Introduction

The freshwater turtles of India inhabit a wide range of aquatic habitats, and due to their diverse life-history traits and role as transformers of biomass, they are often considered keystone species of aquatic ecosystems (Moll et al., 2004; Souza and Abe, 2000; Ernst et al., 1994). Scavenging freshwater turtles, particularly soft-shell turtles of the genus Nilssonia are known to exist in highly polluted stretches of Varanasi, Uttar Pradesh and are regarded as water purifiers having profound importance in cleaning rivers from sources of human pollution (Sinha, 1995). The River Ganga is currently in a precarious state as one of the five most polluted rivers in the world (Vaseem and Banerjee, 2016). Among growing concerns are partially cremated human corpses on the ‘ghats’ of the river and untreated sewage from open drains. Thus the ability of these turtles to thrive in polluted rivers and the overall far reaching benefits of turtles as scavengers must be valued and not overlooked (Lovich et al., 2018). The River Ganga is also known for its major flooding events that happen once every few years. The frequency and magnitude of such flooding events are of immense significance as they cause the water from the main river to flow across the floodplains, temporarily connecting small wetlands to the river (Junk et al., 1989). This connectivity can result in an influx of freshwater turtles from the river to smaller seasonal waterbodies. The drying and seasonality of the wetlands acts as a primary driver of biological connectivity for aquatic turtles between the river and wetlands (Smith et al., 2018). However, habitat fragmentation and alteration of lands in the floodplains can impact movements of species between perennial and seasonal waterbodies leading to isolation of turtle populations (Joyal et al., 2001).

The Ganges soft-shell Nilssonia gangetica (Cuvier, 1825) is a large turtle that grows 70 - 90cm in length. It has strong webbing developed on its fore and hind limbs and is generally associated with lotic rivers and streams, with occurrences in the main stems of the Indus, Ganga, Brahmaputra, Mahanadi, Kosi and other rivers across upper Peninsular India (Das, 1995). However, there are anecdotal records of the species being encountered in stagnant lakes and ponds near flowing streams which are either dispersing or isolated populations. They are also strongly associated with the Temple Pond culture and religious beliefs which consider turtles the holy ‘kurma’ reincarnation of the Hindu God ‘Vishnu’.

‘Community ponds: a tool for conservation’. A case study of Nilssonia gangetica (Cuvier, 1825) in Kashipur village, Uttar Pradesh, India

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Abstract. Ganges Softshell turtle (Nilssonia gangetica), a species listed as Vulnerable (IUCN Red List, A1d+2d, Ver 2.3), is generally associated with the major river systems of northern India. However, anecdotal records indicate this species has strong associations with community and temple ponds. Connectivity between rivers and these ponds play an important role in the exchange of individuals between wetlands thus maintaining viable healthy populations of the species in the landscape. This article details a survey of a pond (area 3381 m²) in Kashipur village, Uttar Pradesh, India, to investigate the current status of a large population of Nilssonia gangetica. The ponds were found to be extremely polluted with solid and liquid garbage and under several landscape level pressures impeding connectivity which threatens the survival and fitness of this population. We also review the implications of such community and temple ponds and their future in conserving these threatened turtles.

Keywords. Freshwater turtles, Ganges River, seasonal wetlands, temple ponds, biological connectivity

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These century old customs have been archived dating back to reports by Annandale and Shastri (1914) who commented on the sacredness of the Ganges softshell turtle, *Nilssonia gangetica* in various shrines across the country. Devotees are known to keep and feed turtles in Temple ponds which have now become a safe house for many extant freshwater turtle species with reports from many states, compiled in this study (Table 1).

This article details a survey investigating the current status of large turtle populations of two species (*Nilssonia gangetica* and the Peacock Softshell Turtle *Nilssonia hurum*) reported in the Kashipur village ponds near the middle stretch of river Ganga in Uttar Pradesh. There were repeated concerns from the members of Environment Stewardship Programme (ESP) of Nuclear Power Corporation of India Limited (NPCIL) Narora, Uttar Pradesh, that the two ponds were reaching its carrying capacity after observing the growing numbers of turtles over the years. We also review the implications of such Temple and community ponds, and their future in conserving these threatened turtles.

### Table 1. A compiled list of Temple ponds in Bangladesh and India from published literature sources available, and the list of species present in the ponds.

<table>
<thead>
<tr>
<th>Location</th>
<th>List of Species recorded</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bangladesh-</strong></td>
<td></td>
<td></td>
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<tr>
<td>Bostami Pond, Chittagong district</td>
<td><em>N.N</em></td>
<td>Annandale &amp; Shastri, 1914; Praschag et al., 2007; Deb, 2008</td>
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<tr>
<td><strong>West Bengal, India-</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baneshwar temple pond, Cooch behar district</td>
<td><em>C.I, L.P</em></td>
<td>Deb, 2008</td>
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<tr>
<td><strong>Assam, India-</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kamakhya Temple Pond (Guwahati);</td>
<td><em>G.H, N.G, N.H, N.N, P.S, P.Syl, P.T, P.Tec</em></td>
<td></td>
</tr>
<tr>
<td>Deopani Temple Pond (Diphu);</td>
<td><em>N.N, P.T, P.Tec</em></td>
<td></td>
</tr>
<tr>
<td>Gorokhiya Gohainr Than, (Sorbhog);</td>
<td><em>C.I, G.H, N.G, N.N, P.Syl, P.T, P.Tec</em></td>
<td></td>
</tr>
<tr>
<td>Barokhelia Temple Pond, (Golagh);</td>
<td><em>N.N, Pangshura sp.</em></td>
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<tr>
<td>Nagshankar Temple Pond, (Tezpur);</td>
<td><em>C.I, N.G, N.H, N.N, P.S, P.Syl, P.T, P.Pec</em></td>
<td></td>
</tr>
<tr>
<td>Ugratara Temple Pond, (Guwahati);</td>
<td><em>G.H, N.H, N.N, P.Syl, P.T, P.Tec</em></td>
<td></td>
</tr>
<tr>
<td>Atkhelia Temple Pond, (Golagh);</td>
<td><em>N.N, P.T, P.Tec</em></td>
<td></td>
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<tr>
<td>Mandir Devalaya, (Golagh);</td>
<td><em>N.N</em></td>
<td></td>
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<tr>
<td>Kedar Temple, (Hajo);</td>
<td><em>N.N, P.Syl, P.T, P.Tec</em></td>
<td></td>
</tr>
<tr>
<td>Dhareshwari Devalaya,( Silguri);</td>
<td><em>N.G, N.N, P.Syl, P.T, P.Tec</em></td>
<td></td>
</tr>
<tr>
<td>Srimanta Shankardev Namghar, (Golagh)</td>
<td><em>N.G, P.T, P.Tec</em></td>
<td></td>
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<tr>
<td><strong>Orissa, India-</strong></td>
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<td></td>
</tr>
<tr>
<td>Vishnu temple pond, Puri;</td>
<td><em>N.G</em></td>
<td>Annandale &amp; Shastri, 1914; Sethy, Samantasinghar and Pramanik, 2015</td>
</tr>
<tr>
<td>Temple pond of Paralakhemundi and gajapati districts</td>
<td><em>G.E, M.T</em></td>
<td></td>
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<tr>
<td><strong>Gujarat, India-</strong></td>
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<tr>
<td>Gomti Temple Pond</td>
<td><em>L.P</em></td>
<td>Soni and Thomas, 2013</td>
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<tr>
<td><strong>Andhra Pradesh</strong></td>
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<tr>
<td>Kotapalli village temple pond</td>
<td><em>N.L</em></td>
<td>Das et al., 2014</td>
</tr>
</tbody>
</table>

Study Area and Methods

Kashipur village (GPS 28.1518° N, 78.5097° E) is located in Budaun district, Uttar Pradesh and lies approximately 5.25 km away from the Ganges river on the left bank of the floodplains. The two village ponds are in the centre of settlements with about 50 houses situated at the periphery of the two ponds (Fig. 1.).

The turtles were said to have established themselves after a major flooding event that occurred in 1998. After the flooding event, the pond has been divided into two by the District Administration, separating them by a narrow cement road with a culvert below, connecting them (Fig. 2.). The combined area of the two ponds is 3381 m² and the distance of the pond from the main stem of the Ganga River is 5.25 km. Unlike ephemeral ponds, the ponds are monsoon dependent and are prone to low water levels in the summer seasons. Major flash flooding events replenish the ponds and the last flooding event occurred in 2011 when a few turtles are said to have dispersed out of the ponds.

The two ponds were surveyed on multiple visits in January 2017 and in January 2018. We walked along the boundary to look for turtles, turtle tracks and nesting signs. The ponds were scanned using binoculars for basking turtles. The water level and overall quality of the ponds was visually assessed to note if it was adequate for the turtles and if the nesting habitat was suitable. Turtles were not captured or physically assessed due to the sentiments of the local people.

Results

On the first preliminary survey in January 2017, approximately 40 turtles were observed in the pond which were identified as *Nilssonia gangetica*. On the subsequent visits in January 2018, a total of eight *N. gangetica* turtles were observed surfacing and two large adult turtles were observed basking on straw piles. Turtle sightings varied and were opportunistic due to lack of
basking areas, poor water quality, and their hibernation behaviour during winter months. Interactions with local people revealed observations of approximately 100 turtles subsisting in the ponds.

The ponds were extremely polluted. Solid garbage and liquid sewage flow through open drains from the households on the periphery of the pond. Villagers were observed offering cooked food or rice cereal to the turtles (Fig. 3.), and the turtles seemed familiar with the villagers, similar to behaviour seen at Temple ponds. The turtles bask on large straw piles on the periphery of the pond and use these piles as nesting substrates, and also occasionally nest in adjoining fields. There is no monitoring or protection of these nests from predators, and hatchlings encountered by local villagers are released back into the pond.

**Discussion**

Freshwater turtles inhabiting seasonal wetlands require connectivity through the landscape to adjacent aquatic ecosystems for foraging and breeding needs to ensure viable populations are maintained (Smith et al., 2018). These exchanges across various gene pools improve the survival and reproductive fitness by sustaining genetic variation within and among populations (Castellano et al., 2009). Human activities that modify the floodplains with settlements and agricultural fields, decrease biological connectivity significantly (Ficetola et al., 2004) making the transfer of individuals between wetlands a possibility only in the events of large-scale flash floods as is the case in the present study site. The isolation of the Kashipur pond from the main stem of the river Ganga is exacerbated due to water abstraction by the Narora barrage upstream and anthropogenic modifications of associated floodplains, which alters the propensity of annual flooding events. The turtles have limited dispersal abilities due to barriers such as the road and settlements surrounding a significant portion of the pond. This loss of connectivity can ultimately lead to reduced fitness of turtles due to inbreeding and risk of diseases from the pollution in the Kashipur ponds. Moreover the turtles of the Kashipur pond now exhibit temple pond behaviour wherein the turtles have assumed a similar semi-domesticated state. Currently, nesting sites are not protected and potential predators such as domesticated dogs, Golden Jackals (*Canis aureus*) and Monitor lizards (*Varanus bengalensis*) are abundant, which are predominant predators of *N. gangetica* eggs (Vasudevan, 1998). Once the ecological needs of many large bodied *N. gangetica* far exceeds the
current available habitat, the pond reaches its carrying capacity. The threats to this site need to be mitigated to transform it into a community pond which can serve as an assurance colony for *N. gangetica* which is listed as a Vulnerable species by IUCN (Asian turtle trade working group, 2000).

Similar to the concept of Sacred Groves in India, which are owned by village Panchayats and managed by all villagers (Deb, 2008), an inter-departmental combined approach is recommended for the overall improvement and upgradation of the Kashipur Turtle Pond and similar community ponds elsewhere. The local stakeholders can be empowered to take on the responsibility for the upkeep of the pond, ensure proper sewage disposal systems, and prevent further pollution. Setting up of basking areas increases the basking potential of the species, and sighting of these large turtles during basking hours can serve as an educative tool for visitors and generate positive interest in conservation of such community ponds. The nesting areas at the periphery of the pond can be increased and modified into small sandy tracts with sparse vegetation and the hatching success rates can be substantially improved with predator-proof fencing. Once turtles are observed to be nesting, the nests can be monitored and translocated to augment the population in the river Ganga. This will also reduce the pressures on the existing large populations in the ponds, prevent inbreeding and maintain genetic variation within and among populations.

However it should be noted that translocations and head-starting are not long-term solutions to the threats of habitat degradation, fragmentation and overall species population declines (Buhlmann, 1995). While ex-situ conservation of turtles in community ponds and temple ponds are a useful mechanism for conservation, a holistic management of the floodplain landscape and maintenance of biological connectivity is imperative.

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