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Research article

Evidence for the continued use of river dolphin oil for bait fishing and traditional medicine: implications for conservation

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ABSTRACT

Populations of the Ganges river dolphin (*Platanista gangetica gangetica*) are endangered, with ~3500 individuals estimated worldwide. Threats to this precarious population is exacerbated by accidental entanglement and illegal hunting for oil, which is used in bait fisheries and traditional medicine. Alternatives to dolphin oil have been proposed and extensively promoted in India, to curb the immediate threat to dolphin populations. However, it is not known whether dolphins are still being poached for oil, despite the proposal of aforementioned alternatives. Herein, a molecular protocol to monitor the presence of Dolphin DNA, using species identification of DNA extracted from bait oils obtained from fishermen is presented. This is coupled with information from social surveys to understand the current status of use of dolphin oil. Results indicate that molecular tools provide an accurate technique for detecting the presence of dolphin DNA, and can be used by enforcement agencies to monitor and identify points of threat to dolphins. Social survey results indicate the preference of fishermen to continue the use of dolphin oil for bait, despite knowing the legal implications. It is found that alternate oils do not provide an effective solution to curb dolphin oil use, and only shifts the threats of endangerment from one species to another, in the long run. The ban of bait fishing, effective enforcement combined with monitoring through molecular tools, continued community engagement and livelihood skill development are the most viable solutions for a holistic conservation approach.

1. Introduction

Ganges river dolphin (*Platanista gangetica gangetica*) is restricted to parts of the Ganges-Brahmaputra-Meghna and Karnaphuli river systems of India, Nepal and Bangladesh (Jones, 1982). In India it is declared as the National aquatic animal and is accorded highest conservation priority by being listed in Schedule-I of India's Wildlife Protection Act (1972). There are about 3500 individual Ganges river dolphins distributed globally (Sinha and Kannan, 2014), but there has been a decrease in the distribution range of the species within the last few decades, with some local extinctions (Wakid, 2009). Water development projects, especially dams and barrages (Sinha, 1997; Sinha and Sharma, 2003), pollution (Mazumder et al., 2014), deliberate killing for oil and accidental killing through fishing nets (Choudhary et al., 2006) are the major human-driven causes of this population decline.

Dolphin oil use for medicine and bait fishing is widespread across the Ganga and Brahmaputra river systems (Sinha, 2002). Apart from deliberate killing of River dolphins, even non-targeted deaths due to net entanglement, contribute to the dolphin oil market for oil-bait fishing, and medicinal purposes. Dolphin oil is said to cure rheumatism, nervous disorders, asthma and is also believed to be an aphrodisiac (Choudhary et al., 2006; Pelletier and Pelletier, 1980). Further, this oil is used as bait to enhance capture of cat-fishes in the river (Faruqui and Sahai, 1943). This practice of using aquatic mammal fat, especially dolphin oil, for increasing catch by fishermen is a common practise around the world (Mintzer et al., 2018; Williams et al., 2016). River dolphins inhabiting the South American rivers are also regularly exploited as bait for fishing in Bolivia, Brazil, Colombia, Peru and Venezula (Mintzer et al., 2018). In India, the use of dolphin oil for catfish (*Clupisoma garua* and *Eutropiicthys vacha*) lure is an age old practice, and was first reported by Faruqui and Sahai (1943), and later confirmed by several others (Bairagi, 1999; Job and Pantulu, 1953; Motwani and Srivastava, 1961; Wakid, 2009). Dolphin oil is used in combination with charcoal, entrails of goat/cattle/fish/chicken and their fat, and is sometimes also mixed with dung of cattle/buffalo (Bairagi, 1999;

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Mohan and Kunhi, 1996; Motwani and Srivastava, 1961; Sinha, 2002; Wakid, 2009). Around 50 dolphins per annum were estimated to be used for dolphin oil extraction just between Patna to Rajmahal (~460 km) on the river Ganga (Mohan and Kunhi, 1996), and in Brahmaputra, 100 boats were involved per annum in fishing using dolphin oil between Dhubri to Goalpara (~80 km) (Bairagi, 1999). Dolphin blubber is 30–40% of its total body weight and one dolphin on an average yields about 25 L of oil (Bairagi, 1999; Tsuyuki and Itoh, 1972). It is reported 1–1.5 L of dolphin oil is being used on an average, per boat. While fisherfolk are aware of the conservation status and precarious population size of species, they still engage in capture and killing of river dolphins, which continues unhindered due to the difficulty in implementation and enforcement of law. It is needless to reiterate that the extent of mortality is quite high, despite the protected status of the species.

Considering the prevelance of this practise an alternative to dolphin oil was proposed to reduce the poaching of dolphins for bait oil, in the form of shark oil, sardine oil, and fish oil (Mohan and Kunhi, 1996; Sinha, 2002). These alternative oils have not been able to completely replace the use of dolphin oil by fishermen. Another aspect of using bait oil is the species they target. Whether it is dolphin oil or alternate oils, they target native cat fish species, *C. garua* and *E. vacha,* whose population continues to decline at a rapid rate (Gupta and Banerjee, 2016; Patra et al., 2005). Use or sale of dolphin oil is illegal, however the oil is marketed under the guise of fish or livestock fat, or other alternate oils. In order to understand if dolphin oils are still being used, it is important to develop a technique to monitor and accurately identify whether the oil used by fishermen is derived from dolphins. This study is aimed at understanding whether bait oils used by fishermen continue to use dolphin fat, and in developing a molecular assay to detect the presence of dolphin DNA in oil. We couple this investigation by information on social survey to understand the prevalence of use of dolphin oil in bait fisheries.

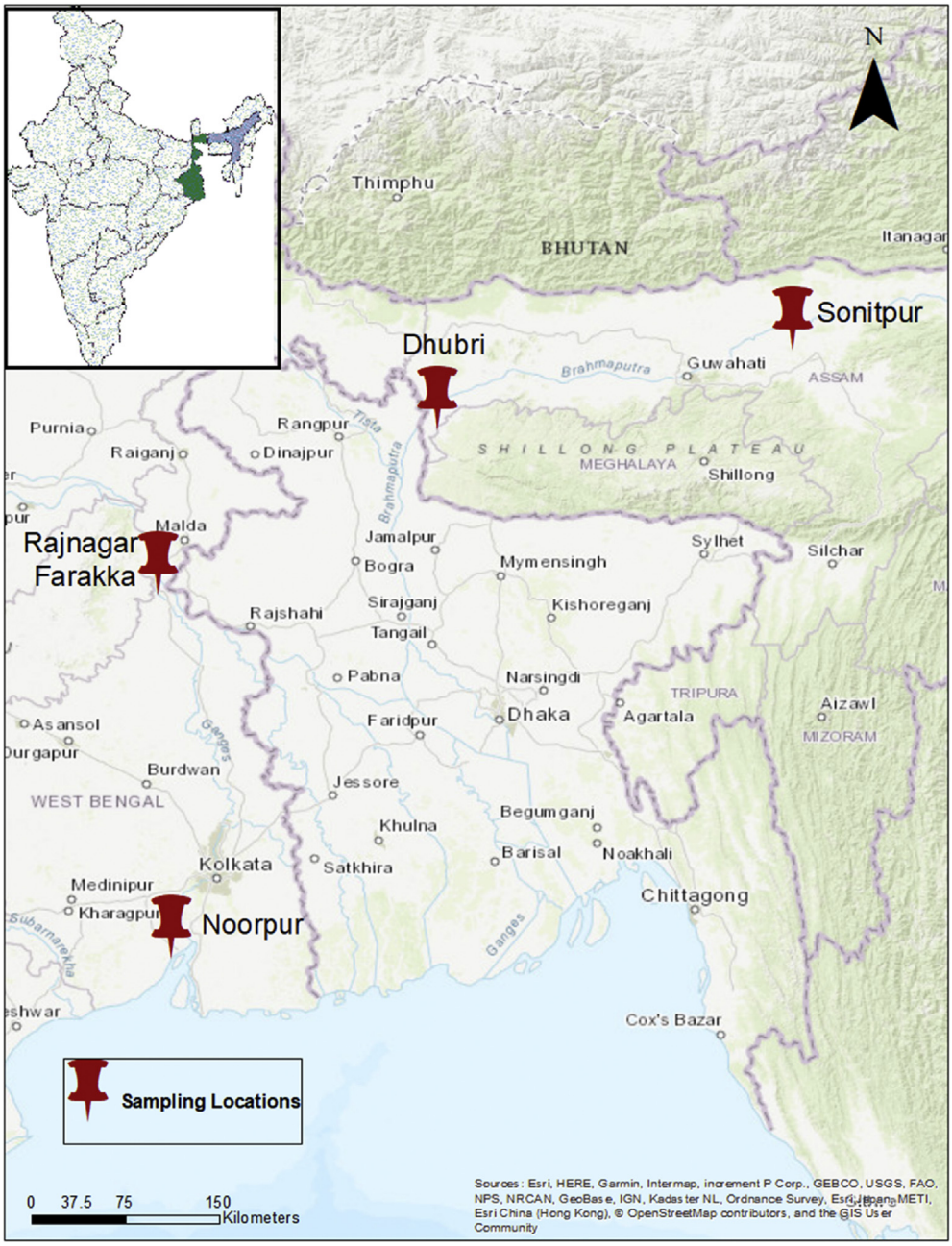

Figure 1. Sampling locations of bait oil samples collected for this study.

2. Methods

2.1. Collection of bait oil and it's molecular characterisation

Using dolphin oil for bait is illegal, and this renders the local community apprehensive in sharing of bait oils or information regarding its use with outsiders. Despite these challenges, a total of four dolphin oil samples were collected from the fishing villages of Assam and West Bengal during the social surveys (Figure 1). Social surveys were conducted to understand the socio-economic conditions of fishermen and cater to the objectives of the larger Dolphin Recovery and Conservation program, only pertinent results are discussed here.

In Assam, two samples were collected from Bin community fishermen of Dhubri and Sonitpur, who practice traditional oil bait fishing. These samples were obtained from the members of Dolphin Conservation Network, which consists of local community members. In West Bengal, samples were obtained from two different locations, one from Rajnagar, Farakka in Malda District and one from Noorpur, South 24 Parganas district. Collected samples were stored in 20–50 ml vials, weighing approximately between 15-40ml, and posted to the institute laboratory for further analysis. These samples were weighed in the laboratory, and 10ml separated out for further analysis.

2.1.1. DNA extraction

A modified protocol of that described by Consolandi et al. (2008) was used for extraction of DNA. As a pre-treatment, oil samples were vigorously mixed for 5 min, and 1ml was pipetted into a tube. 500 μl PBS was added to each sample, and kept on a shaker for 1 day. Samples were centrifuged at 14,000rpm for 30 min and the supernatant was discarded. PBS was again added to these tubes, and the samples were kept on the shaker for another day. Samples were then centrifuged at 14,000rpm for 30 min. Without discarding the supernatant, 500 μl of Hexane was added to the centrifuged tube, shaken vigorously for 5 min, and kept on shaker for a day. The samples were then centrifuged for 15 min at 14,000rpm, resulting in a supernatant and a pellet. The oily supernatant and pellet was then transferred to two different 2ml tubes. From here on, the protocol described by Consolandi et al. (2008) was followed till the final step of elution. For the final step, the pellet and supernatant were both transferred to silica columns provided in the Qiagen kit, and elution of DNA was performed with AE buffer (Qiagen DNeasy Blood and tissue kit). The sample extractions and further downstream processes were done in replicates of 3.

2.1.2. DNA amplification

For species identification, universal primers described by Verma and Singh (2003), were used to target the variable cytochrome b region of mitochondrial DNA. PCR reactions were set up using a 16µl reaction volume containing 5µl of 2X MasterMix with HotStart Taq Polymerase (Qiagen), 3µl of 2 mg/ml Bovine serum Albumin (BSA), 0.3µm unlabelled forward and 0.3µm of unlabelled reverse primer, 2µl of Coral Dye (Qiagen) and 5µl of extracted DNA were carried out in Eppendorf thermocycler. PCR conditions were: initial denaturation (95 °C for 15 min), 45 cycles of denaturation (94 °C for 45 s), annealing (54.3 °C for 30 s) and extension (72 °C for 1 min 30s) and a final extension (60 °C for 10 min). DNA extraction and PCR were both performed with appropriate negative controls. PCR products were first checked through gel electrophoresis, for a product at ~450bp. The products where then sequenced using ABI 3500XL capillary sequencing machine. The resulting sequences were checked for quality using Chromas (McCarthy, 1996). The sequences were assigned species using NCBI blast (Altschul et al., 1990).

2.2. Social surveys

As explained above, social surveys were conducted at different districts of Assam and West Bengal in the context of understanding issues related to dolphin conservation as part of the Dolphin Recovery and Conservation program. In this context, the participants were also asked regarding the use of dolphin fat in bait oil by fishermen and perception about dolphin conservation. In this particular article, we will focus only on the results pertaining to the aforementioned aspects of the larger social survey.

A semi-structured questionnaire was designed for this study, including three broad sections, first asking for demographic details, second for enquiring about the fishing practices and the third intended to capture behavioural data in form of three-point rating scale (Jacoby and Matell, 1971) (For further information, please refer to Supplementary.docx). Since the study was designed specifically for fisherfolks, non-probability sampling was executed (Marshall, 1996). Participants were included in the study through snowball sampling technique (Morgan, 2008). Before starting field work, local administration was informed about the study and research team. Only river-based fishers were approached for the study; after acquiring verbal consent of the participants, further interviews were conducted. Semi-structured open-ended approach was used for conducting interviews. All questionnaires were verbally translated to the local dialect with the help of team members and responses were noted on individual data sheets. Team members maintained their field notes for further reference and no digital audio recordings were made due to ethical constraints. Questionnaires were in English and the interviews were in Assamese and Bengali. Since the interviewers were not native, assistants well versed in local dialect were engaged as Assamese-English and Bengali-English translators. A total of 364 in depth interviews were conducted during 2016–18. Out of the interviews conducted, 82 participants were exclusively engaged in oil bait fishing. After completing the field-based interviews, all data was compiled for analysis in tabular forms. Descriptive analysis was conducted using Microsoft excel and open-ended data was coded using semantic clustering (Braun and Clarke, 2006).

The study was carried out with appropriate permissions and clearance issued by Ministry of Environment, Forests and Climate change, Government of India, as well as State Forest Departments.

3. Results

3.1. Molecular characterisation of fish bait oil

The PCR product run through gel electrophoresis, yielded a positive amplification in three of the four oil samples at 450 bp, in all three replicates. The extraction and PCR negative controls did not show any positive amplification, ruling out the possibility of contamination. Two sequences showed 100% identity with *Platanista gangetica gangetica* sequences on the NCBI database, while the remaining sample was identified to be that of a domestic goat. The sequences were deposited in Genbank with accession numbers (MK492249 and MK492250).

3.2. Social survey

All of the interviewees were related to fishing profession (N = 364). Majority were males (96.15%) as women opting for river fishing was rare in the study sites. Average age of the fishermen was 42.7 years and their experience in fishing was 22.07 years. As fishing is a caste-based trade in India, majority of the responding fishermen were from Bin community, (89.3%). 63.5% of the respondents were illiterate, rest had basic school education. Only 4.4% of respondents had annual household income above 2 Lakhs INR (2810 USD), 12.6% had income between 1-2 Lakhs

INR (1405–2810 USD). Of all the respondents, around 83% had less than 1 Lakh INR (USD1406) annual household income with an average family size of 5 individuals. Along with fishing, respondents were involved in other trades like agriculture, rickshaw driver, daily labour, cattle farming and small-scale businesses.

86% of the respondents encountered or have had a personal experience relating to dolphin in their lifetime (Figure 2). In our surveys, it was evident that many fishermen were aware that using river dolphin oil was illegal (64.6%), but were actively involved in bait oil fishery using dolphin oil. Additionally, of the fishermen who had experienced entanglement of dolphin in fishing nets, 57.8% admitted to selling the carcass for oil (Figure 3). When asked about the effectiveness of the alternate oils for bait, 61.9% of the respondents had responded as saying they have used these alternatives for fishing but still consider river dolphin oil as a better bait for catching cat fish.

An overwhelming 91% percent of the oil bait fishermen (of the 64.6% involved in bait fishing) responded that they are willing to leave this occupation if better alternatives are available. Overall fishing was perceived as a trade with uncertain income and high risk, and many of the responded expressed desire for shifting to alternative trade.

4. Discussion

Habitat degradation, with increasing human disturbance are severe threats that have long-term and long lasting impacts. For the Ganges river dolphin, whose range wide population trend is not well known, immediate threats like illegal hunting, and death due to net entanglements are equally severe and can lead to population crashes and extinctions, if not monitored and curtailed. In the recent past, Baiji river dolphin was driven to extinction due to human induced effects (Turvey et al., 2007). When the use of animal body parts are ingrained in culture for either traditional medicinal purposes, or for livelihood, it becomes far more difficult to restrict or put an end to such activities. Such use, we know, has led to the extinction and endangerment of several species of flora and fauna (Yi-Ming et al., 2000). In the current study we demonstrate the successful identification of dolphin DNA from oil, and also detail a method for extraction and identification, for further monitoring purpose. Out of the four samples examined, three samples positively contained dolphin DNA, while one other sample indicated the presence of goat DNA. Most protocols for extraction of DNA from oil has largely been for verification of food material presence, for example in testing contaminants of food sources (Consolandi et al., 2008). Herein, we present an alternative use for the same approach, where it can contribute to the conservation of an endangered species. We also show through social survey results, how the use of dolphin fat for bait oil use is prevelant despite the presence of alternatives.

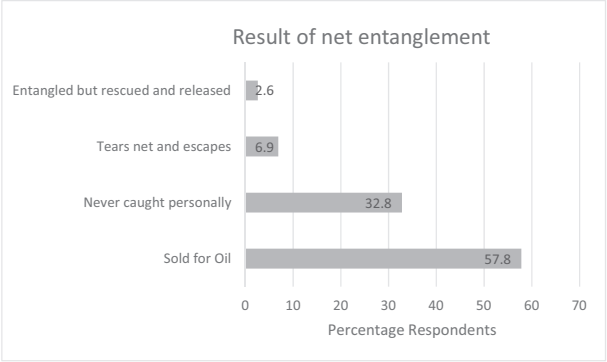

Figure 3. Social survey results indicating fishermens response to their actions when a dolphin gets entangled in their nets.

Wakid (2015) reports an estimate of 35–45 dolphin carcasses are necessary to meet the requirement of dolphin oil bait fishing in Brahmaputra alone, where currently only ~900 Dolphins (Qureshi et al., 2017) are estimated to be surviving. To save dolphin populations, alternate oil bait was proposed (Mohan and Kunhi, 1996; Sinha, 2002; Wakid, 2009). The results of our molecular analysis and social survey show clearly that the use of dolphin oil has not ebbed, and continues to be the most popular lure for oil bait fishing amongst the fisherfolk. Almost half of the fishermen involved in oil bait fishing believe that dolphin oil is better than the alternates proposed. We presume that far more people agree with this view, and this is just a conservative estimate, as using dolphin oil is punishable by law in India and as fishermen are aware of the implications, few tend to publicly state their honest opinion.

While the use of alternative oil to dolphin oil is a proximal solution to curtailing the hunting of dolphins, one needs to also explore the implications of promoting alternate bait oils. Alternative bait oils definitely seek to combat the immediate threat of targeted dolphin killing, however, long term implications of this solution threaten to endanger two other species, *E. vacha* and *C. garua,* the native catfishes targeted by bait oils. This situation is similar to the Amazonian river dolphin oil being used to hunt Capaz (*Pimelodus grosskopfii*) in Brazil. As the use of this oil was very popular, over time, not only did the population of Capaz decline severely to "Critically Endangered", the Amazonian river dolphin population also declined rapidly. As the Capaz fish was rare, using the same dolphin oil, another fish, the Piracatinga (*Calophysus macropterus*), started to get hunted in the place of the Capaz. With the demand of particular fish species like Piracatinga, river dolphins in the amazon were hunted with increased frequency, leading to their population reduction in several parts of Brazil (Williams et al., 2016). The only respite for either

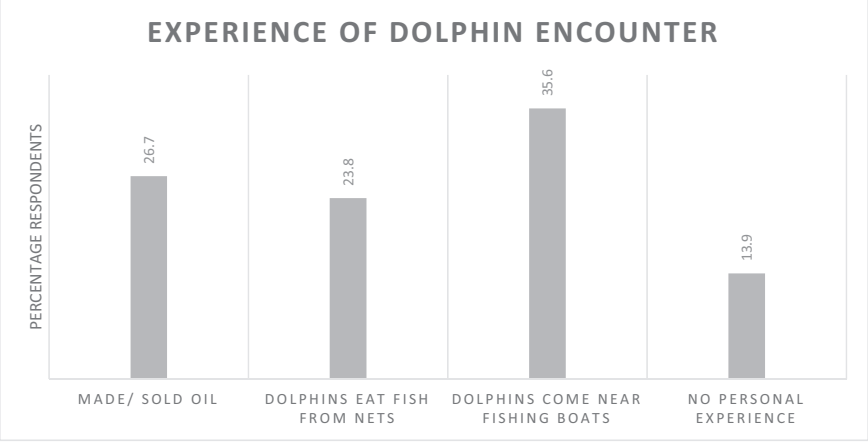

Figure 2. Social survey results depicting personal encounters or experience of fishermen with dolphins.

populations arrived with the complete ban of fishing for Piracatinga. However, Williams et al. (2016) report that due to the economic demands, hunting continues, and the dolphin populations are declining rapidly. In India, too *E. vacha* and *C. garua*, cat fish species are hunted using dolphin oil across Brahmaputra and Ganges river systems (Qureshi et al., 2017). Vacha and Garua species are extremely profitable, with an average return of >300₹ per kg. Both the species of cat fish being hunted are on decline (Gupta and Banerjee, 2016; Patra et al., 2005). The unintended consequences of the alternate bait oils is the over harvesting of particular fish species. While dolphin oil might be costly (~825₹ per litre –(Qureshi et al., 2017)) to procure, or increased enforcement might halt the use of dolphin oil for bait, alternate oil from fat of other animals is being used to target the same species. Therefore, this alternate bait oil cannot address the concern of overfishing of native cat fishes.

The existing laws in India provide adequate legal mechanism to prosecute offenders, but its implementation in riverine systems is challenging (Korhonen, 1996). Owing to the dynamic nature and vast spread of riverine systems, and lack of mechanism and manpower to coordinate multi-agency monitoring, the task of enforcing any protection action is arduous. Another dimension to this challenging task is the involvement of economically backward societies which are dependent for their livelihood on fishing. Bait fisheries is a skill that is practised largely by *Bin* community, and given that 90% of fishermen are willing to leave bait fisheries, a targeted weaning off of this practise is possible. Providing skill development in a targeted manner, with strong legal discouragement of bait fisheries, encouragement of hatcheries and pisciculture for consumers and restocking, along with campaign for sensitising fishermen on the perils of targeted fishing of catfish in the long run could be possible solutions to curtail this practise.

Until a way forward is determined to address this problem of bait fishing, enforcement agencies can periodically monitor lures for the presence of dolphin DNA using the protocol developed here. This can act as an index of continued threat to the survival of dolphin population, and can provide insights on areas to monitor for illegal use of dolphin oil.

Declarations

Author contribution statement

Vishnupriya Kolipakam: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Shweta Singh, Shovana Ray: Performed the experiments; Analyzed and interpreted the data.

Leela Prasad, Kanad Roy: Performed the experiments.

Abdul Wakid: Conceived and designed the experiments, Performed the experiments.

Qamar Qureshi: Conceived and designed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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Competing interest statement

The authors declare no conflict of interest.

Additional information

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References

Altschul, S.F., Gish, W., Miller, W., Myers, E.W., Lipman, D.J., 1990. Basic local alignment search tool. J. Mol. Biol. 215, 403–410.
Bairagi, S., 1999. Oil bait fishery of catfishes in Brahmaputra River affecting river dolphin populations in Assam. India J. Bombay Natur. History Soc. 96, 424–426.
Braun, V., Clarke, V., 2006. Using Thematic Analysis in Psychology Qualitative Research in Psychology, 3, pp. 77–101.
Choudhary, S.K., Smith, B.D., Dey, S., Dey, S., Prakash, S., 2006. Conservation and Biomonitoring in the Vikramshila Gangetic Dolphin Sanctuary, 40, pp. 189–197. Bihar, India Oryx.
Consolandi, C., et al., 2008. A procedure for olive oil traceability and authenticity: DNA extraction, multiplex PCR and LDR–universal array analysis. Eur. Food Res. Tech. 227, 1429–1438.
Faruqui, A., Sahai, R., 1943. On the methods of catching fish in United Provinces and scope of establishing inland fisheries in these provinces. Proc. Natl. Acad. Sci. India 13.
Gupta, S., Banerjee, S., 2016. Eutropiichthys vacha (Hamilton, 1822), a threatened fish of Indian subcontinent. J. Fish. 4, 397–400.
Jacoby, Jacob, Matell, Michael S, 1971. Three-point Likert scales are good enough. J. Market. Res. 8 (4), 495–500.
Job, T.J., Pantulu, V.R., 1953. Fish trapping in India. J. Asiatic Soc. 19, 175–196. Bengal.
Jones, S., 1982. The present status of the gangetic susu, Platanista gangetica (Roxburgh), with comments on the Indus susu. Minor FAO Fish. Series 5, 97–115.
Korhonen, I.M., 1996. Riverine ecosystems in international law. Nat. Resour. J. 36, 481.
Marshall, M.N, 1996. Sampling for qualitative research. Fam. Pract. 13 (6), 522–525.
Mazumder, Muhammed Khairujjaman, Freeman, Boro, Badruzzaman, Barbhuiya, Utsab, Singha, 2014. A study of the winter congregation sites of the Gangetic River Dolphin in southern Assam, India, with reference to conservation. Glob. Ecol. Conserv. (2), 359–366.
McCarthy, C., 1996. Chromas Version 1.45 School of Health Science. Griffifth University, Gold Coast Campus, Queensland, Australia.
Mintzer, V.J., Diniz, K., Frazer, T.K., 2018. The use of aquatic mammals for bait in global fisheries. Front. Mar. Sci. 5, 191.
Mohan, L.R.S., Kunhi, M.K.V., 1996. Fish oils as alternative to river dolphin, Platanista gangetica (Lebeck) oil for fishing catfish Clupisoma garua in the river Ganges, India. J. Bombay Nat. Hist. Soc. 93, 86–88.
Morgan, D.L., 2008. Snowball Sampling. The SAGE Encyclopaedia of Qualitative Research Methods. SAGE Publications Inc., Thousand Oaks, pp. 816–817, 9781412941631.
Motwani, M., Srivastava, C., 1961. A special method of fishing for Clupisoma garua (Hamilton) in the Ganges River system. J. Bombay Nat. Hist. Soc. 58, 285–286.
Patra, M.K., Acharjee, S.K., Chakraborty, S.K., 2005. Conservation categories of siluroid fishes in North-East Sundarbans. India Biodivers. Conserv. 14, 1863–1876.
Pelletier, C., Pelletier, F., 1980. Rapport sur l'expedition delphinasia (Septembre 1977–Septembre 1978). In: Annales de la Société des sciences naturelles de la Charente-Maritime, pp. 647–679.
Qureshi, Q., Hussain, S.A., Kolipakam, V., Wakid, A., Raza, H.R., Ray, S., 2017. Campa Dolphin Project: Development of Conservation Action Plan for Ganges River Dolphin. Wildlife Institute of India, Dehradun.
Sinha, R.K., 1997. Status and conservation of Ganges River dolphin in Bhagirathi-Hooghly River systems in India. Int. J. Ecol. Environ. Sci. 23 (4), 343–355.
Sinha, R.K., 2002. An alternative to dolphin oil as a fish attractant in the Ganges River system: conservation of the Ganges River dolphin. Biol. Conserv. 107, 253–257.
Sinha, R.K., Kannan, K., 2014. Ganges River dolphin: an overview of biology, ecology, and conservation status in India Ambio, 43, pp. 1029–1046.
Sinha, R.K., Sharma, Gopal, 2003. Current status of the Ganges river dolphin, *Platanista gangetica* in the rivers Kosi and Son. J. Bombay Nat. Hist. Soc. 100 (1), 27–37.
Tsuyuki, H., Itoh, S., 1972. Fatty acid component of various blubber oil of Ganges river dolphin. Sci. Rep. Whale Res. Inst. 24, 117–125.
Turvey, S.T., et al., 2007. First human-caused extinction of a cetacean species? Biol. Lett. 3, 537–540.
Verma, S., Singh, L., 2003. Novel universal primers establish identity of an enormous number of animal species for forensic application. Mol. Ecol. Notes 3, 28–31.
Wakid, A., 2009. Status and Distribution of the Endangered Gangetic Dolphin (Platanista Gangetica Gangetica) in the Brahmaputra River within India in 2005 Current Science, pp. 1143–1151.
Wakid, A., 2015. Promoting Fish Oil as Alternate of Dolphin Oil Amon the Bin Community Fishermen. Aaranyak, Guwahati, Assam.
Williams, R., Moore, J.E., Gomez-Salazar, C., Trujillo, F., Burt, L., 2016. Searching for trends in river dolphin abundance: designing surveys for looming threats, and evidence for opposing trends of two species in the colombian amazon. Biol. Conserv. 195, 136–145.
Yi-Ming, L., Zenxiang, G., Xinhai, L., Sung, W., Niemelä, J., 2000. Illegal Wildlife Trade in the Himalayan Region of China Biodiversity & Conservation, 9, pp. 901–918.