Section 1

GENERAL BIOLOGY
Two species belonging to genus *Kachuga* have been studied from four different locations (1. Poiya Ghat, 2. Sikandarpur, 3. Yamuna pump and 4. Balkeshwar) along the river Yamuna, near Agra (Fig. 1). These species are: *Kachuga tentoria circumdata* (Mertens) and *Kachuga dhongoka* (Gray).

*Kachuga* is the most diverse genus of the Asiatic batagurines (Moll, 1986). *K. tentoria* is smaller, with carapace length (CL) < 30 cm, while *K. dhongoka* is the larger (CL > 40 cm) of the two species. Sexual dimorphism in size characterizes both species.

Turtles suffer from the effects of pollution, deforestation, illegal capture and habitat destruction. The drastic reduction in their number due to the above stated reasons has led to their being listed now under the Wildlife Protection Act, 1972. Various amendments till 1991 have included 15 species of tortoises and freshwater turtles in the schedules providing legal protection. The 1981 IUCN Red List of threatened animals also includes 10 Indian species. With the exception of the widely distributed Indian flapshell turtle *Lissemys punctata*, no freshwater turtle or land tortoise in India can be termed as abundant.
Both the species under study are exploited for food in India, chiefly in the states of Arunachal Pradesh, Assam, Bihar and Uttar Pradesh. *K. dhongoka* is commercially exploited for food in Bihar. At present, seven captive breeding centres have *K. tentoria circumdata*, out of which two centres have bred this species in captivity. Four captive breeding centres have *K. dhongoka* (Choudhury and Bhupathy, 1993). Being poikilotherms with a high fecundity and ability to convert a high percentage of food consumed into body biomass, these semi-aquatic turtles can be utilized on a sustainable basis like fish resource instead of being mined (Choudhury and Bhupathy, 1993).

This chapter comprises of general observations on the biology of these *Kachuga* species. We have included informations available on the two target species along with our own field observations in order to present a comprehensive account which preludes necessarily for all detailed studies to follow. The identification keys and systematic positions have been based on available literature dated 1986, as no update or revision has been made. We have considered it as our baseline for turtle research. Habitat status, food and feeding habits and distribution of both the species have also been studied.
**Table 1:** COMMON NAMES FOR THE SPECIES UNDER STUDY

<table>
<thead>
<tr>
<th>GENUS</th>
<th>SPECIES</th>
<th>Common name in Hindi</th>
<th>Common name in English</th>
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</thead>
<tbody>
<tr>
<td>Kachuga</td>
<td>tentoria</td>
<td>Pacheda</td>
<td>Pink-ringed Tent Turtle</td>
</tr>
<tr>
<td></td>
<td>circumdata</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kachuga</td>
<td>dhongoka</td>
<td>Dhond</td>
<td>Three-striped Roofed Turtle</td>
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<tr>
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<td></td>
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</tr>
</tbody>
</table>
Fig 1  Map of the river Yamuna in Agra showing sampling localities.
Plate 1: The turtle, *Kachuga tentoria circumdata*

Plate 2: The turtle, *Kachuga dhongoka*
1.1 IDENTIFICATION KEY (After Moll, 1986)

For the Indian species of *Kacnuga* (ADULTS)

- Apex of shell at second vertebral; fourth vertebral contacts third broadly, upper mandible bicuspid with median notch.

- Second vertebral pointed posteriorly, shell usually unpatterned with three stripes, a distinct dark mid-dorsal stripe flanked by less distinct broken or continuous lateral stripes.

  *(Kacnuga dhongoka)*

- Apex of shell at third vertebral, fourth vertebral attenuated anteriorly, narrowly contacting third. Upper mandible not bicuspid, lacks median notch.

- Head pattern lacks broad crescentic band, one or two reddish to brownish postocular spots often present; plastron with a single, large dark blotch per scute or unmarked.

  *(Kacnuga tentoria)*
1.1.1 Kachuga tentoria circumdata (Mertens, 1969)

Pink - ringed Tent Turtle

IDENTIFICATION:

- Carapace elevated with flat sides and a strong median keel
- Third vertebral longer than second
- Carapace olive-brown with a geranium pink ring around pleuro-marginal juncture, keel (mid dorsal stripe) comprised of streaks of geranium pink
- Plastron straw yellow, with single large black blotch on each scute, seams of plastral scutes and marginals washed with pink
- Head olive-green with geranium pink circular spots at posterior edge of upper eyelid and adjacent skin, a larger post-ocular spot; two irregular broken pink spots on middle of head, neck olive grey with dull, cream stripes
- Rump and base of tail also striped
SEXUAL DIMORPHISM:

- Females greatly exceed males in size. Males differ from females by having a longer tail with a proportionately thicker base.

HATCHLINGS:

- Same as adults, lower jaw with three lateral pink spots

1.1.2 Kachuga dhongoka (Gray, 1834)

Three-striped Roofed Turtle

IDENTIFICATION:

- Carapace depressed and smooth
- Median keel prominent
- Snout upturned, projecting beyond lower jaw
- Digits well webbed
- Carapace olive/brown with three black stripes, one on vertebral area, two on sides
- Plastron yellowish and unpatterned
• A creamish yellow stripe begins at snout and runs above eye and tympanum
• Head and neck olive grey, a single denticulated ridge on palate

SEXUAL DIMORPHISM:
• Females larger than males. Males have longer tails.

HATCHLINGS:
• Coloration similar to that of adults
• Central stripe usually broken and most pronounced on vertebral 2 and 3
• Lateral stripes less obvious consisting of a broken line of dashes/spots along pleural scutes
• Carapace weakly serrated posteriorly
1.2 SYSTEMATIC POSITION

Classification from world turtle species given by Pritchard (1979) has been followed. The English common names as given by Iverson (1985) are followed (Table 1).

PHYLUM           Chordata
SUB PHYLUM       Vertebrata
SUPER CLASS      Tetrapoda
CLASS            Reptilia
SUBCLASS         Anapsida
ORDER            Testudinata
SUBORDER         Cryptodira
FAMILY           Emydidae
SUB FAMILY       Batagurinae
GENUS            Kachuga
SPECIES          tentoria circumdata
dhongoka
1.3 HABITAT STATUS

The river Yamuna is the largest tributary of the river Ganga. Its drainage basin is largely semi-arid around Agra. Its flow depends on monsoons, and is 146 meters above mean-sea level. Average slope of river bed is less than 20 cm/km. The river has been subjected to great anthropogenic stress through Delhi down to Agra, and is severely polluted with total organic load being more than 40 (Gopal and Sah, 1993). Between Delhi and Agra, the water quality is of class E because of polytrophic phase of river. From Agra, eutrophic phase causes improvement to class D.

1.3.1 CLIMATE

The climate is generally sub-tropical, marked by strong seasonality. Monsoon period is from June to September. During summers (March–June) peak temperatures rise above 45 °C. Hot wind blows at the speed of 13 km/hour. Winter period is from mid October to February. Temperature falls to 2-9 °C in December–January.

1.3.2 NATURAL VEGETATION

Natural vegetation exists in congruence with changes in the climate, thus being highly variable. Aquatic vegetation is typical, comprising of *Hydrilla* and *Ceratophyllum*. 
1.4 FOOD AND FEEDING HABITS

K. tentoria

Based on our observations of turtles in captivity, this species is omnivorous. Hatchlings preferred carnivorous diet including live earthworms, snails (shell removed), small live fish, chopped fish meat and even insect larvae. Captive adults accepted dead fish, chopped fish meat, earthworms, snake gourd, gourd, cucumber and aquatic vegetation—Hydrilla and Ceratophyllum (food material for turtles). Among the adult K. tentoria, earthworms were preyed upon only by males, whereas minced meat was accepted only by females. Thus food preference could be categorized on male/female basis. (Table 2)

K. dhongoka

Captive adults preferred herbivorous food, chiefly aquatic vegetation. They also accepted gourds and cucumber. Hatchlings were omnivorous, thriving on aquatic vegetation and earthworms. (Table 2).

1.4.1 FEEDING BEHAVIOR AND FEEDING MECHANISM

Inspite of the provision of an array of food material, hatchlings of both the species and K. tentoria males were aggressive while feeding. Snatching live earthworms from each other was
### Table 2: FOOD PREFERENCE IN CAPTIVITY

<table>
<thead>
<tr>
<th>Species</th>
<th>Herbivorous Diet</th>
<th>Carnivorous Diet</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Hydrilla</td>
<td>Ceratophyllum</td>
</tr>
<tr>
<td>Kachuga dhongoka</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td>Adult</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hatchling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kachuga tentoria circumdata</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Adult</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hatchling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kachuga tentoria circumdata</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adult</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hatchling</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

+++: Preferred diet           + : Nibbling
++: Accepted diet             - : Not accepted
Plate 3: Earthworm preying mechanism of K. tentoria
normal behavior and *K. dhongoka* individuals always happened to be the first to locate live worms dropped into water.

While feeding on aquatic vegetation or vegetables, both species used the lateral sides of their jaws as well as fore-limbs to tear at large chunks of vegetables or stem and leaves. Otherwise, the food was usually bit at from front of mouth with the neck being jerked and darted back and forth in an attempt to bite.

There was an interesting difference in the earthworm preying mechanism of the two species. A *K. tentoria* would locate an earthworm, move towards one end of the worm's body so as to fall in a straight line behind it. Then it would swallow the whole organism in a single linear attempt (Plate 3). A *K. dhongoka* would hold one end of the earthworm in its mouth, then use its fore-limbs to tear off rest of the body, swallow the small chunk, again bite at the remnant and this process continued.

1.5 TURTLE POPULATION

The sampling of the populations for collection of turtles for experiments over a period of 2 years have been depicted in Table 3, which also summarises all the aspects of the populations. The
sampling sites touched a maximum stretch of 50 Km in the river Yamuna.

All these four sites, even though close, have a distinct catchment zone as the river makes turns at each site. The populations available in general in these areas remain localized largely with very few inter exchanges as has been observed during our field collections.

In all, 85 specimens of adult *K. tentoria* and *K. dhongoka* were sampled even though the density of these species was quite high in these areas. As mentioned before, both the species inhabit the same ecological zone and have common preys, so much so that their nesting sites and basking sites have also been reported to overlap (Rao, 1990). During our survey we have found the two species together performing similar activities in captivity as well as in field. However, as indicated in Table 3, the number of *K. tentoria* seems to be relatively higher than *K. dhongoka*. Our study has indicated a ratio of 3:2 for *K. tentoria* and *K. dhongoka* respectively.

The population count made in combination with the turtles captured by trap and turtles sighted show variations in the count, if viewed categorically in different seasons. The two years
### Table 3: POPULATION DETAILS

<table>
<thead>
<tr>
<th>Time of catch</th>
<th>Number of specimen</th>
<th>Site of Collection</th>
<th>Season of activity</th>
<th>Population Type</th>
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<tr>
<td></td>
<td>Kt</td>
<td>Kd</td>
<td></td>
<td>Kt</td>
</tr>
<tr>
<td>Feb 1993</td>
<td>7</td>
<td>5</td>
<td>Poiya Ghat</td>
<td>Nesting</td>
</tr>
<tr>
<td>Aug 1993</td>
<td>12</td>
<td>8</td>
<td>Sikandarpur</td>
<td>3 Months After Hatching</td>
</tr>
<tr>
<td>Dec 1993</td>
<td>6</td>
<td>4</td>
<td>Yamuna Pump</td>
<td>Nesting</td>
</tr>
<tr>
<td>Mar 1994</td>
<td>8</td>
<td>5</td>
<td>Poiya Ghat</td>
<td>Nesting ends</td>
</tr>
<tr>
<td>Aug 1994</td>
<td>12</td>
<td>8</td>
<td>Sikandarpur</td>
<td>3 Months After Hatching</td>
</tr>
<tr>
<td>Dec 1994</td>
<td>6</td>
<td>4</td>
<td>Balkeshwar</td>
<td>Nesting</td>
</tr>
</tbody>
</table>

A : Adult  
SA : Sub Adult  
+: Rank of abundance
of continuous observation indicate characteristic differences between the two species. Except for the monsoon catch, rest all catches held more females than males in case of K. tentoria. In contrast, K. dhongoka significantly showed rise in number of males. The post-monsoon catch in 1994 showed a recovery of males in number in K. tentoria. In both the monsoon catches, adult males were more in case of K. tentoria.

Sub-adults showed variations in their counts in all the seasons. Variations were also observed in the sex ratio. Sub-adults increased in number during monsoon catches.
TABLE 4: MORPHOMETRICAL DATA

*Kachuga tentoria circumdata*

<table>
<thead>
<tr>
<th>Adult</th>
<th>CL (cms)</th>
<th>BW (gms)</th>
<th>BW/CL</th>
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<td>1025</td>
<td>62.12</td>
</tr>
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<td>2</td>
<td>13.0</td>
<td>450</td>
<td>34.61</td>
</tr>
<tr>
<td>3</td>
<td>15.0</td>
<td>710</td>
<td>47.30</td>
</tr>
<tr>
<td>4</td>
<td>17.8</td>
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<td>1050</td>
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<td>12</td>
<td>19.8</td>
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<td>54.29</td>
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(Contd ...)

Kachuga tentoria circumdata

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<thead>
<tr>
<th>Adult</th>
<th>CL (cms)</th>
<th>BW(gms)</th>
<th>BW/CL</th>
</tr>
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<tbody>
<tr>
<td>13</td>
<td>18.9</td>
<td>1050</td>
<td>55.55</td>
</tr>
<tr>
<td>14</td>
<td>12.8</td>
<td>500</td>
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<td>16</td>
<td>16.7</td>
<td>2000*</td>
<td>119.76</td>
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<td>2100*</td>
<td>108.24</td>
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<td>18</td>
<td>19.4</td>
<td>2100*</td>
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<td>23</td>
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</table>

*Note:* These females had very high weight due to presence of eggs. Hence, BW/CL ratios for these have been excluded from analysis.
Kachuga tentoria circumdata

<table>
<thead>
<tr>
<th>Adult</th>
<th>CL (cms)</th>
<th>BW (gms)</th>
<th>BW/CL</th>
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<td>65</td>
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<td>100</td>
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<td>85</td>
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<td>70</td>
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<td>7.5</td>
<td>65</td>
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* Note: These males were unusually large. They gave a variant G6PD isozyme pattern. Hence, BW/CL ratios for these have been excluded from analysis.
**Kachuga tentoria circumdata**

<table>
<thead>
<tr>
<th>Sub-Adult</th>
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<th>BW (gms)</th>
<th>BW/CL</th>
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<table>
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<th>BW (gms)</th>
<th>BW/CL</th>
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### Female Kachuga dhongoka

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### Male Kachuga dhongoka

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<th>BW (gms)</th>
<th>BW/CL</th>
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*Note:* These females had very high weight due to presence of eggs. Hence, BW/CL ratios for these have been excluded from analysis.
### Female Sub-Adult Data

<table>
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<th>Sub-Adult</th>
<th>CL (cms)</th>
<th>BW (gms)</th>
<th>BW/CL</th>
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</tr>
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</tr>
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### Male Sub-Adult Data

<table>
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<th>BW/CL</th>
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TABLE 5: STATISTICAL ANALYSES OF MORPHOMETRICAL DATA

A. Females

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<thead>
<tr>
<th>Species</th>
<th>CL (cms)</th>
<th>BW/CL</th>
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<tbody>
<tr>
<td><strong>Kachuga tentoria</strong></td>
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<tr>
<td>(Adult)</td>
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<tr>
<td></td>
<td>X=16.61</td>
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<tr>
<td></td>
<td>SD=2.35</td>
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<td>SE=0.49</td>
<td>SE=5.19</td>
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<tr>
<td></td>
<td>Range=12.8-19.8</td>
<td>Range=19.23-119.76</td>
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<tr>
<td><strong>Kachuga dhongoka</strong></td>
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<tr>
<td>(Adult)</td>
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<tr>
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<td></td>
<td>Range=33.0-36.2</td>
<td>Range=120.48-124.30</td>
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<tr>
<td><strong>Kachuga tentoria</strong></td>
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<td>(Sub-Adult)</td>
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</tr>
<tr>
<td></td>
<td>X=7.45</td>
<td>X=13.9</td>
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<tr>
<td></td>
<td>SD=2.14</td>
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<tr>
<td></td>
<td>SE=0.76</td>
<td>SE=1.75</td>
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<tr>
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<td>Range=8.33-16.30</td>
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<tr>
<td><strong>Kachuga dhongoka</strong></td>
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<td>X=9.11</td>
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<td>SD=2.05</td>
<td>SD=3.29</td>
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<tr>
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<td>SE=0.68</td>
<td>SE=1.09</td>
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<tr>
<td></td>
<td>Range=6.6-12.8</td>
<td>Range=7.57-16.20</td>
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(Contd ...)
### B. Males

<table>
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<tbody>
<tr>
<td><strong>Kachuga tentoria</strong></td>
<td>X=8.10, SD=1.59, SE=0.39, Range=7.0-13.2</td>
<td>X=11.67, SD=3.31, SE=0.88, Range=6.49-202.00</td>
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<td>(Adult) N=16</td>
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<td><strong>Kachuga dhongoka</strong></td>
<td>X=13.05, SD=2.31, SE=0.69, Range=12.3-17.8</td>
<td>X=28.93, SD=9.02, SE=2.72, Range=21.60-45.45</td>
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<tr>
<td><strong>Kachuga tentoria</strong></td>
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<td>X=5.53, SD=0.39, SE=0.19, Range=5.08-6.15</td>
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<td>(Sub-Adult) N=4</td>
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<tr>
<td><strong>Kachuga dhongoka</strong></td>
<td>X=6.35, SD=0.29, SE=0.09, Range=5.9-6.6</td>
<td>X=7.673, SD=975, SE=0.308, Range=6.66-9.09</td>
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