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Environmental Factors Related to Basking
in the Midland Painted Turtle,
Chrysemys picta marginata (Agassiz).

File!

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ABSTRACTS

The time of the day, the radian temperature, and the sky condition are the three most important individual factors relative to the basking behavior of painted turtles. Painted turtles bask more in the late morning than during any other daylight hours. Painted turtles do not bask at night.

The combined effects of four factors; sky condition, air temperature, water temperature near the bottom, and the time of day account for more than 95% of the statistical significance of the variance.

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PURPOSE AND OBJECTIVES

The purpose of this experiment was to answer a frequently asked question, "Why are there more turtles on the logs at some times than at other times?". This question was asked by visitors and other employees at the Rocky River Trailside Interpretive Center during my employment as a Seasonal Naturalist in 1976.

My objectives were to determine what factors influenced the basking of turtles, and what combinations of factors were important.

METHODS

The painted turtles were studied in the West Channel Pond of Metropark Rocky River, a part of the Cleveland (Ohio) Metroparks system.

All readings were made as close as possible to the central location of the basking turtles. This was accomplished by walking out on the fallen trees to the vicinity of the turtles. I counted the number of basking turtles with binoculars before venturing into the vicinity of the turtles.

The air and water temperatures were measured on a centigrade thermometer. The air temperature was measured six inches above the water's surface. The two water temperatures for each observation were taken at one inch depth and one foot depth, respectively. The water depth exceeded $1\frac{1}{2}$ feet ($\frac{1}{2}$ m) in very few locations within the

basking area. The one foot depth measurement is essentially the temperature of the water at the bottom of the pond.

The wind speed was measured with a hand held wind meter at a height of six inches above the water. The wind chill temperatures were determined from a comparison of the wind speed and the air temperature using Dick Goddard's wind chill chart.

The radian temperature was measured on a pyronometer at the Lewis Research Center of the National Aeronautics and Space Administration, which is located about one kilometer distant. The pyronometer measures both direct and diffuse solar energy in $\text{mw-hours/cm}^2\text{-days}$.

Relative humidity was measured on a Taylor hygrometer, again at a height of six inches above the water.

Percent turbidity was measured on a Bausch and Lomb Spectronic 20 spectrophotometer, which measures the percentage of light transmittance compared to de-ionized water at a wavelength of 400 angstroms. Most of the percent turbidity water samples were accidentally destroyed before analysis. The amount of turbidity was also subjectively recorded based on personal observations.

I also subjectively determined the sky condition by looking up and recording what I saw. There is a high correlation between the radian temperatures and the sky conditions. The sky condition was recorded to overcome a deficiency caused by the fact that the radian temperature is a daily total rather than being specific to the time of the observations.

Date and time were also recorded for each observation. Most observation times were between 8:00 a.m. and 6:00 p.m., although

three 24-hour study periods were included.

The data was analyzed by regression analysis, the scatter process, and Spearman correlations using Statistical Analysis System (SAS) canned programs on the Ohio State University computer.

FINDINGS

Sky condition is the single most important variable. Time of day and radian temperature are close behind in statistical significance. There is a high correlation (.85) between the sky condition and the radian temperature.

The water temperature at one foot and the turbidity are about one half as significant as the first three variables. Relative humidity is half again as significant as these two variables. The remainder of the variables are much less significant as single independent variables. From highest significance to lowest, these variables are: water temperature at one inch, wind speed, air temperature, and finally, wind chill temperature.

When all combinations of two variables are considered, the water temperature at one foot combined with the sky condition proved most significant. This combination of variables accounted for 82.9% of the maximum R^2 of all variables.

The combined effects of three variables; water temperature at one foot, sky condition, and the air temperature; account for 92.5% of the maximum R^2 . Notice that the air temperature, which seems insignificant as an independent variable, is very important in combination

with other factors.

When the factor of time is considered with these three variables, 95.6% of the maximum R^2 is determined.

The greatest numbers of turtles bask between 10:15 a.m. and 12:30 p.m., although significant numbers can be found anytime between 8:30 a.m. and 5:45 p.m. These are roughly the hours that direct sunlight reaches the pond. Turtles do not bask at night. Trees block the direct sunlight before 8:30 a.m., while Fort Hill blocks the sunlight after 5:45 p.m.

The highest percentage of turtles per observation occurred when the sky was cloudy and/or very hazy. The percentages of turtles per observation were as follow:

<u>Sky Condition</u>	<u>Turtles per Observation</u>
Cloudy and/or very hazy	6.2
Clear	5.5
Partly cloudy	4.9
Mostly clear	4.5
Light rain	1.0
Heavy rain	.3

Yes, there were turtles basking even during a heavy rain.

Turtles could be found basking when the radian temperatures were between 108 and 773 $mW-hr/cm^2$ -day. The average number of turtles per observation remained relatively constant when the radian temperature was between 200 and 800 $mW-hr/cm^2$ -day.

<u>Radian Temperature</u>	<u>Turtles per Observation</u>
100-200 $mW-hr/cm^2$ -day	2.4
200-400	5.3
400-600	4.6
600-800	5.4

Turtles could be found basking when the water temperature at one foot was from 5°C to 28°C. The highest numbers of turtles were found when this temperature was between 11°C and 20°C.

The surface water temperature (1 in.) ranged from 9°C to 35.5°C. The highest numbers of basking turtles were found when this temperature was between 13.5°C and 25°C.

Painted turtles could be seen basking when the air temperature was between 8°C and 33°C. The highest numbers of turtles were found when the air temperature was between 12°C and 29°C. There is a 99% correlation between the air temperatures and the wind chill temperatures. The pond is very well sheltered from the wind. The wind speed itself proved insignificant. I never recorded any speed over 9 mph.

Basking behavior was distributed over the entire range of relative humidities (33% to 100%).

More turtles are found basking when the water is less turbid based on my subjective determinations.

<u>Turbidity</u>	<u>Turtles per Observation</u>
Little cloudiness	6.9
Middle cloudiness	8.0
Muddy	2.2
Very muddy	4.3

The percent turbidity data proved insignificant.

The average number of turtles per observation was higher when rain had occurred during the previous 24 hours (5.6 turtles/observation) than the overall average (4.1 turtles/observation).

CONCLUSIONS

Midland painted turtles bask more in the late morning hours, 10:15 a.m. to 12:30 p.m., than during any other daylight hours. Painted turtles do not bask at night.

The amount of incoming solar energy, as represented by the radian temperature and the sky condition, is the most important environmental factor. I believe that the reason that there are more turtles basking per observation when the sky is cloudy than when the sky is clear is because the turtles warm more slowly on a cloudy day. Since the turtles warm more slowly, it takes longer to achieve the necessary effects. If each turtle spends a longer time basking, it is more likely that at any one time there will be more turtles basking.

Cooler water temperatures (11-20°C) near the bottom of the pond stimulate the turtles to bask. Temperatures below 8°C induce hibernation (Brattstrom, 1965); although two turtles were seen basking when the temperature at one foot was only 5°C.

The air temperature, water temperature at 1 ft., and the sky condition are the three factors which, in combination, account for the number of turtles basking.

Rain during the previous 24 hours increases the likelihood that a turtle will be found basking.

APPENDIX I

LOCAL FLORA AND FAUNA

The following plants are found in and around the West Channel Pond.

<u>Scientific Name</u>	<u>Common Name</u>
<u>Lemna minor</u>	duckweed
<u>Elodea sp.</u>	waterweed
<u>Potamogeton pusillus</u>	pondweed
<u>Sparganium sp.</u>	bur-reed
<u>Bidens connata</u>	beggar's-ticks
<u>Leersia oryzoides</u>	rice cutgrass
<u>Phalaris arundinacea</u>	reed canary grass
<u>Polygonum arifolium</u>	arrow-leaved tearthumb
<u>Polygonum sagittatum</u>	halberd-leaved tearthumb
<u>Polygonum coccineum</u>	smartweed
?	Japanese millet (planted)

The following vertebrates live in or frequent the West Channel Pond.

<u>Ictalurus natalis</u>	yellow bullhead
<u>Lepomis macrochirus</u>	bluegill sunfish
<u>Lepomis cyanellus</u>	green sunfish
<u>Lepomis gibbosus</u>	pumpkinseed sunfish
<u>Eucalia inconstans</u>	brook stickleback
<u>?Fundulus diaphanus</u>	mudminnow
<u>Micropterus salmoides</u>	large-mouth bass
<u>Semotilus atromaculatus</u>	creek chub
<u>Cyprinus carpio</u>	carp
<u>Catostomus commersoni</u>	white sucker

APPENDIX I cont.

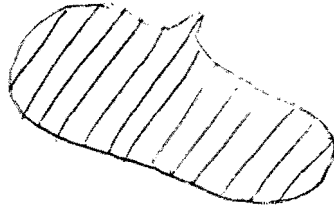
<u>Ambystoma sp.</u>	blue-spotted salamander X ?
<u>Rana catesbeiana</u>	bullfrog
<u>Rana clamitans</u>	green frog
<u>Hyla crucifer</u>	spring peeper
<u>Bufo americanus</u>	American toad
<u>Chrysemys picta marginata</u>	midland painted turtle
<u>Chelydra serpentina</u>	snapping turtle
<u>Ondatra zibethica</u>	muskrat
<u>Anas platyrhynchos</u>	mallard
<u>Aix sponsa</u>	wood duck
<u>Ardea herodias</u>	great blue heron
<u>Butorides virescens</u>	green heron
<u>Megaceryle alcyon</u>	kingfisher

APPENDIX II
POPULATION ESTIMATE

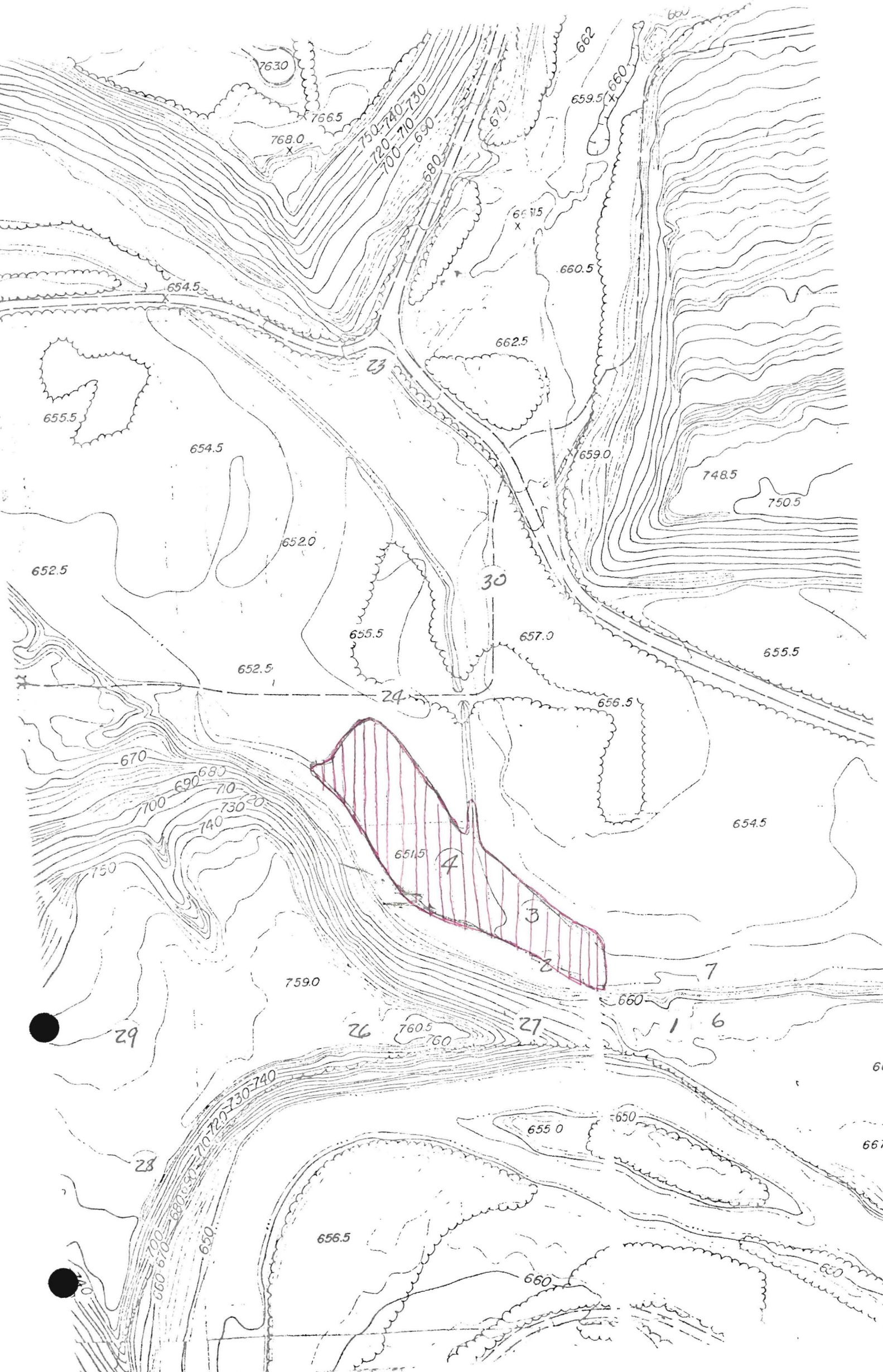
The following population estimate was made using the Lincoln-Peterson Index and data collected primarily for Karl Smith's research on the growth of the painted turtles in the pond.

There are about 110 turtles in the pond.

APPENDIX III
MAP OF THE AREA



WEST CHANNEL POND



LITERATURE CITED

- Brattstrom, B.H. 1965. Body temperatures of reptiles. Am. Midl.
Nat. 73:376-422.