its diverse animal populations. Bangladesh has a remarkably diverse fauna, including about 62 species of amphibians,

**Author for correspondence: <rahman.matiur@bau.edu.bd>, ²Department of Fisheries, Jamalpur Science and Technology University, Jamalpur-2012, Bangladesh, ³Evolution and Diversity Research Laboratory, Jamalpur Science and Technology University, Jamalpur-2012, Bangladesh*
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160 species of reptiles, 500 species of birds, 130 species of mammals, and 250-300 species of freshwater fish (IUCN, 2015; Hasan *et al.*, 2025; Rahman *et al.*, 2022). Despite its rich biodiversity, wildlife research in Bangladesh lags behind neighboring countries. Comprehensive and analytical studies are now more crucial for addressing the growing threats posed by human activities (IUCN, 2015; Rahman *et al.*, 2019). A number of research projects have explored the history, distribution, biodiversity, and species descriptions of wildlife since independence in 1971. These studies have aided in the discovery of novel species and conservation initiatives. The number of anurans recorded in Bangladesh, for instance, rose from 24 in 2009 (IUCN, 2009) to 54 in 2015 (IUCN, 2015), and then to 62 in 2022 (Rahman *et al.*, 2022). According to recent reports, this number could be even higher. The continued discovery of new species underscores the need for continued exploration and research in Bangladesh. Effective biodiversity management and conservation depend on such efforts.

The recognized principles of right and wrong enforced by individuals or societies are known as ethics where in the context of wildlife, ethics encompasses concerns such as animal rights, biodiversity preservation, ecological balance, and human-animal interactions (Murie, 1954). Wildlife ethics is a complex approach that integrates various ethical considerations regarding animal rights, respect for their value, and the right to live free from suffering and exploitation. It is unethical to inflict pain on animals. Necessary steps must be taken to protect them from such unnecessary harm; otherwise, it will be in opposition to other conservation objectives, such as controlling invasive species or protecting habitats. Ethical justifications for safeguarding species and ecosystems range from utilitarian and rights-based perspectives to those centered on human interests, as well as arguments emphasizing the intrinsic value of nature itself (Norton, 1986). Ethics aims to separate fact from fiction when researchers or groups of researcher's study animals. When the law or principles fail to curb or control abuse, ethics can curb it. The World Health Organization (WHO) emphasizes that upholding ethical principles is crucial to ensuring research participants' rights, dignity, and overall well-being. Therefore, to guarantee conformance to pertinent ethical standards, an ethics committee must look into each study involving human beings. However, ethical and legal issues pertaining to wildlife study frequently present difficulties, resulting in disputes between researchers and local residents (Palmer & Greenhough, 2021). To address these issues, it is imperative to adhere to ethical guidelines and international standards when performing wildlife research, and researchers must prioritize ethical considerations related to handling wild animals before undertaking research.

MATERIAL AND METHODS

A comprehensive literature review was conducted where articles were retrieved from Google Scholar, PubMed, and ResearchGate (Mariom et al., 2026) using the keywords “animal,” “species,” “principles,” “biodiversity,” and “conservation.” Local and international wildlife legislation and its implementation were considered throughout the writing of this manuscript and personal observations and their implications in the field were also considered. Throughout the study, several views, especially those linked to fish and fisheries, were considered.

RESULTS AND DISCUSSION

Bangladesh's Wildlife Law, Policies, and Regulations: Gradually, Bangladesh's wildlife policies, laws, and regulations witnessed substantial modifications (Fig. 1). The main foundation for wildlife laws, policies, and regulations in Bangladesh was the Wild Birds and Animals Protection Act of 1912, which was implemented throughout the British colonial era for the Indian subcontinent. A significant step toward the conservation and management of wildlife was taken in independent Bangladesh in 1973, with the establishment of the first Wildlife Preservation Act (Khan, 2023), and its subsequent modification in 1974 (Chowdhury et al., 2009). Bangladesh has undergone significant biodiversity loss despite this rule, with declines in mammal, bird, and reptile species linked to habitat destruction and illicit trade (Barkat et al., 2021). Lastly, the government passed the Wildlife Preservation and Security Act in 2012, which substituted the previous law, to ensure more security and conservation of forests, wildlife, and biodiversity (Islam, 2022). Penalties for breaking wildlife laws, including imprisonment for intentionally killing protected species, are imposed under the Wildlife Preservation and Security Act, 2012 (Islam, 2023). To improve the proper implementation of the Wildlife Preservation and Security Act, a comprehensive guide was developed in 2017, providing a more detailed and comprehensive framework for conservation efforts (Barkat et al., 2021). The focus is transferring from conservation efforts to addressing the innate ethical significance of each species, as demonstrated by the growing inclination worldwide to include animal welfare and ethical issues in wildlife laws (Dubois et al., 2017; Scholtz, 2017). Compared with India, which has recently enhanced its legal requirements, Bangladesh's legal framework is still not effectively implemented, even if it complies with international agreements like CITES (Suvra and Ontar, 2024a). Effective wildlife policy implementation is hampered by continuous political instability, chronic corruption, and a lack of logistical support (Muhammed et al., 2008). Only 17% of forest areas are currently protected by the Wildlife Act, although it describes many punishments for wildlife offences (Islam, 2023). The most effective practices for managing wildlife

include a strong emphasis on alleviating harm through evidence-based tactics, engaged community members, and open, honest decision-making procedures (Dubois et al., 2017; Scholtz, 2017). Lack of public awareness and participation significantly limits efforts towards successful conservation and ethical animal management (Shawon et al., 2025; Khan, 2023).



Fig. 1. Trends in wildlife laws, policies, and regulations over time in Bangladesh.

The Three Rs (Replacement, Reduction, and Refinement) serve as the framework for ethical and legal limitations on laboratory animal research (Russell et al., 1959). The Three Rs concept provides a framework for promoting ethical behaviour and sustainable practices across a scope of fields. The first principle, "Replacement," stimulates the use of alternatives to live animals whenever possible, such as simulation or in vitro methods (Rowan, 1980). The second, "Reduction," reinforces minimizing the number of animals used through efficient experimental protocols and advanced statistical methods to acquire reliable results (Pandiyarajan et al., 2022). Eventually, "Refinement" intends to elevate procedures to mitigate animal pain and distress, thereby improving both their welfare and the quality of scientific results (Pandiyarajan et al., 2022). Nevertheless, there are no equivalent constraints for research on wild animals. The nine Rs are integrated principles that extensively embrace ethical issues concerning both wild and laboratory animals. According to Curzer et al. (2013), the "nine Rs theory" (Fig. 2) determines an ethical policy formation framework for research involving animals and ecosystems. The first principle, "animal refusal," recommends abandoning a study entirely if the potential knowledge gained does not justify the harm caused to the animals, particularly when the

chances of meaningful discovery are low or the suffering involved is too intense. Correspondingly, “ecological refusal” endorses rejecting a research project if it risks causing environmental harm that exceeds the potential benefits of the results. “Animal replacement” promotes the application of alternative methods that avoid unnecessary animal discomfort while still achieving the study objectives. Similarly, “ecological replacement” involves replacing the original research topic with substitutes that are less susceptible or have a lower ecological impact, without compromising scientific value. “Animal reduction” reinforces minimizing the number of animals used in a study to limit harm while preserving the quality and quantity of data. “Ecological reduction” aims to constrain environmental degradation during research while still gaining valuable knowledge. “Animal refinement” involves modifying procedures to obtain maximum information with minimum animal suffering. “Ecological refinement” encourages adapting research methods to minimize harm to individual elements of an ecosystem without compromising the quality of knowledge gained. Finally, “animal/ecological relaxation” refers to cases where no ethical option clearly outweighs another; in such situations, either approach may be considered ethically acceptable (Curzer et al., 2013; Brink and Lewis, 2023).

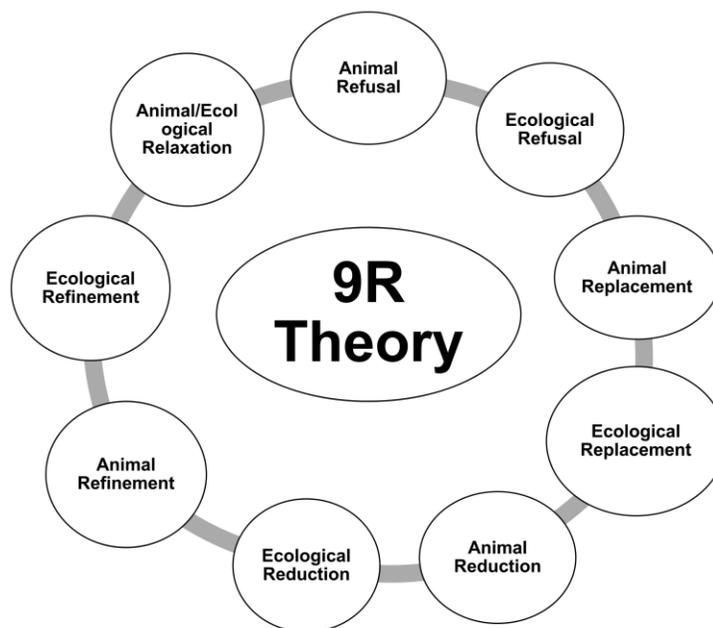


Fig. 2. The nine R theory (Curzer et al. 2013).

Ethical Considerations in Wildlife Research: Habitat loss and inadequate management are the main factors contributing to the decline of wildlife species in Bangladesh. These problems are exacerbated by the lack of a dedicated

wildlife strategy and skilled workforce (Khan, 2023). Human activities exert considerable pressure on biodiversity and wildlife habitats (Shawon et al., 2025). When humans and wildlife coexist and share scarce resources, human-wildlife conflict (HWC) is common (Schwerdtner and Gruber, 2007) and has become a major global problem (Wang and Macdonald, 2006). Consequently, in order to successfully alleviate the adverse effects of these changes, it is critical to improve public knowledge, perceptions, and practices (KPP) (Shawon et al., 2025). Wildlife protocols must concede that any disruption to the species' normal state might be distressing and result in pain, anxiety, fear, and frustration ethical damages that must be compared against the anticipated advantages (Russow and Theran, 2003). Ethical considerations must be integrated into every stage of animal research, from planning to execution and reporting (Fig. 3).

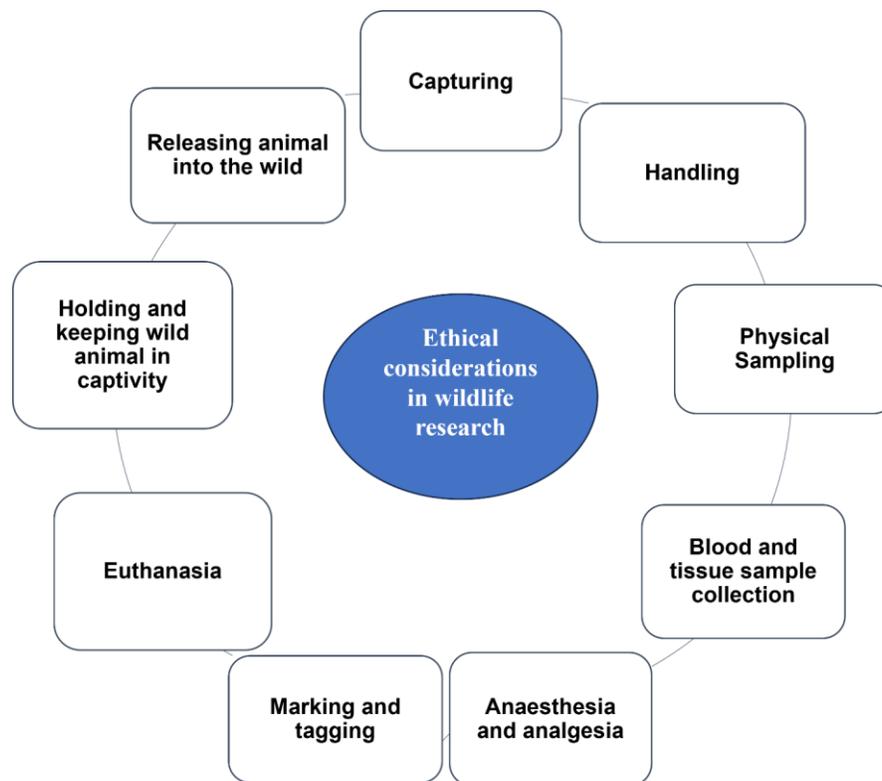


Fig. 3. Ethical considerations in wildlife research.

Capture: Wildlife capture, especially fish are extremely stressful (Wilson and McMahon, 2006). The significance of protecting wildlife and the illegal

activity of some capture techniques are not widely understood by the Bangladeshi population (Shawon et al., 2025). Due to Socioeconomic constraints such as poverty and a lack of other sources of income, some groups rely on illegal hunting and capture as a means of existence or income (Hasnat, 2023). Illegal wildlife obtaining is still a major issue due to the profitable global wildlife trade (Uddin et al., 2024; Suvra and Ontar, 2024b). Any moral modification to a species' natural habitat has the potential to bring about pain, anxiety, fear, and frustration; these constraints must be balanced against any possible advantages (Nisbet and Paul, 2004). Protecting biodiversity from these challenges is a major ethical concern as illegal capture and trafficking have complicated conservation implications and seriously damage ecosystems (Uddin et al., 2024; Ahmad, 2020). In addition, fish welfare is becoming more and more important in recent ethical discussions, emphasizing the consequences of lowering the stress, suffering, and distress associated with fish farming, exploitation, and death (Islam and Wang, 2024).

Handling: By limiting injury through positive reinforcement and enabling voluntary participation wherever practical, handling should put the welfare of the animals first (Brando and Norman, 2023; Dubois et al., 2017; Thulin and Röcklinsberg, 2020; Van Dooren et al., 2023). Stress is certain when handling animals for sampling, in case of more disruptive procedures such as blood or fecal collection, basic measurements like body weight or limb length, or evaluation of reproductive status (Putman, 1995). Handling and experiments should be conducted quickly to reduce unnecessary stress and exposure time (Jenkins et al., 2014). Before, during, and after experimental procedures, researchers should assess whether the placement of study animals is appropriate (Barker et al., 2002). Captured fish should be handled with care to avoid pain, distress, suffering, and unnecessary consumption of external organs (CCAC, 2005). While post-experimental confinement allows for monitoring of recovery, it may be inappropriate for species susceptible to captivity-induced stress and is often impractical in field studies, particularly with large animals (Jepsen et al., 2002). Following an experimental procedure, all fish should be released in good health, able to return to normal physiological and behavioral functions in the wild (CCAC, 2005).

Physical sampling: Physical sampling must be ethically justified by clear and meaningful scientific or conservation objectives that cannot be achieved by less invasive methods (Russow and Theran, 2003). Non-invasive techniques, such as collecting feathers, hair, or feces, provide researchers with DNA and other information without trapping or harming animals, and reduce stress and risk, particularly for vulnerable populations. They are now favored by the public and regulators for their ethical advantages (Pauli et al., 2010). Repeated

sampling of the same individuals can have welfare implications and raise ethical issues. Therefore, a balance must be found between the three “Rs”: reduction, refinement, replacement, and statistical needs based on biological characteristics such as behavior and response to capture (Green and Mitchell, 2024). Non-lethal sampling facilitates the long-term monitoring and conservation of endangered species (Thorstensen *et al.*, 2022; Sciuto *et al.*, 2024). Genetic, physiological, and contaminant analyses can be conducted without harming fish by collecting small fin or scale fragments and buccal swabs (Thorstensen *et al.*, 2022; Sciuto *et al.*, 2024). Purse seining only requires the collection of water samples to determine fish diversity and presence without coming into physical contact with any animals (Castañeda *et al.*, 2020).

Blood and tissue sampling: To promote optimal welfare monitoring, blood biomarkers and advanced techniques such as flow cytometry and omics provide significant information on animal health and stress (Shahjahan *et al.*, 2022; Gomes *et al.*, 2021). Non-lethal blood collection is a helpful technique for assessing environmental consequences and contaminant exposure, especially in endangered species (Pollard *et al.*, 2022; Shahjahan *et al.*, 2022). Fish blood is derived for many reasons, such as parasitological study (Shahi *et al.*, 2013), hematological and clinical chemistry analysis (Satheeshkumar *et al.*, 2012), and studies on adaptation to cryogenic conditions (Miya *et al.*, 2014). While reducing stress and damage to fish, methods include skin sampling, blood collection from the caudal blood vessels, and non-destructive internal tissue sample facilitate effective physiological, contamination, and DNA investigations (Haseneiet *al.*, 2025; Thorstensen *et al.*, 2022). For rainbow trout, for example, systematic and thorough tissue collection procedures enhance reliability, reduce sampling bias, and maintain moral and scientific norms (Fiedler *et al.*, 2023).

Anesthesia and Analgesia: Anesthesia and analgesia are essential for maintaining animal well-being because they successfully reduce discomfort during operations and alterations (Brønstad, 2022; Fish, 2008; Martins *et al.*, 2018a; Oh and Narver, 2024). As there is no comprehensive protocol, the drug type and dosage should be specific to the species, size, and procedure. Due to their distinct physiology and the stress of being removed from the water, fish and other aquatic animals need special care (Brønstad, 2022; Neiffer and Stamper, 2009; Martins *et al.*, 2018a; Ross and Ross, 2018). Ensuring safety and recovery is efficiently aided by proper personnel and animal equipment preparation, as well as existing observation before, during, and following anesthesia (Fish, 2008; Neiffer and Stamper, 2009; Brønstad, 2022). Fish and other animals' responses to anesthetics vary significantly across species, stressors, and environmental factors (Martins *et al.*, 2018b; Neiffer and Stamper,

2009, Khatun et al., 2026). A diversity of commonly used fish anesthetics, their recommended dosages, and potential side effects are described in Table 1. According to SANS 10386 (SABS, 2008), four anesthetics are approved for use in fish in South Africa: tricaine methanesulfonate (MS-222), benzocaine (including benzocaine hydrochloride), metomidate, and ketamine hydrochloride. However, none of these substances are approved for use in countries such as Australia, New Zealand, the United States, Canada, or European countries (Javahery and Moradlu, 2012). Of these, only MS-222 has received approval from the United States Food and Drug Administration (FDA) for use in animals (Jenkins et al., 2014), although its application in field studies is limited due to a mandatory 21-day waiting period before fish can be released into their natural habitat. Alarmingly, fish analgesia remains a largely neglected field, and further research is urgently needed to develop reliable pain management protocols (Neiffer, 2021).

Table 1. Common fish anesthetics, doses, and side effects

Drug Name	Typical Dose Range (mg/L or ppm)	Side Effects
MS-222 (Tricaine)	100–300 mg/L (Nile tilapia: 300 ppm)	At any dose, it can cause stress (higher cortisol levels), acidosis, osmotic stress, and possible ECG abnormalities (Rairat et al., 2021; Reis et al., 2024).
Eugenol (Clove oil)	25–150 mg/L (Nile tilapia: 90 ppm)	This may cause signs of stress and tissue destruction, but not as much as other choices (Rairat et al., 2021; Yousefi et al., 2018).
2-Phenoxyethanol	900 mg/L (Nile tilapia)	Like MS-222, it can cause stress and changes in metabolism (Rairat et al., 2021).
Alfaxalone	6–9 mg/L (Goldfish)	At 6 mg/L, it acts gently with few adverse effects, but higher doses can produce respiratory depression and excitation (Leonardi et al., 2019).
Etomidate	2–4 mg/L (Zebrafish)	High doses may cause bradycardia and slow recovery, while modest doses are safe for short-term treatments (Reis et al., 2024).
Thymol	25–200 mg/L (Carp)	It has fewer negative consequences than eugenol, meaning it causes less stress and tissue damage (Yousefi et al., 2018).
Linalool (natural oil)	100–300 µL/L (Silver catfish)	Its negative consequences are fewer, and the changes it brings to the organism are relatively transient (Félix et al., 2023).

Tagging and marking: According to Soulsbury et al. (2020), ethical research enforces the use of advanced techniques, suitable analgesia, and adherence to the 3Rs: replacement, reduction, and refinement to minimize the adverse impacts of treatments, including branding, tagging, euthanasia, and stomach insertion. Although different non-invasive procedures are sometimes used with considerable effort, the majority of tagging and branding methods involve some degree of intrusion (Thorsteinsson, 2002). Fin clipping, laser hot branding, and liquid nitrogen freeze-branding are examples of fish tagging techniques that

generally result in minimal harm (Murray and Fuller, 2000). Chemical tags are an alternative tagging method that can develop spontaneously through ambient accumulation or be induced deliberately through ingestion, allowing chemicals to become deeply embedded in various calcified structures (Sandford et al., 2020). To reduce tag-related constraints and ensure effective data collection and sustainability, the tag size and weight should be precisely matched to fish size, weight, and species (Cooke et al., 2011). External tagging is a direct method that typically doesn't involve either anesthesia or the removal of the animal from the water (Thorsteinsson, 2002). A glass or plastic rod can be used to manually place a device into the stomach, the cardiac sphincter, or include it in bait for voluntary ingestion (Liedtke and Rub, 2012; Thorsteinsson, 2002). The surgical implantation is more invasive than the stomach insertion technique (Winger and Walsh, 2001).

Euthanasia: Euthanasia is prioritized by those who have a stronger emotional connection with animal welfare to reduce their pain and suffering (Walraven et al., 2018). It is generally considered an alternative, implemented only after all other possible interventions have been carefully considered (White et al., 2023; Walraven et al., 2018). In the case of fish, they have high sensitivity to stress, which requires the use of humane and species-specific euthanasia methods, often involving sedatives. Overdosing with immersion medications depends on a commonly used approach, physiological variations among species, and the impact of injectable agents on efficacy and water quality, which requires customization of the method (Neiffer and Stamper, 2009; Keeney and Harrison, 2022). Sedative agents are often administered after anesthesia; however, their use can induce complications such as prolonged death or incomplete euthanasia, highlighting the importance of precise techniques and continuous monitoring (Keeney and Harrison, 2022).

Keeping and conserving wild animals in captivity: Keeping fish and wild animals in captivity is a complex and highly controversial topic with ethical considerations that have generated much discussion in various fields. While species such as Asian elephants, polar bears, and other wide-ranging carnivores frequently experience health problems, reproductive difficulties, and stress-induced stereotypic behaviors due to restricted opportunities for spontaneous expression, ring-tailed lemurs and snow leopards have adapted well to captivity (Limin et al., 2025). Stereotypic behaviors, such as repetitive and purposeless behaviors like pacing, rocking, or self-mutilation, are frequently observed in captive animals and are generally considered signs of psychological distress and welfare (Lecorps et al., 2021). Natural selection pressures are altered in captivity, frequently leading to rapid phenotypic and genetic changes that can be

detrimental to animal welfare in the wild. Even the first generation of captive animals may acquire traits that are beneficial in captivity but detrimental to their survival after release, undermining reintroduction attempts (Crates et al., 2023; Farquharson et al., 2018). The argument made by accredited zoos and aquariums in favor of confinement is that, when well-managed, the benefits of conservation, education, and improved animal care can outweigh the costs associated with individual animal welfare (Muka and Zarpentine, 2021). Although some argue that freedom is necessary for animal welfare, others counter those certain freedoms, including immunity from disease, hunger, and predators, which are not always available in the wild, can be afforded in confinement (Browning and Veit, 2021; Delon, 2020). With suggested tools and frameworks highlighting the importance of choice, control, and environmental complexity in promoting welfare in captivity, ethical responsibility requires developing environments that enhance animals' ability to thrive by considering their ecological history and psychological needs (Brando and Buchanan-Smith, 2017; Brando and Norman, 2023). Reducing stress and increasing positive experiences through continuous assessment and improvement of care regimes are now top priorities in best practices for confined animal management (Brando and Norman, 2023). Genetic and behavioral changes triggered by prolonged captivity also raise ethical questions about involuntary domestication, the maintenance of natural characteristics, and the preservation of species (Farquharson et al., 2018).

Releasing animals into the wild: Reintroducing animals can help in conserving species and restoring ecosystems, but it can also be harmful for people, especially if the animals are not adapted to their original habitat or are under threat from malnutrition and illness and this demonstrates how conflicting personal demands are with more general conservation objectives (Thulin and Röcklinsberg, 2020; Soulsbury et al., 2020). Releasing animals can lead to conflicts among local people, farmers, or loggers; therefore, human interests must be ethically considered, along with animal welfare and conservation goals (Thulin and Röcklinsberg, 2020). Conservation decisions often involve difficult constraints, such as prioritizing larger-scale habitat protection initiatives or funding the rescue and restoration of individual animals (Palmer, 2018; Macdonald, 2023).

Challenges of Ethical Wildlife Research: while conducting animal research adhered to ethical considerations in natural settings, scientists face several social, moral, and regulatory challenges (Palmer & Greenhough, 2021).

Interactions with the public and key stakeholders: While field sites are frequently used by a variety of groups, laboratories are usually occupied only by researchers, research staff, and animal caretakers (Gieryn, 2006; Kohler, 2002).

Transparency in animal research may be seen as a personal risk by researchers who are concerned about their work being misunderstood by the public or being threatened by animal rights activists (Holmberg & Ideland, 2012). Conflicts over ethics can also occur when researchers work with stakeholders who have different viewpoints. It is critical to acknowledge that different social, cultural, and ethnic groups have different perspectives on animal welfare and conservation (Palmer and Greenhough, 2021).

Management and ethical implications: In contrast to controlled laboratories, field research poses substantial ethical, regulatory, practical, and animal welfare challenges. Researchers' physical demands in remote or hostile settings can have an indirect impact on animal care because challenging field conditions can jeopardize accepted welfare standards (Palmer and Greenhough, 2021). Researchers can carefully monitor animal experiments in the lab to reduce the suffering of the animals. But in the field, where animal welfare—whether utilized or not—is frequently unpredictable and challenging to observe, such control is practically impossible. Incidentally captured species are a significant fieldwork concern that illustrates how wildlife research can impact not only the animals under study but also other species that share their habitat. This has led some researchers to contend that the ethics of field research should take into account the risks and ecological impacts for entire populations and ecosystems, rather than just the welfare of individual animals (Paquet and Darimont, 2010; Ramp and Bekoff, 2015; Vucetich and Nelson, 2007). These conversations are in line with the growing demand for a "compassionate conservation" approach, which aims to balance ecosystem goals with the welfare of individual animals in conservation plans. Given the moral conundrum known as "intrusive care," in which individual animals—often non-native or overpopulated—are injured or killed in order to support the wellbeing of native ecosystems or populations, this strategy is especially pertinent (Srinivasan, 2014; Van Dooren, 2014).

Guidelines for Wildlife Research Involving Animals: To guarantee humane, responsible, and successful wildlife research, ethical and scientific frameworks are provided by the guidelines for wildlife research involving animals (Fig. 4). We offer three main suggestions to raise the bar for ethics and openness in wildlife research:

Integrate ethical principles from the outset: The 3Rs (replacement, reduction, and refinement) or the more all-encompassing 9Rs framework (Curzer et al., 2013) should be incorporated into the study design phase of any animal research project, including those involving vertebrates and invertebrates. Post-experiment or post-study follow-up should be reported whenever feasible.

Ensure rigorous and transparent ethical review: An ethical review must be conducted before the start of any study involving animals. The publication's "methods" or "ethics" section must specifically include the name of the appropriate ethics committee and the approval reference number (Gelling, 2016). This enables reviewers and editors to confirm adherence to ethical standards. Retrospective approval of the study must be explicitly declared and justified only if the original work satisfies current ethical standards and if its replication would result in appreciably more harm (Soulsbury et al., 2020).

Standardize reporting practices: In order to ensure effective knowledge sharing, accurate and thorough reporting of procedures, protocols, and results is equally as important in animal research as rigorous study design, adherence to animal welfare, and appropriate methodologies (Filipeckiet al., 2011). A standardized framework for recording procedures and findings in wildlife studies is necessary to accomplish this. Although laboratory research has established such standards (Kilkenny et al., 2012), wildlife researchers urgently need comparable guidelines (Field et al., 2019). Whether or not they were the study's main goal, these reports should also describe the effects of the experiment, including any unintended consequences like injuries or fatalities. In the end, thorough reporting like these aids in improving animal welfare procedures, especially in fields with little research.

Furthermore, the National Committee on Ethics in Scientific and Technological Research (NENT) has developed a set of guidelines for researchers and others involved or interested in research involving animals. These ethical principles aim to ensure responsible and respectful treatment of animal life:

- Recognize the intrinsic value, importance, and usefulness of animals, and treat them with respect;
- Explore and implement alternatives to the use of animals whenever possible;
- Weigh the potential benefits of the research against the potential suffering of the animals involved.
 - Use the smallest number of animals necessary to obtain valid results.
 - Take measures to minimize distress and improve animal welfare.
 - Ensure that research practices do not harm species diversity.
 - Evaluate the impact of research on the environment and ecosystems.
 - Promote openness through the sharing of data, results, and materials.

- Ensure that researchers have the necessary knowledge and skills to handle and study animals. Maintain accurate and ethical data collection and documentation practices.

Respectful and sustainable scientific methods that can be tailored to regional environmental conditions and aid in the preservation of natural ecosystems are based on adherence to these ethical guidelines in wildlife research.

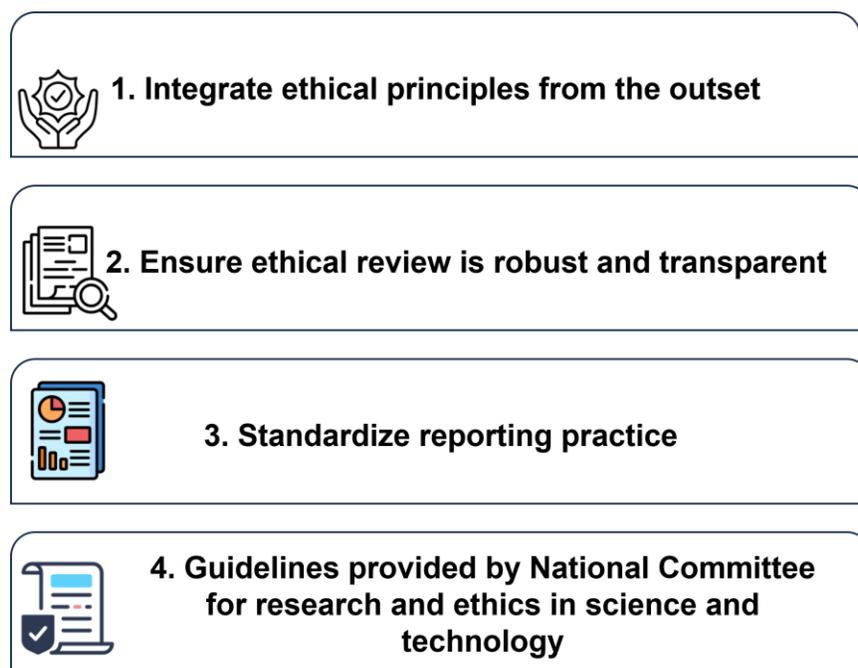


Fig. 4. Guidelines for wildlife research involving animals.

CONCLUSION

Ethical considerations are crucial to ensure animal protection and welfare, preserve scientific integrity, and comply with international research standards in wildlife research in Bangladesh. Despite increased awareness, issues like insufficient legislation, standardized protocols, limited ethics review mechanisms, and inadequate training on animal welfare still exist. To address these concerns, government agencies, research institutions, and conservation organizations must work together, create context-specific ethical guidelines, and establish specialized wildlife research ethics committees. Bangladesh can effectively contribute to conservation efforts and scientific advancement by promoting sustainable and humane wildlife research by fortifying ethical frameworks and guaranteeing responsible conduct.

LITERATURE CITED

- AHMAD, S. 2020. Detrimental consequences of unethical anthropogenic interventions upon the ecosystem of Teknaf Peninsula, Chattogram, Bangladesh. *Bangladesh Journal of Bioethics*, **11**(2), 17-30. <https://doi.org/10.62865/bioethics.v11i2.178>
- BARKAT, A. I., LIZA, F. T., AKTER, S., SHOME, A. R., and RABBE, MD. F. 2021. Wildlife hunting practices of the Santal and Oraon communities in Rajshahi, Bangladesh. *Journal of Threatened Taxa*, **13**(11), 19484–19491. <https://doi.org/10.11609/JOTT.7260.13.11.19484-19491>
- BARKER, D., ALLAN, G. L., ROWLAND, S. J., and PICKLES, J. M. 2002. A guide to acceptable procedures and practices for aquaculture and fisheries research. *NSW Fisheries Animal Care and Ethics Committee*, New South Wales.
- BRANDO, S., and NORMAN, M. 2023. Handling and training of wild animals: Evidence and ethics-based approaches and best practices in the modern zoo. *Animals: An Open Access Journal from MDPI*, **13**(14), 2247. <https://doi.org/10.3390/ani13142247>.
- BRANDO, S., and BUCHANAN-SMITH, H. 2017. The 24/7 approach to promoting optimal welfare for captive wild animals. *Behavioural Processes*, **156**, 83-95. <https://doi.org/10.1016/j.beproc.2017.09.010>.
- BRINK, C. B., and LEWIS, D. I. 2023. The 12 Rs framework as a comprehensive, unifying construct for principles guiding animal research ethics. *Animals*, **13**(7), 1128. <https://doi.org/10.3390/ani13071128>.
- BRØNSTAD, A. 2022. Good anesthesia practice for fish and other aquatics. *Biology*, **11**(9):1355. <https://doi.org/10.3390/biology11091355>.
- BROWNING, H., and VEIT, W. 2021. Freedom and animal welfare. *Animals: An Open Access Journal from MDPI*, **11**(4), 1148. <https://doi.org/10.3390/ani11041148>.
- CASTAÑEDA, R., VAN NYNATTEN, A., CROOKES, S., ELLENDER, B., HEATH, D., MACISAAC, H., MANDRAK, N., and WEYL, O. 2020. Detecting native freshwater fishes using novel non-invasive methods. *Frontiers in Environmental Science*, **8**, 29. <https://doi.org/10.3389/fenvs.2020.00029>.
- CCAC (Canadian Council on Animal Care). 2005. Canadian Council on Animal Care guidelines on: the care and use of fish in research, teaching and testing. Available: <http://ccac.ca/Documents/Standards/Guidelines/Fish.pdf>.
- CHOWDHURY, M. S. H., KOIKE, M., and MUHAMMED, N. 2009. Embracing collaborative protected area management for conservation: An analysis of the development of the forest policy of Bangladesh. *International Forestry Review*, **11**(3), 359-374. <https://doi.org/10.1505/ifer.11.3.359>.
- COOKE, S. J., WOODLEY, C. M., BRAD EPPARD, M., BROWN, R. S., and NIELSEN, J. L. 2011. Advancing the surgical implantation of electronic tags in fish: A gap analysis and research agenda based on a review of trends in intracoelomic tagging effects studies. *Reviews in Fish Biology and Fisheries*, **21**(1), 127-151.

- CRATES, R., STOJANOVIĆ, D., and HEINSOHN, R. 2023. The phenotypic costs of captivity. *Biological Reviews*, **98**(2), 434-449. <https://doi.org/10.1111/brv.12913>.
- CURZER, H. J., WALLACE, M. C., PERRY, G., MUHLBERGER, P. J., and PERRY, D. 2013. The ethics of wildlife research: A nine R theory. *ILAR Journal*, **54**(1), 52-57. <https://doi.org/10.1093/ilar/ilt012>.
- DELON, N. 2020. Pervasive captivity and urban wildlife. *Ethics, Policy & Environment*, **23**(2), 123-143. <https://doi.org/10.1080/21550085.2020.1848173>.
- DUBOIS, S., FENWICK, N., RYAN, E., BAKER, L., BAKER, S., BEAUSOLEIL, N., CARTER, S., CARTWRIGHT, B., COSTA, F., DRAPER, C., GRIFFIN, J., GROGAN, A., HOWALD, G., JONES, B., LITTIN, K., LOMBARD, A., MELLOR, D., RAMP, D., SCHUPPLI, C., and FRASER, D. 2017. International consensus principles for ethical wildlife control. *Conservation Biology*, **31**(4), 753-760. <https://doi.org/10.1111/cobi.12896>.
- FARQUHARSON, K., HOGG, C., and GRUEBER, C. 2018. A meta-analysis of birth-origin effects on reproduction in diverse captive environments. *Nature Communications*, **9**(1), 1055. <https://doi.org/10.1038/s41467-018-03500-9>.
- FÉLIX, L., VIEIRA, R., MONTEIRO, S., and VENÂNCIO, C. 2023. A meta-analytic review of monoterpene for fish anaesthesia. *Fish and Fisheries*, **24**(3), 367-380. <https://doi.org/10.1111/faf.12731>.
- FIEDLER, S., SCHRADER, H., THEOBALT, N., HOFMANN, I., GEIGER, T., ARNDT, D., WANKE, R., SCHWAIGER, J., and BLUTKE, A. 2023. Standardized tissue sampling guidelines for histopathological and molecular analyses of rainbow trout (*Oncorhynchus mykiss*) in ecotoxicological studies. *PLOS ONE*, **18**(7). <https://doi.org/10.1371/journal.pone.0288542>.
- FIELD, K. A., PAQUET, P. C., ARTELLE, K., PROULX, G., BROOK, R. K., and DARIMONT, C. T. 2019. Publication reform to safeguard wildlife from researcher harm. *PLOS Biology*, **17**(4), e3000193. <https://doi.org/10.1371/journal.pbio.3000193>.
- FILIPCEKI, A. T. P., MACHADO, C. J. S., VALLE, S., and TEIXEIRA, M. D. O. 2011. The Brazilian legal framework on the scientific use of animals. *ILAR Journal*, **52**(1), E8-E15. <https://doi.org/10.1093/ilar.52.1.E8>.
- FISH, R. 2008. Anesthesia and analgesia in laboratory animals. <https://doi.org/10.1016/b978-0-12-373898-1.x5001-3>.
- GELLING, L. H. 2016. Applying for ethical approval for research: The main issues. *Nursing Standard*, **30**(20), 40-44. <http://dx.doi.org/10.7748/ns.30.20.40.s46>.
- GIERYN, T. F. 2006. City as truth-spot: Laboratories and field-sites in urban studies. *Social Studies of Science*, **36**(1), 5-38. <https://doi.org/10.1177/0306312705054526>.
- GOMES, J., CHARLIE-SILVA, I., SANTOS, A., RESENDE, R., GOMES, J., DE CARVALHO, A., and CORRÊA, J. 2021. Flow cytometry in the analysis of hematological parameters of tilapias: Applications in environmental aquatic toxicology. *Environmental Science and Pollution Research*, **28**(5), 6242-6248. <https://doi.org/10.1007/s11356-020-12119-7>.

- GREEN, D., and MITCHELL, C. 2024. The birthday problem: Repeated sampling of animal populations and ethics of experimental design. *Animal: An International Journal of Animal Bioscience*, **18**(11), 101352. <https://doi.org/10.1016/j.animal.2024.101352>.
- HASAN, M., KAMBAYASHI, C., ANIK, Z.H., and ISLAM, Md.S. 2025. Cryptic biodiversity of freshwater fish species in Bangladesh. *PLoS One*, **20**(4), e0318982. <https://doi.org/10.1371/journal.pone.0318982>.
- HASENEI, A., FOYLE, L., and RUMMER, J. 2025. A novel, nonlethal liver biopsy procedure in an elasmobranch. *Australian Veterinary Journal*. <https://doi.org/10.1111/avj.13432>.
- HASNAT, M. A. 2023. When it rains, it pours: Bangladesh wildlife trade booms during monsoon. *Mongabay*, August **21**.
- HOLMBERG, T., and IDELAND, M. 2012. Secrets and lies: "Selective openness" in the apparatus of animal experimentation. *Public Understanding of Science*, **21**(3), 354-368. <https://doi.org/10.1177/0963662510372584>.
- ISLAM, M. Z., and WANG, S. 2024. What triggered the human-wildlife conflicts in Bangladesh between forest proximity people and wildlife? A responsive study. *Israel Journal of Ecology and Evolution*, **70**(3), 159-171. <https://doi.org/10.1163/22244662-bja10078>.
- ISLAM, MD. Z. 2022. The role of law in conserving wildlife in Bangladesh. *International Journal of Environmental Studies*, **80**(4), 1159-1168. <https://doi.org/10.1080/00207233.2022.2103998>.
- ISLAM, MD. Z. 2023. Combating illegal wildlife trade and conserving biodiversity in Bangladesh through legal provisions. *Israel Journal of Ecology & Evolution*, **69**(03-04), 127-138. <https://doi.org/10.1163/22244662-bja10055>.
- IUCN BANGLADESH. 2009. Red list of threatened species of Bangladesh: Volume 1: Summary. *International Union for Conservation of Nature (IUCN), Bangladesh Country Office*.
- IUCN BANGLADESH. 2015. Red List of Bangladesh: A brief on assessment result 2015. *International Union for Conservation of Nature, Bangladesh Country Office*.
- JAVAHERY, S., and MORADLU, A. H. 2012. AQUI-S, a new anesthetic for use in fish propagation. 205-210.
- JENKINS, J. A., BART JR, H. L., BOWKER, J. D., BOWSER, P. R., MACMILLAN, J. R., NICKUM, J. G., and WARKENTINE, B. E. 2014. Guidelines for the use of fishes in research. *Bethesda, Maryland, USA: American Fisheries Society*. <https://doi.org/10.1080/03632415.2014.924408>.
- JEPSEN, N., KOED, A., THORSTAD, E. B., and BARAS, E. 2002. Surgical implantation of telemetry transmitters in fish: How much have we learned? *Hydrobiologia*, **483**(1), 239-248. <https://doi.org/10.1023/A:1021356302311>.
- KEENEY, C., and HARRISON, T. 2022. Euthanasia complications in non-domestic species. *Journal of Zoological and Botanical Gardens*, **3**(4), 616-623. <https://doi.org/10.3390/jzbg3040045>.
- KHAN, M. A. R. 2023. Bangladesh wildlife: A call to arrest its declination through remedial policies and management. *Khulna University Studies*, 1-10. <https://doi.org/10.53808/kus.si.2023.ices.k01-ls>.

- KHATUN, N., SUMAIYA, N. J., SULTANA, N., HOSSIAN, S., & RAHMAN, M. M. 2026. The Efficacy of Clove Seed Aqueous Extract as an Anesthetic Agent on the Stress Response of *Mystus cavasius* During Transportation. *Aquaculture Research*, **2026**(1), 4009780. <https://doi.org/10.1155/are/4009780>
- KILKENNY, C., BROWNE, W. J., CUTHILL, I. C., EMERSON, M., and ALTMAN, D. G. 2012. Improving bioscience research reporting: The ARRIVE guidelines for reporting animal research. *Osteoarthritis and Cartilage*, **20**(4), 256-260. <https://doi.org/10.1016/j.joca.2012.02.010>.
- KOHLER, R. E. 2002. Landscapes and labscales: Exploring the lab-field border in biology. *University of Chicago Press*.
- LECORPS, B., WEARY, D., and VON KEYSERLINGK, M. 2021. Captivity-induced depression in animals. *Trends in Cognitive Sciences*, **25**(7), 539-541. <https://doi.org/10.1016/j.tics.2021.03.010>.
- LEONARDI, F., COSTA, G., INTERLANDI, C., ROSA, J., GHIDELLI, A., and MUSICÒ, M. 2019. Immersion anaesthesia in goldfish (*Carassius auratus*) with three concentrations of alfaxalone. *Veterinary Anaesthesia and Analgesia*, **46**(1), 79-83. <https://doi.org/10.1016/j.vaa.2018.08.006>.
- LIEDTKE, T. L., and WARGO RUB, A. M. 2012. Techniques for telemetry transmitter attachment and evaluation of transmitter effects on fish performance: Chapter 4. *Telemetry Techniques: A User Guide for Fisheries Research*, **4**.
- LIMIN, N., HATTA, S., ZAKI, N., and YUSOF, N. 2025. Abnormal behaviors in captive wildlife: To keep or not to keep? *Science Letters*, **19** (1), 117-140. <https://doi.org/10.24191/scl.v19i1.6356>.
- MACDONALD, D. 2023. Mitigating human impacts on wild animal welfare. *Animals*, **13**(18), 2906. <https://doi.org/10.3390/ani13182906>.
- MARIOM, HOSSAIN, M. S., RIFA, R. J., MONDAL, C., AHAMED, M. I., & SUDIPTA, A. P. 2026. Lactic acid bacteria (LAB) in aquaculture: current insights, research gaps, and future directions for sustainability. *Archives of Microbiology*, **208**(1), 72. <https://doi.org/10.1007/s00203-025-04625-4>
- MARTINS, T., DINIZ, E., FÉLIX, L., and ANTUNES, L. 2018a. Evaluation of anaesthetic protocols for laboratory adult zebrafish (*Danio rerio*). *PLOS ONE*, **13**(5), e0197846. <https://doi.org/10.1371/journal.pone.0197846>.
- MARTINS, T., VALENTIM, A., PEREIRA, N., and ANTUNES, L. 2018b. Anaesthetics and analgesics used in adult fish for research: A review. *Laboratory Animals*, **53**(4), 325-341. <https://doi.org/10.1177/0023677218815199>.
- MIYA, T., GON, O., MWALE, M., and CHENG, C. H. 2014. The effect of habitat temperature on serum antifreeze glycoprotein (AFGP) activity in *Nototheniarossii* (Pisces: Nototheniidae) in the Southern Ocean. *Polar Biology*, **37**(3), 367-373. <https://doi.org/10.1007/s00300-013-1437-y>.
- MUHAMMED, N., KOIKE, M., and HAQUE, F. 2008. Forest policy and sustainable forest management in Bangladesh: An analysis from national and international perspectives. *New Forests*, **36**(2), 201-216. <https://doi.org/10.1007/S11056-008-9093-8>.

- MUKA, S., and ZARPENTINE, C. 2021. Cetacean conservation and the ethics of captivity. *Biological Conservation*, **262**, 109303. <https://doi.org/10.1016/J.BIOCON.2021.109303>.
- MURIE, O. J. 1954. Ethics in wildlife management. *The Journal of Wildlife Management*, **18**(3), 289-293.
- MURRAY, D. L., and FULLER, M. R. 2000. A critical review of the effects of marking on the biology of vertebrates. *Research Techniques in Animal Ecology: Controversies and Consequences*, 15-64.
- MYERS, N., MITTERMEIER, R. A., MITTERMEIER, C. G., DA FONSECA, G. A., and KENT, J. 2000. Biodiversity hotspots for conservation priorities. *Nature*, **403**(6772), 853-858.
- NEIFFER, D. 2021. Anesthesia and analgesia. *Clinical Guide to Fish Medicine*, 35-36. <https://doi.org/10.1002/9781119259886.ch10>.
- NEIFFER, D., and STAMPER, M. 2009. Fish sedation, anesthesia, analgesia, and euthanasia: Considerations, methods, and types of drugs. *ILAR Journal*, **50**(4), 343-360. <https://doi.org/10.1093/ILAR.50.4.343>.
- NISBET, I. C., and PAUL, E. 2004. RE: Ethical issues concerning animal research outside the laboratory. *ILAR Journal*, **45**(3), 375-377. <https://doi.org/10.1093/ilar.45.3.375>.
- NORTON, B. 1986. On the inherent danger of undervaluing species' and 'epilogue'. *B. Norton, The Preservation of Species; the Value of Biological Diversity, Princeton University Press, New Jersey*, **113**.
- OH, S., and NARVER, H. 2024. Mouse and rat anesthesia and analgesia. *Current Protocols*, **4**(2), e995. <https://doi.org/10.1002/cpz1.995>.
- PALMER, A. 2018. Saving and sacrificing: Ethical questions in orangutan rehabilitation.
- PALMER, A., and GREENHOUGH, B. 2021. Out of the laboratory, into the field: Perspectives on social, ethical, and regulatory challenges in UK wildlife research. *Philosophical Transactions of the Royal Society B*, **376**(1831), 20200226.
- PANDIYARAJAN, V., NEELAKANTAN, T. R., SRIDHARAN, S. A., and RAMRAO, N. 2022. Three "R" concept in waste management for sustainable environment. *Journal of Sustainability Perspectives*, **2**, 255-262. <https://doi.org/10.14710/jsp.2022.15520>.
- PAQUET, P. C., and DARIMONT, C. T. 2010. Wildlife conservation and animal welfare: Two sides of the same coin? *Animal Welfare*, **19**(2), 177-190. <https://doi.org/10.1017/S0962728600001433>.
- PAULI, J., WHITEMAN, J., RILEY, M., and MIDDLETON, A. 2010. Defining noninvasive approaches for sampling of vertebrates. *Conservation Biology*, **24**(1), 349-352. <https://doi.org/10.1111/j.1523-1739.2009.01298.x>.
- POLLARD, S., ANDERSON, J., BAH, F., MATEUS, M., SIDHU, M., and SIMMONS, D. 2022. Non-lethal blood sampling of fish in the lab and field with methods for dried blood plasma spot omic analyses. *Frontiers in Genetics*, **13**, 795348. <https://doi.org/10.3389/fgene.2022.795348>.
- PUTMAN, R. J. 1995. Ethical considerations and animal welfare in ecological field studies. *Biodiversity & Conservation*, **4**(8), 903-915. <https://doi.org/10.1007/BF00056197>.

- RAHMAN, M. M., AHMAD, S., MAHMUD, A. S., HASSAN-UZ-ZAMAN, M., NAHIAN, M. A., AHMED, A., and STREATFIELD, P. K. 2019. Health consequences of climate change in Bangladesh: An overview of the evidence, knowledge gaps, and challenges. *Wiley Interdisciplinary Reviews: Climate Change*, **10**(5), e601. <https://doi.org/10.1002/wcc.601>.
- RAHMAN, M.M., NNEJI, L.M., HOSSAIN, M.M., NISHIKAWA, K., and HABIB, K.A. 2022. Diversity and distribution of amphibians in central and northwest Bangladesh, with an updated checklist for the country. *Journal of Asia-Pacific Biodiversity*, **15**(2), 147–156. <https://doi.org/10.1016/j.japb.2021.12.002>.
- RAIRAT, T., CHI, Y., HSIEH, C., LIU, Y., CHUCHIRD, N., and CHOU, C. 2021. Determination of optimal doses and minimum effective concentrations of Tricaine Methanesulfonate, 2-Phenoxyethanol, and Eugenol for laboratory managements in Nile tilapia (*Oreochromis niloticus*). *Animals*, **11**(6), 1521. <https://doi.org/10.3390/ani11061521>.
- RAMP, D., and BEKOFF, M. 2015. Compassion as a practical and evolved ethic for conservation. *BioScience*, **65**(3), 323-327. <https://doi.org/10.1093/biosci/biu223>.
- REIS, T. D. S., ARAÚJO, D. B. D., PAZ, C. A. D., SANTOS, R. G., BARBOSA, A. D. S., SOUZA, L. V. D., & HAMOY, M. 2024. Etomidate as an anesthetic in *Colossomamacropomum*: Behavioral and electrophysiological data complement each other as a tool to assess anesthetic safety. *PLOS ONE*, **19**(8), e0305093. <https://doi.org/10.1371/journal.pone.0305093>.
- ROSS, L., and ROSS, B. 2008. Anaesthetic and sedative techniques for aquatic animals. *John Wiley & Sons*. <https://doi.org/10.1002/9781444302264>.
- ROWAN, A. N. 1980. The concept of the three R's: An introduction. *Developments in Biological Standardization*, **45**, 175–180. <https://www.ncbi.nlm.nih.gov/pubmed/7399146>.
- RUSSELL, W. M. S., BURCH, R. L., and HUME, C. W. 1959. The principles of humane experimental technique.
- RUSSOW, L. M., and THERAN, P. 2003. Ethical issues concerning animal research outside the laboratory. *ILAR Journal*, **44**(3), 187-190. <https://doi.org/10.1093/ilar.44.3.187>.
- SANDFORD, M., CASTILLO, G., & HUNG, T. C. 2020. A review of fish identification methods applied on small fish. *Reviews in Aquaculture*, **12**(2), 542–554. <https://doi.org/10.1111/raq.12345>.
- SATHEESHKUMAR, P., ANANTHAN, G., SENTHILKUMAR, D., KHAN, A. B., and JEEVANANTHAM, K. 2012. Comparative investigation on haematological and biochemical studies on wild marine teleost fishes from Vellar estuary, southeast coast of India. *Comparative Clinical Pathology*, **21**(3), 275-281. <https://doi.org/10.1007/s00580-010-1091-5>.
- SCHOLTZ, W. 2017. Injecting compassion into international wildlife law: From conservation to protection? *Transnational Environmental Law*, **6**(3), 463-483. <https://doi.org/10.1017/S2047102517000103>.
- SCHWERDTNER, K., and GRUBER, B. 2007. A conceptual framework for damage compensation schemes. *Biological Conservation*, **134**(3), 354-360. <https://doi.org/10.1016/j.biocon.2006.08.010>.

- SCIUTO, S., COLUSSI, S., ESPOSITO, G., MELETIADIS, A., PREARO, M., PIZZUL, E., ACUTIS, P., GOZLAN, R., and PASTORINO, P. 2024. Buccal swabs for long-term DNA storage in conservation genetics of fish: One-and-a-half-year analysis timeframe. *Global Ecology and Conservation*, **51**, e02867. <https://doi.org/10.1016/j.gecco.2024.e02867>.
- SHAHI, N., YOUSUF, A. R., RATHER, M. I., AHMAD, F., and YASEEN, T. 2013. First report of blood parasites in fishes from Kashmir and their effect on the haematological profile. *Open Veterinary Journal*, **3**(2), 89-95.
- SHAHJAHAN, M., ISLAM, M., HOSSAIN, M., MISHU, M., HASAN, J., and BROWN, C. 2022. Blood biomarkers as diagnostic tools: An overview of climate-driven stress responses in fish. *The Science of the Total Environment*, 843, 156910. <https://doi.org/10.1016/j.scitotenv.2022.156910>.
- SHAWON, R. A. R., RAHMAN, M. M., DANDI, S. O., AGBAYIZA, B., IQBAL, M. M., SAKYI, M. E., and MORIBE, J. 2025. Knowledge, perception, and practices of wildlife conservation and biodiversity management in Bangladesh. *Animals*, **15**(3), 296. <https://doi.org/10.3390/ani15030296>.
- SOULSBURY, C. D., GRAY, H. E., SMITH, L. M., BRAITHWAITE, V., COTTER, S. C., ELWOOD, R. W., and COLLINS, L. M. 2020. The welfare and ethics of research involving wild animals: A primer. *Methods in Ecology and Evolution*, **11**(10), 1164-1181. <https://doi.org/10.1111/2041-210X.13435>.
- SOUTH AFRICAN BUREAU OF STANDARDS (SABS). 2008. South African National Standard: The care and use of animals for scientific purposes (SANS 10386:2008). Groenkloof, Pretoria: SABS Standards Division.
- SRINIVASAN, K. 2014. Caring for the collective: Biopower and agential subjectification in wildlife conservation. *Environment and Planning D: Society and Space*, **32**(3), 501-517. <https://doi.org/10.1068/d13101p>.
- SUVRA, A. N., and ONTAR, M. H. 2024a. Comparative legal responses to illicit wildlife trade in Bangladesh and India: Indigenous vs. extraneous approaches. *Administrative and Environmental Law Review*, **5**(2), 107-134. <https://doi.org/10.25041/aclr.v5i2.3482>.
- SUVRA, A. N., and ONTAR, M. H. 2024b. Illegal wildlife trade in Bangladesh and India: A study of comparative laws. *Uti Possidetis: Journal of International Law*, **5**(3), 488-547. <https://doi.org/10.22437/up.v5i3.36570>.
- THORSTEINSSON, V. 2002. Tagging methods for stock assessment and research in fisheries. *Report of Concerted Action FAIR CT*, **96**, 179.
- THORSTENSEN, M., VANDERVELDE, C., BUGG, W., MICALESKI, S., VO, L., MACKEY, T., LAWRENCE, M., and JEFFRIES, K. 2022. Non-lethal sampling supports integrative movement research in freshwater fish. *Frontiers in Genetics*, **13**, 795355. <https://doi.org/10.3389/fgene.2022.795355>.
- THULIN, C., and RÖCKLINSBERG, H. 2020. Ethical considerations for wildlife reintroductions and rewilding. *Frontiers in Veterinary Science*, **7**, 163. <https://doi.org/10.3389/fvets.2020.00163>.

- UDDIN, N., ISLAM, A., AKHTER, T. A. N. I. A., ARA, T. A. S. N. I. M., HOSSAIN, D., FULLSTONE, C., and HUGHES, A. C. 2024. Exploring market-based wildlife trade dynamics in Bangladesh. *Oryx*, **58**(1), 56-68. <https://doi.org/10.1017/S0030605322001077>.
- VAN DOOREN, T. 2014. Flight ways: Life and loss at the edge of extinction. *Columbia University Press*. <https://doi.org/10.1177/0309132514564047>.
- VAN DOOREN, T., PRICE, C., BANKS, P., BERGER-TAL, O., CHRULEW, M., JOHNSON, J., LAJEUNESSE, G., LYNCH, K., MCARTHUR, C., PARKER, F., OAKEY, M., PITCHER, B., ST. CLAIR, C., WARD-FEAR, G., WIDIN, S., WONG, B., and BLUMSTEIN, D. 2023. The ethics of intervening in animal behaviour for conservation. *Trends in Ecology & Evolution*, **38**(9), 822-830. <https://doi.org/10.1016/j.tree.2023.04.011>.
- VUCETICH, J. A., and NELSON, M. P. 2007. What are 60 warblers worth? Killing in the name of conservation. *Oikos*, **116**(8), 1267-1278. <https://doi.org/10.1111/j.0030-1299.2007.15536.x>.
- WALRAVEN, E., ANDREW, P., BOYLE, N., and DUFFY, S. 2018. Euthanasia and small-population management: Development of transparent processes, good governance and a practical application. *International Zoo Yearbook*, **52**(1), 258-266. <https://doi.org/10.1111/IZY.12192>.
- WANG, S. W., and MACDONALD, D. W. 2006. Livestock predation by carnivores in Jigme Singye Wangchuck national park, Bhutan. *Biological Conservation*, **129**(4), 558-565. <https://doi.org/10.1016/j.biocon.2005.11.024>.
- WHITE, K., HÄNNINEN, L., and VALROS, A. 2023. Euthanasia and the rehabilitation of wildlife casualties in Finland: Decision-making varies depending on the background education of the caregivers. *Frontiers in Veterinary Science*, **10**, 1207930. <https://doi.org/10.3389/fvets.2023.1207930>.
- WILSON, R. P., and MCMAHON, C. R. 2006. Measuring devices on wild animals: What constitutes acceptable practice? *Frontiers in Ecology and the Environment*, **4**(3), 147-154. <https://doi.org/10.1890/1540-9295>.
- WINGER, P. D., and WALSH, S. J. 2001. Tagging of Atlantic cod (*Gadus morhua*) with intragastric transmitters: Effects of forced insertion and voluntary ingestion on retention, food consumption and survival. *Journal of Applied Ichthyology*, **17**(5), 234-239. <http://dx.doi.org/10.1046/j.1439-0426.2001.00280.x>.
- YOUSEFI, M., HOSEINI, S., VATNIKOV, Y., NIKISHOV, A., and KULIKOV, E. 2018. Thymol as a new anesthetic in common carp (*Cyprinus carpio*): Efficacy and physiological effects in comparison with eugenol. *Aquaculture*, **495**, 376-383. <https://doi.org/10.1016/J.AQUACULTURE.2018.06.022>.

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