Biodiversity in Bengaluru

A manual for scientists communicating with journalists

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Abstract

Bengaluru is one of the fastest growing cities in the world. This rapid urbanisation brings with it a host of environmental problems such as pollution and large scale biodiversity loss. The reporting manual to biodiversity in Bengaluru is designed to help journalists explore various themes and ideas related to urban biodiversity. As coverage on urban biodiversity increases, journalists will turn to researchers for information. But these interactions are not always positive, particularly for researchers who may not be well versed in the media industry. This Researcher's handbook to communicating with the Media, is meant to aid scientists in the country navigate the sometimes messy world of journalism. This manual aims to help researchers understand the media industry and how to best communicate their research to journalists and the public at large. This document is meant to be a companion to the Journalist's manual on urban biodiversity reporting particularly in Bengaluru, but we hope that researchers across fields and geographic locations will find useful lessons on how to deal with media interactions.

Understanding the Media Ecosystem

A Brief History of Indian Journalism

The story of Indian news media began with the publication of India's first newspaper the *Hicky's Bengal Gazette* in 1782 by James Hicky, an Irishman living in Kolkata. The newspaper lasted just two years before the East India Company forcibly shut it down for its criticism of the then Governor General of India. Several other newspapers followed including the *Calcutta Chronicle*, *Madras Courier* and *Bombay Herald* in English and the *Amrita Bazaar Patrika* which switched from Bengali to English after the British government passed the repressive Vernacular Press Act. Several of these newspapers have died out today while some like the Times of India is India's oldest existing English language newspaper[1], The Hindu and The Hindustan Times have survived.

Radio broadcasting in India began in 1927 and the All India Radio, India's largest FM Radio station run by the National Broadcasting Company Prasar Bharathi began in 1936 under the British government and was taken over by the Indian Government in 1947. While several private FM Radio channels have sprung up in India since the 1990s, news remains a monopoly of AIR[2]. Private radio channels are banned from broadcasting independent news content. In 2019, the Central Government allowed private radio channels to broadcast AIR news (with no editorial changes allowed)[3].

Television news arrived in Indian homes at a much slower pace. Prasar Bharathi began broadcasting news through National channel Doordarshan in 1965. The news channel also acquired rights from CNN to the country first international TV news broadcast of the First Gulf War in 1991. But news remained the monopoly of Prasar Bharthi, until 1998 when NDTV then a production house began producing news shows for Star TV, India's first private satellite TV channel. NDTV began its own network in 2003 becoming India's first 24x7 news network. Several English and Regional language channels followed soon after[4].

According to the Registrar of Newspapers for India, there are 1,18,239 registered news publications in the country, of which 17,573 are newspapers and 1,00,666 are periodicals. Hindi publications have the highest circulation reaching 19,56,21,990 readers followed by English publications which reach 5,34,53,564 people. The Hindi newspaper Dainik Bhaskar has the highest circulation for a daily newspaper reaching 51,19,720 people while

The Times of India in English is the second largest national newspaper and largest English language newspaper with 43,34,769 readers[5].

In Karnataka the Kannada language daily Vijaya Karnataka is the most read newspaper with close to eight million readers[6], while the Karnataka focussed English language daily Deccan Herald is the most read newspaper in the state with the exception of Bengaluru where the Times of India is the most read English daily[7].

However, like other parts of the world, Print Media in India is undergoing a financial crisis. Advertising, the main source of revenue is falling particularly because of the rise of the internet and social media advertising. In 2020 with the

CoVid 19 Pandemic, print media in India saw a 40 percent fall in revenue[8].

With the rise in internet usage, India has seen a boom in digital media. Between 1995 and 2010, only eight percent of India's population accessed the internet on a regular basis. But with the growth and accessibility of smart phone technology this grew to around 30 percent by 2015[9]. In 2021 1.09 billion people had mobile phones and 439 million had access to smart phones making India the second largest country in terms of smart phone usage. By January 2021, 45 percent of the country, 624 million people, were using internet regularly and 448 million people were using social media. The CoVid 19 and associated lockdowns seems to have increased these numbers substantially. Between 2020 and 2021, internet users increased by forty seven million and social media users increased by 78 million[10].

Against this backdrop, India has seen a rise in digital online news platforms. While legacy print media such as the TOI and The Hindu and Television news channels such as NDTV have expanded their news content to digital versions. A slew of independent news outlets with only digital access such as the Wire, The Print, Scroll. in have also cropped up in the country. As a relatively new industry in newly online country digital media outlets have yet to identify a successful revenue model. Some outlets like the Quint and Scroll.in rely on an advertising and subscription based model. But like much of the world, these outlets are struggling to hold on to ad revenues while competing with giant tech companies like Google and Facebook. They are also struggling to retain subscribers willing to pay much more than they do for their daily newspaper or Cable TV access. Some digital news media outlets like The Wire and Newslaundry are non-profit outlets and rely on a combination of subscription and user donations[11]. Digital media extensions of already established organisations like TOI and NDTV are currently doing better in terms of viewership and social media engagement[12].

While digital news media is already struggling to keep afloat the Union Government introduced a 26 percent cap on Foreign Direct Investment in September 2019. The move forced foreign media companies operating in India such as Huffpost India and Buzzfeed India to shut shop[13]. As budgets and revenues continue to shrink, journalists are increasingly being laid off across newsrooms in all formats in the country[14].

This brief overview of the news industry provides scientists with the backdrop against which science journalism happens in India.

Science Journalism in India

Media researchers often trace the birth of science journalism and communication in India to the 1950s, when the Independent Indian Government under the first Prime Minister Jawaharlal Nehru passed the National Scientific Policy Resolution which emphasised that progress in science and technology was key to improving living standards of the vast majority of the country[15]. The Hindu's Readers' Editor S. Viswanathan traced the history of science journalism to even farther back in the 19th century[16]. In 1989, the Department of Science and Technology set up the Vigyan Prasar, an autonomous body with the aim of communicating science and scientific advancements to the Indian audience. Vigyan Prasar continues to run, funding science communication materials such as films and radio programmes and conducting

training workshops for science communicators[17]. Despite these early beginnings, science coverage in Indian press is woefully inadequate and biodiversity coverage even more so. A study of 31 Hindi newspapers and 21 English newspapers in India funded by Vigyan Prasar between 1999 and 2000, found that on average only 3.3 percent of the reportage covered science. One third of this coverage was devoted to health and medicine[18]. A study of the Times of India and Deccan Chronicle in Hyderabad found that both newspapers approximately 9.57 percent of their reporting covered science stories[19]. Another study from 2015 analysed two English newspapers, The Hindu and The New Indian Express and two Kannada newspapers Prajavani and Vijaya Karnataka. The authors reported that English newspapers only devoted 1.77 percent of their available publishing space to Science and Technology coverage while the two Kannada dailies devoted approximately 1.90 percent space to science coverage[20].

In terms of content, the Karnataka study found that English newspapers in particular focused more on breaking news, i.e. coverage of new discoveries or advancements while the Kannada dailies gave almost equal coverage to breaking news and features. Another study from 2018, found that newspapers overwhelmingly covered topics related to Human Behaviour and Health, followed by Technology and then Environment. Preference was given to 'quirky' or odd stories with rare discoveries and lifestyle news with a hint of science[21].

Biodiversity Coverage in Media

As with studies on science coverage we only have piecemeal information on how biodiversity is covered in the Indian Media and the overwhelming focus is on print journalism. But the few studies are illustrative of media focus. An analysis of 766 news stories across 50 newspapers in India in 2011 showed that print media coverage overwhelmingly focussed on large terrestrial mammals, particularly the Tiger. Approximately a third of all coverage related to tigers. Stories on tigers were also the most diverse covering the latest research, entertainment and tourism news as well as conservation issues related to tigers[22]. A Masters Dissertation by a student from Christ University Bangalore analysed 10 leading English and Kannada newspapers in Karnataka and similarly found that tigers and other charismatic animals like elephants received the most newspaper coverage. Reptiles, insects and plants received negligible coverage. The Karnataka based study points out that that less than 1 percent of total news coverage per month is devoted to biodiversity or wildlife reporting. Kannada newspapers tended to do slightly better in terms of overall biodiversity coverage compared to English dailies. But most of the coverage tended to focus on national or state level issues of wildlife. Few stories focused on urban biodiversity[23].

Worryingly for science journalism, both studies found that newspapers overwhelmingly depended on government sources such as bureaucrats for information. Very few stories depended on scientists or researchers for information. This could be changing greatly with the growth of digital news portals and social media. But we have very little structured data on how digital-only news organisations cover science and biodiversity. Even less is known about how any news media in the country are covering urban biodiversity issues. However there appears to be a healthy appetite for science coverage in

general and particularly biodiversity coverage across digital media. Media outlets like The Wire Science, Mongabay India, Citizen Matters, Scroll.in, The News Minute (South India focussed), The Quint, The Federal, The Bastion and News Click carry regular science and biodiversity news on their platforms.

Despite the poor coverage, there is a case to be made for researchers and conservationists engaging with the media on a regular basis as well as communicating science themselves. For instance, a study by conservation biologists working on leopards in the and around the Sanjay Gandhi National Park in Mumbai found that print media coverage of leopards in the city changed considerably after they held workshops on leopard ecology and behaviour for journalists. Where coverage of human -leopard conflicts prior to engaging with the city's journalists, tended to focus on leopards as the aggressor, after the media workshops coverage showing leopards as neutral actors or even victims of habitat loss, increased. Post workshop coverage also focused on how human beings could modify behaviour to avoid conflicts[24].

Studies are also reporting that coverage of environmental issues, particularly climate change impacts are rising in India[25]. The CoViD 19 pandemic has led to an increase science journalism particularly related to health and affiliated fields such as immunology[26]. The theory that SARS Cov2 spread as a result of spill over from wild animals has also increased attention towards biodiversity issues such as fragmentation, spill over and spread of zoonotic diseases.

Urbanisation and urban biodiversity the focus of this set of manuals is intricately related to all these issues. From climate change to biodiversity loss, increased probability of epidemic spreads, our increasingly urbanised world is likely to face multiple environmental crises in the coming years.

Urbanisation and Biodiversity in Bengaluru

According to a 2018 report by the Department of Economic and Social Affairs of the United Nations, approximately 4.1 billion people, that is nearly 55 percent of the world's population lives in cities. By 2030, the UN report projects that the global urban population will be 5.3 billion and by 2050, nearly 70 percent of the world's population will be urbanised.

Approximately 33 percent of India population lives in urban areas and by 2030 nearly half of the country's population will be urban with a projected 840 million people living in cities. Several new mega cities are emerging in the country and growing rapidly both in population and space. Bengaluru is today India's fourth most populated city according in India. The Karnataka Government's Directorate of Economics and Statistics estimates that the city's population will be over 14 million in 2021, which is a whopping 48 percent increase in a decade[27]. Researchers have mapped the impact of this massive growth on the city's biodiversity in great detail.

Despite this dire state, Bengaluru still has substantial wildlife. Forty one species of mammals including slender lorises, leopards, jungle cats, common mongooses, several species of bats and rodents have been recorded in the city[28].

Citizen scientists have documented over 300 species of birds are found in the city, including long-distance migratory birds from the Himalayas, Central Asia and Siberia[29]. Seventeen species of amphibians, 52 species of reptiles, 1707 species of insects and arachnids and thousands of species of plants are also present in the city[30].

Researchers have found that parks in the city, on an average support at least 55 species of trees, 45 species of birds, 41 species of butterflies and 68 types of insects. Sacred groves in temples, churches and cemeteries across the city are home to 5000 individual trees belonging to 98 different species. Unlike the managed parks in the city, these sacred groves favour native species and keystone species like fig trees that are vital habitats for other wildlife[31].

But the growing city is eating into these habitats. A study by the Centre for Ecological Sciences (CES) at the Indian Institute of Sciences (IISc) reported that built-up area in Bengaluru had increased from 7.97 percent in 1973 to 73.72 percent in 2013, a nearly 65 percent increase[32]. Another study from 2017 found that built-up area has increased from 2.53 percent in 1973 to 48.61 percent in 2016[33]. Simultaneously, vegetation, green cover and wetlands in the city have declined affecting the city's biodiversity. Dense vegetation which once covered 68.27 percent of the city had declined to less than 15 percent of the city in 2013 and covered only approximately eight percent of the city in 2016.

Peri-urban areas, which retain several wild spaces and greater diversity of flora and fauna, are under immense threat from the expansion of the city. The Bannerghatta National Park in the Southwest is under pressure from illegal granite quarrying for construction projects in Bengaluru[34] and increased commercial farming and horticulture to cater to the city Residential and commercial real estate projects are routinely cleared within in the 10 km buffer zone of the

park. Researchers from the Centre for Ecological Sciences have found that between 1973 and 2015 there was nearly 20 percent decline in vegetation cover in Bannerghatta. They predict that by 2027 forest cover in the park and the buffer zone would decline by an additional five percent decline with a simultaneous increase in urban areas[35].

The spread of real estate projects and roads in the buffer zones of BNP and the Cauvery and Kanakapura forests has often shrunk habitats for animals like leopards leading to the big cats straying into schools and residential complexes in the city[36]. The Government of Karnataka proposed that the Hesarghatta grasslands in Northwest Bengaluru, the last remaining grassland patch in the city be converted into a Film City showcasing the Karnataka Film Industry[37]. Massive public outrage has temporarily put the plan on a back burner[38].

Researchers have also noted that there were over 1000 waterbodies within the borders of what is the current city of Bengaluru[39]. By the 1970s Bengaluru had grown to 161 square kilometres and had 285 lakes. By 2016, Bengaluru had grown to nearly seven times the size. But only 194 lakes remained in an area of 741 square kilometres. Even these are not in good shape. Of 105 lakes surveyed in 2013, 98 percent were found to be encroached to various degrees and 90 percent were found to be sewage fed[40]. Encroachments continue. The BBMP's own survey of lakes found this year that nearly 4500 acres of lakes were being encroached upon[41].

Wetlands of Bengaluru are important biodiversity hotspots. The lakes are occupied by resident and migratory birds including ducks, waders, and terrestrial birds. Birdwatchers have recorded well over 150 to 200 species of birds in lakes under intense real estate pressure such as the Jakkur Lake, Yelahanka lake, Hennagara lake and the Kaikondrahalli lake[42].

Missing gaps

This overview of biodiversity in Bengaluru has been presented in greater detail in the complementary reporting manual for journalists. As interest in biodiversity issues grow, journalists are going to increasingly turn to scientists for answers to these pressing concerns. Scientists can help journalists and consequently the public make sense of these complex interactions between urbanisation and biodiversity in the city in a few ways.

Updated Baseline data

While there is piecemeal information on the city's wildlife, there is no comprehensive updated baseline data on abundance, composition and richness of flora and fauna in the city and its outskirts. We consequently don't have basic information such as which native tree species are disappearing in the city, whether specialist birds or certain guilds (such as insectivores like Babblers and Pied Bushchats) are declining or generalist species (such as House Crows and Common Mynahs) are increasing. Smaller fauna such as insects, reptiles and rodents are especially poorly unknown.

This is important because environmental management in the city tends to focus on tree planting and biodiversity successes are often counted on the basis of number of species. But there is little understanding of whether city planning can include preserving a diversity of species.

Baseline data for key habitats such as all lakes, botanical gardens and large university campuses such IISc and GKVK and PAs like BNP and Nandi Hills would be particularly useful for journalists reporting on impacts of new projects, residents making decisions about development activities as well as city planners. Citizen Science data from platforms such as eBird and iNaturalist can be a particularly useful tool for journalists. But researchers may be better placed to scientifically collate this data and make statistically responsible inferences.

Diversity of habitats

While there is overwhelming focus on planting trees as part of greening the city, Bengaluru and its periphery are actually home to a variety of habitats including agricultural lands, rocky hills, grasslands and deciduous and scrub forests. Researchers, particularly ecologists and naturalists can help journalists understand how these different habitats serve different flora and fauna as well as local communities. Stories focusing on Bengaluru's biodiversity, species discoveries, ecosystems and changes, need to be located in the city's geography. For the lay reader, a general story on the impacts of urbanisation on trees or birds may be abstract. But a story that shows the impact of a development project on the biodiversity or habitat in a neighbourhood where the readers live, or work can be powerful. It can empower the reader and resident of the city to weigh in on local governance decisions.

Habitat Connectivity and Migration

Like any 'wild habitat', animals in a city move. Snakes, lizards, birds and insects all disperse from their natal grounds in search of new territories to establish themselves. But habitat connectivity within the city is poorly understood and impacts of new construction and infrastructure projects rarely take into account if they are actually fragmenting landscapes.

Bengaluru is a pitstop as well as destination for many migratory species in winter and monsoon, especially because it is situated between the Western Ghats and Eastern Ghats. Butterflies such as Blue Tigers and Glassy Tigers pass through the city in huge numbers. Migratory birds including species breeding in Central Asia and the Arctic settle down in the city in large numbers. But we have little information on the sort of habitats that need to be preserved, or created to aid these species that are globally vulnerable. We also know very little about whether their numbers are declining or stable within the city.

Ecology and City Planning

As city planners eye more rural areas and agricultural lands, there is likely to be trickle down impacts on several plant and animal populations. We need studies on how the BDA's latest Masterplan for instance impacts biodiversity. What is lost or gained with land use change in peri-urban areas.

People and Biodiversity

How the city's residents interact with nature gives insight into how green spaces can be managed democratically. While there is a lot of work done in regard to lakes and communities depending on them in Bengaluru, this needs to extend to other urban commons such as pastoral lands used by cattle herders in the city. Access to nature is also now understood to be vital for human well-being, both physical and mental. More research and more communication is needed on how different communities are able to access nature and how that impacts their livelihoods as well physical and mental health.

Interacting with Journalists

Interacting with Journalists

Despite some positive interactions between scientists and journalists as highlighted in the case of leopards in Mumbai, there are issues with these interactions. In a column summarising a science journalism workshop organised by the Institute of Mathematical Sciences, Chennai, and the Indian Academy of Sciences, writer Shreya Ghosh noted a trust deficit between the two parties[43]. "While many scientists hold a dismissive view of journalists as only being interested in "flashy" stories and operating under the dictatorship of entertainment and profit, scientists are often perceived as esoteric, eccentric and closed-off individuals," Ghosh wrote.

In the following sections we attempt to highlight some of the rules of engagement, media ethics that journalists are bound by (whether it is followed or not), challenges journalists face and the ways in which researchers can communicate their work to ensure accuracy. We also highlight some steps scientists can take to protect the integrity of their work when communicated in the media.

The Journalist as a Lay Person

In a column in 2009, The Hindu's then Readers' Editor S. Viswanathan noted that journalists covering science are not always well versed with the field they cover[44]. Researchers interacting with the media on a regular basis will come across this scenario at some point. A majority of the journalists in India, particularly those working in legacy print media or television, are likely to have degrees in journalism, mass communication or allied fields. Some may have a basic understanding of environmental issues, or conservation issues, but lack knowledge in natural history or the principles of ecological theory. For others all these topics may be new. This is changing in India as a newer crop of science journalists are emerging from within academia and research environments. Such journalists can often carry with them valuable understanding of the field from their own research experiences and understand the scientific process better. But in the vast majority of cases currently, journalists particularly those covering urbanisation and biodiversity are likely to lack training in ecology or biodiversity research.

Scientists can try to gauge how well versed the journalist is in their field by looking at their past work on social media, reading their previous reporting (if time permits) or by simply asking them. Of course, it also helps if journalists are up front with scientists about their familiarity with the field. It may not seem like it but there are advantages to talking to 'generalist' reporters who lack specialised knowledge in biodiversity. They may have fewer pre-conceived notions about certain issues, they may be more excited and open to understanding the field, they may be able to ask scientists fresh questions that are not always addressed in the media. City based journalists with experience in reporting on urbanisation and development in the city have the added advantage of being well versed with bureaucracy, local politics and urban governance. They may be able to connect biodiversity research to the more human dimensions of city planning and growth in ways ecologists are often unable to.

Researchers communicating with such journalists must attempt to explain their study and findings in simple terms, devoid of jargon. For instance, do not assume that a journalist will be familiar with concepts like alpha or beta diversity. If understanding that is key to communicating a study, scientists should try to explain the concept in a couple of lines. In a series of tips for scientists talking to the media, senior correspondent for Chemical and Engineering News, Bethany Halford advises that scientists should avoid talking about their research to journalists, like they would to their scientific colleagues. "Instead, think about how you might explain your research or your latest finding to your dentist or to a stranger sitting next to you on an airplane," Halford suggests[45].

Communicating Uncertainty and Scientific Method

A common sore point for scientists is the inability of journalists to grasp uncertainty in results. Part of the problem is the ingrained belief and deference to scientists and published papers, that makes it hard for journalists to understand that published studies are not always absolute truths, notes Carrie Figdor, an Associate Professor of Philosophy at the University of Iowa, USA. Figdor a former journalist also noted that journalists often don't understand or ignore the fact that scrutiny of scientific studies do not end with peer review. The process of repeated experimentation to replicate results is vital for a reported phenomenon to achieve universality[46].

Journalists are also often under pressure from their editors to produce a report that makes for a good story. A headline like "Sparrows are disappearing in India as their chicks starve," is a more eye grabbing for an editor than "Reduced insect prey during breeding season may contribute to sparrow decline in cities, but there are other unexplained factors." This does not mean scientists should compromise on the integrity of their research or allow sensationalism. Instead, scientists should try to explain the reasoning behind an inference in simple terms. A way to explain uncertainty could be: "We tried to understand what was causing sparrow decline in India. We found that in cities where sparrow numbers had declined, insect prey was much lower in the breeding season. Although sparrows are primarily seed eaters as adults, sparrow chicks are fed a diet rich in insects, which provide additional protein." Details like why insects are important to sparrows can clarify the link between these two taxa.

It is also helpful to convert numbers in results into commonly understood terms. For instance, instead of giving a probability value between 0 and 1, scientists could use percentages. "Reduced insect prey explained 30 percent of the cause for sparrow declines. But we still don't understand the other factors."

A good way to remind journalists of the uncertainty is to also highlight other factors that could possibly play a role in the phenomenon of interest. If the scientist is also studying those other factors in the future, it helps to explain that to journalists.

A good story also does not have to come from sensationalising findings. Good journalists are also able to highlight the highs and lows of the scientific process. Readers are often as intrigued by what happens behind the scenes of a study. There is an appetite for stories about the challenges of research, whether securing funding,

creating a hypothesis, tracing the inspiration for questions or difficulties while collecting data. Scientists are often uninterested in talking about these experiences. But these anecdotes humanise scientists and the scientific process. They also inform aspiring researchers of the challenges in the field and provide a realistic picture of the work. It helps to add these details where possible, especially if the journalist is asking these questions.

Budget and time constraints

Scientists are often frustrated by journalists not doing in-depth research on particular topic before interviews. It is important that journalists come well prepared with questions and that they read the research paper. But scientists should not assume that journalists will have read and understood technical details such as methodology or results. If this is important to understanding the research, it must be explained to the journalist. Journalists will also sometimes ask obvious questions; questions which can be answered by reading the paper. For instance, "what was your main finding from the study?" This does not always mean the journalist hasn't done the work, but sometimes they are hoping for a less technical and more humane explanation of the paper in question. An explanation rooted in everyday examples or analogies.

It is also important for scientists to remember that journalists work under the constraint of both time and money. Media budgets are shrinking worldwide and most media outlets in the country do not have a dedicated science desk or science reporter. Freelancing is becoming the norm for science journalists in India. The average pay for staff journalists in India is between 30,000-40,000 and even this can be subject to a lot of uncertainty for freelancers. Staff writers may have to produce large amounts of reporting in a day while freelancers have to balance detailed reporting with taking on enough assignments to make ends meet. So, journalists interviewing scientists may not always have to time to read multiple related papers or books published by scientists on the topic.

The Rules of Engagement

Another point of conflict arises from scientists not understanding the professional ethics that govern journalism. While editorial policies differ across newsrooms, there are a few common rules that scientists should remember.

Nothing is off the record (unless explicitly stated): Journalists are meant to bring the facts and the views of policymakers and domain experts to the public. If a scientist agrees to an hour long interview, they cannot post facto decide which thoughts or views are meant to be on the record and which are off the record. If a journalist asks a question that the scientist is reluctant to answer on the record, they can either say they will answer off the record (in which case it must not be published at all) or they can decline to answer. Similarly, if a journalist reaches out to a researcher after an interview for further clarifications, the scientist must assume that those conversations are also on record, unless both parties have explicitly agreed to an off-the-record conversation.

On the flip side, journalists also have an obligation to ask scientists for permission before recording a conversation. Technically there is no law against a person recording another person in a one on one conversation in India. But the vast majority of Indian media organisations will expect the journalist to ask for consent (except

under exceptional circumstances such as undercover journalism or infiltrating a criminal organisation). In case an Indian journalist is reporting for a foreign media outlet, particularly from the US, UK, Europe or Australia, the journalist is obliged to ask for consent even if the interview takes place in India.

No question is off the table: Journalists may ask questions related to the actual finding. But a good science journalist should also examine funding sources, conflicts of interest or contradictory views of a scientist. They can also ask questions about the reliability of the methodology or the results. They can question scientists about the differences in their study and others. Scientists can choose not to answer or to be prepared for questions, particularly if the results are controversial or if they have conflicts of interest.

Not everything that is said will be included in a story: An hour long interview can often lead to a transcript of over a thousand words, much more information than can be included in most science stories. Journalists are not obliged to report everything a scientist says. It is important that they do not quote a scientist out of context. But it is not necessary that they highlight all findings or issues that a scientist discussed. It is up to the scientist to emphasise what they think is the most important finding or issue on a topic. But it is up to the journalist and the editor to decide the focus of the story.

No co-authors are off the table: Science journalists in India have pointed out the hierarchical nature of academic institutions, where advisors or professors often seek to dominate conservations with journalists. Typically, journalists reporting on a new paper will approach the corresponding author or the researcher they feel has shown most expertise on a topic. But journalists are free to talk to the first author, who may be an early career researcher or other co-authors as well. Such a practice should be welcomed. Senior scientists should also make space for the first author or their students to discuss their work with the journalist without interference. They should also help the journalist get in touch with field collaborators (with consent) who may have more local ecological knowledge.

Journalists are not publicists: While the aim of science journalism is to bring research to the public, journalists are not publicists for scientists. It is not their job to praise a scientist or their work. It is not their duty to showcase the institution, or the research group involved. Even if a scientist helps the journalist with logistics, they cannot expect to dictate the narrative or focus of the story. For instance, allowing journalists access to a lab or stay at a field station does not mean they have an obligation to write an uncritical story.

It is also common practice in science journalism to approach experts who have worked in the same field for their view on a paper or study of interest. It is the journalist's duty to publish these comments even if critical. On the flip side, journalists may sometimes approach a researcher who has little to no experience in the topic of interest. It is the journalist's duty to approach the right person for a comment. But if scientists are asked to comment on a study that they feel unqualified to weigh in on, it helps to be upfront about this. For instance, experience in the field of frog taxonomy may not automatically translate to knowledge of research in frog diseases. Scientists should try to explain this to journalists where possible.

Journalists will not (and should not) share a draft of their story: A near universal rule in journalism is that the subject of a story gets no editorial control. This is meant to preserve the integrity and independence of reporting. This rule is well understood and accepted in the case of politicians or government officials or similar persons in power. But scientists often expect journalists to share drafts of a science story to check for accuracy. The urge is understandable. It can be frustrating to see one's scientific work being misrepresented or misunderstood. But this practice is a slippery slope, in a world where we are also routinely discovering instances of scientific fraud. Poorly designed studies or outright fraud in research papers is so common in India, that the science watchdog Retraction Watch has a separate category for Indian Retractions. It is the job of journalists to write a well-balanced story representing not only the successes of research but also the failures and doubts.

Fact checking is ultimately the journalist's responsibility: A consequence of blind trust in scientists or experts is that journalists can often carry statements or opinions from scientists without scrutiny. Regardless of whether a scientists makes a minor or major error in their statement, inadvertently or intentionally, it is the journalist and the editor's job to carry factually accurate reporting. This also holds true for background information on a species or area of study. Scientists do not have any duty to factcheck a journalist's work post interviews. They can help by clarifying further questions.

How to avoid being misquoted?

There is very little scientists can do to control how a story is written or produced in the newsroom. But there are some steps that can be taken to protect one's own reputation or integrity. First, scientists can enquire as to the journalist's experience with the topic of interest. They can also ask for details of the outlet in which a story is appearing.

In cases where the reporter does not appear to have too much knowledge of the field, scientists can choose the method of interview. For instance, a scientist can ask for an email interview where they can respond to questions in writing instead of an in-person or phone interview. In cases where reporters want one or two quotes for a short turnaround story, the scientist can ask to respond over text or even WhatsApp voice messages. Having responses in the written form can especially ensure that the room for misquoting is low. In extreme cases, scientists are free to also record a conversation with the journalist on their own devices. They should of course inform the journalist.

Of course, not all interactions with journalists will involve long conversations or interviews. Reporters often work with immensely tight deadlines, particularly while working for daily newspapers. In such cases they have a few hours to research, interview and report a new piece of research. Such news stories are also short pieces which don't have room for in-depth conversations with the authors of the papers. Reporters will be looking to report the main finding of the study and one or two quotes from the main authors commenting on the significance of the study. In some cases, reporters will also include quotes from an outside expert commenting on the study.

There is a lot of room for error and misquoting in these cases. The best way to prevent this is to

communicate a new paper or study via a press release. Most research organisations nowadays have a communication department or media officer. Scientists can take their help to craft a brief press release that highlights the key findings and their significance to that field of study. The press release can also include quotes on the findings from the main authors of the study and can be sent directly to media organisations, particularly daily newspapers and uploaded on the institutional or personal website and social media pages of the scientists. This is especially helpful when a researcher is fielding calls or interview requests from multiple journalists.

If journalists ask for additional quotes, scientists can also ask to respond to questions over email or even WhatsApp. This helps scientists craft well thought out responses and makes it easier to hold journalists accountable if they misquote or misreport.

Despite these steps, a journalist may still make a mistake or misquote. Scientists can contact the editor of the outlet, produce their copies of the interviews if any, and ask for a correction with a notification to the readers. Most journalists and media outlets will do this. But in the extreme cases that they do not correct factual errors, scientists should feel free to point this out over social media platforms. Many researchers, particularly early career researchers may hesitate to publicly call out journalists or media outlets. Some may feel it is not worth the time or effort. But a quick correction on social media can ensure that the story is corrected for future readers and scientific misinformation does not spread further. It also helps set the record straight for scientists, particularly if wrong information can impact relations with collaborators, local communities or funding agencies. Good journalists will welcome the move to correct mistakes publicly and good media outlets will continue to cover the work of such scientists.

Scientists as Communicators

While science journalism is growing in India, communicating science to the lay audience is no longer the exclusive domain of journalists. Bengaluru in particular has a growing biodiversity research community thanks to the multiple institutions that have come up in the city. Researchers in the city and the country at large are increasingly talking about their work on social media, through popular writing or even video and podcasts. Scientists already communicate their work when they publish papers, write grant proposals or speak at conferences. But science does not operate in vacuum. Research ideas and research proposals are often influenced by how a particular society views and values science. Research outcomes can have real world consequences whether in shaping policy or developing societal norms.

While journalists can provide an objective outsider's view of science, scientists can provide a crucial inside look. All the things that are out of one's control when talking to journalists, such as the focus of the story, or explaining uncertainty can be controlled when a researcher communicates their own work to the lay audience. It is important then that scientists tell the story of their work in their voice where possible. We mention here a few common ways scientists can dip their toes in these waters. But the internet today is filled with resources that can help scientists develop communication tools and explore different forms of storytelling.

Social Media

Researchers are increasingly on social media, particularly Twitter and Instagram. A paper in Plos Biology argues that social media can help scientists raise their profile, keep up with the latest in their field and communicate their own papers to a large and diverse audience. Early career researchers particularly studying biodiversity have the added advantage of working on popular and aesthetically appealing subjects like wildlife and nature which appeal to a diverse set of users[47]. A simple way to communicate on social media is to post simple language summaries of new papers or research on Facebook, Twitter and Instagram. With the rise of audio only social media platforms like Clubhouse and Twitter Spaces, there is unique space for scientists to hold Q and A s about their work or the broader field of research.

Science Writing

Researchers can explore popular science writing through a personal or professional blog, or writing for institutional and university websites. There are also several media outlets dedicated to science writing by scientists working in those fields. The Australia based website, The Conversation is popular not only amongst scientists and social media but several Indian and International media outlets[48].

Digital and print media

Most digital and print media outlets in India welcome writing by scientists about science. Citizen Matters, Mongabay India, The Wire Science, Scroll.in, The Print and NDTV digital are popular platforms for scientists to write about their work or field. Print media will often take opinion pieces from researchers with expertise in that field. English language dailies like The

Hindu and Deccan Herald are usually interested in biodiversity related opinion pieces. The Education and Public Engagement team at Bengaluru based Nature Conservation Foundation, has an entire project dedicated to connecting nature writers to mass media publications across the country. The project also focuses on regional media and has helped nature writers publish in Gujarati, Hindi and Odia publications[49].

Alternative platforms

While audio storytelling is still nascent in India, journalists and science writers are increasingly exploring podcasts as a form of communicating science. For example, wildlife biologists and doctoral students Ishika Ramakrishna and Akshay Surendra recently started a podcast 'The Thing about Wildlife.[50]' The podcast features ecologists and conservation biologists talking about their research and their experiences working in the field. Kollegala Sharma, a scientist at the Central Food Technological Research Institute, Mysore has been writing about science in Kannada for decades. He recently began a podcast in Kannada called *Janasudhi*, that provides listeners a weekly digest of science news. The podcast is distributed over WhatsApp and picked up by community radio stations across the state. Sharma notes that communicating science as a scientists has brought life to full circle for him. He writes, "Popular science got me interested in science, and science pushed me to communicate with others."[51].

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