



Guide to Monitoring Nest Temperatures and Weather Conditions

Guía para el Monitoreo de las Temperaturas en los Nidos y las Condiciones Meteorológicas

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Hatchery Nest Temperatures

Monitoring the temperatures of the nests in the hatchery is extremely important in order to maintain maximum occlusion success and to provide the potential to produce the best male/female ratio in the hatchlings (although it is not clear at present what that optimum ratio might be). It is thought that the sex of the hatchlings is determined by the temperatures inside the nest during middle third of the incubation period. A PIVOTAL TEMPERATURE can be defined which, under constant temperature conditions, produces 50% males/females. A TRANSITIONAL RANGE OF TEMPERATURES has also been defined, being the range of temperatures (encompassing the pivotal temperature) that produces mixed sexes from a clutch of eggs. With temperatures higher than the pivotal temperature female hatchlings dominate, with lower temperatures males dominate. The following table identifies the critical values for Olive Ridley and Leatherback sea turtles found on the Pacific seaboard of Central America.

Species	Locality	PIVOTAL (SD)	TRT _{5%} (SD)	Incub. Period
<i>Olive Ridley</i>	World	30.06 (SD 0.24)	3.95 (SD 0.047)	~50 days
<i>Leatherback</i>	Costa Rica	29.43 (SD 0.01)	1.17 (SD 0.040)	_60 days

Table 1. Pivotal and Transitional Range of Temperatures (¹)

It can be seen that the Olive Ridelys are less sensitive than the leatherback to temperature fluctuation, and are acclimatized to higher sand temperatures (leatherbacks bury their eggs deeper, where there is less temperature fluctuation).

Hatchery temperatures can be regulated by adjusting shade on the hatchery roof and by watering the sand (evaporation cools the sand).

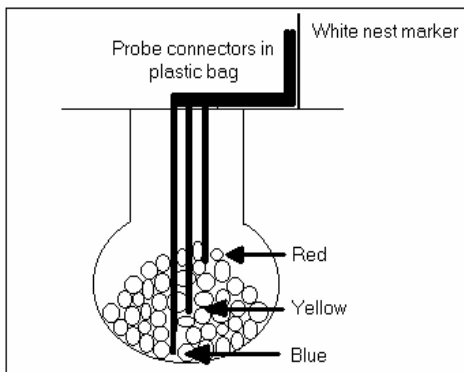


Figure 1. Sensor depths

The way in which we accurately monitor these nest temperatures is to bury three temperature sensors (thermistors) in selected nests when the eggs are first buried. The sensors sit at different levels – one at the base of the egg clutch, in contact with the sand (coded blue), one above the egg clutch, in contact with the sand (coded red), and one in the middle of the egg clutch (coded yellow). We also have a control “nest” (with no eggs) so that we have a record of baseline sand temperature at one (central) hatchery location from July to January. For burial depths see Table 2.

¹ Girondot, M. In press. Statistical description of temperature-dependent sex determination in marine turtles. In Wibbels, T. and Kalb, H. Proceedings of the 19th symposium on sea turtles conservation and biology, South Padre Island, TX, 2-5 March 1999.

	Sensor depth (mm)		
	Olive Ridley		Leatherback
Top	250		400
In eggs	325		500
Bottom	400		600

Table 2. Sensor depths

We try to monitor temperature in actual nests under a range of conditions (species, position within the hatchery, number of eggs buried). Typically two nests should be being monitored at any time (in addition to the control). The first sensors to be buried in a nest with eggs should be as soon as possible into the start of the season (early July). Start a second a couple of weeks later.

The temperatures are recorded by measuring the resistance of the buried sensors (thermistor = resistance whose value varies accurately with temperature). This is done by inserting the multimeter probes into the sockets on the colour-coded leads exposed at the nest surface. To obtain the resistance readings, simply switch the multimeter dial to the ohm sign at the 12 o'clock position. As we are reading resistance there is no positive and negative, so either black or red multimeter probes can be inserted into the nest probe connectors either way around. First note the resistance of the blue connectors, followed by the yellow and lastly the red. NOTE: A good connection between the leads and the multimeter is CRITICAL. The sockets on the leads are gold plated to ensure good connection, but always treat the leads carefully (hold the socket not the wire when you pull out the meter-probe), keep them clean and protected (eg in a plastic bag; this bag should then be tied around the white nest marker to keep it still and upright to avoid any rain getting inside.)

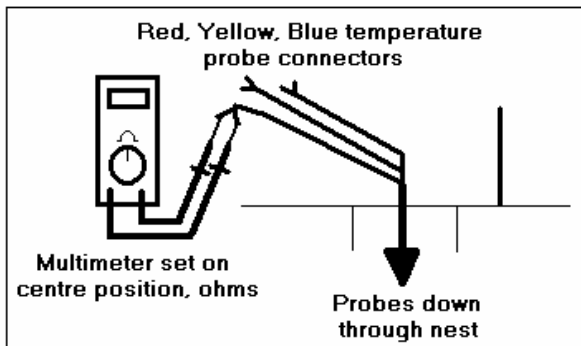


Figure 2. Multimeter lead connections

During the six weeks of incubation the temperatures should be accurately taken three times a day at exactly 6am, midday and 6pm, to capture the changing temperatures throughout the day and through the whole incubation period. MISSING ONE OR TWO READINGS DURING THE SIX WEEKS IS NOT CRITICAL BUT SHOULD BE AVOIDED IF POSSIBLE.

The resistance values are written into a logbook at the time of recording, and then at the end of each day entered into an EXCEL spreadsheet. In this spreadsheet the nest position should also be recorded using a simple mapping code as shown in Figure 3. Typical data logs are shown in the Annex. The spreadsheet will automatically calculate the temperatures

from the resistance data, using a lookup table. The thermistors all have the same resistance/temperature calibration.

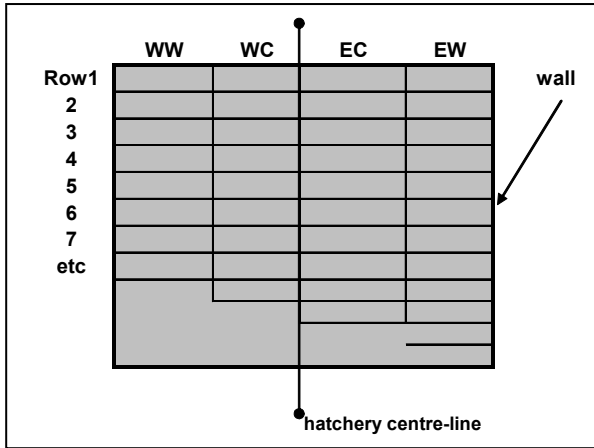


Figure 3. Mapping nest positions inside the hatchery. A nest in the top left hand corner would have a position code

WW Row 1

[WW west wall
WC west centre etc]

Natural (Beach) Nest Temperatures

We monitor beach nest temperatures as part of our research into the natural ecology of the turtles. However, natural beach nests are not found as all nesting turtles are intercepted by egg collectors. Therefore we try to measure beach nest temperatures in a) a control nest (no eggs) on the beach throughout the season and b) one re-buried nest of eggs on the beach each season (normally beach temperatures are very high and occlusion very low, therefore we do not like to lose too many eggs in this way). These nests have to be kept secret from the local egg collectors – if they see us working on a site they come and excavate it and steal the eggs/equipment. Therefore the ‘nests’ are set up when no-one is around, and with 10m long thermistor leads which run to a secret location in the vegetation on the back beach, where we pretend to sunbathe when making the measurements! The three thermistors for the control should be set at 600, 400 and 200mm depth. The real nest depths are set as for the hatchery (see table 2.)

Weather conditions

During the turtle nesting and hatching season from July until January, we need to record the weather conditions: This allows us to understand the climatic changes, how these control nest temperatures and also preferred weather conditions for nesting turtles.

Observations are made at 6am, 12 noon and 6pm, coincident with the nest temperatures. Wind data are also collected more frequently (hourly) when it is unusually windy.

1. For the regular recordings first log the date and time.

2. Record is the amount of cloud cover. This is done on a scale of zero to eight. Imagine the whole sky being a grid of 8 squares, estimate how many of those squares are covered with cloud (0=clear sky, 8= totally overcast). Make sure you have a clear view of all the sky.

3. Go to the crest of the beach and measure the force of the wind. A handheld anemometer is used to measure the wind speed in metres per second. Simply stand facing the wind (you can hear the wind in both ears) holding it at eye level and the needle will indicate its force – watch it for a few minutes and take both the average reading AND the maximum value attained. Note also the wind direction (set up marks on the back-beach, using a compass initially).

4. Measure the amount of rainfall that has fallen since the last reading. The rain-gauge is a large glass bottle partially buried in the ground with large funnel in its stopper. [This gauge has to be set up on the back-beach area, away from buildings/trees etc.]. Carefully pour the retained water into the provided measuring cylinder and record the number of millilitres. If the volume is more than hat of the cylinder, fill the cylinder nearly full, note the measurement, throw away the water and repeat.

5. Record the air temperature and humidity. The supplied electronic maximum-minimum-actual thermometer needs to be located in a secure place in the shade. After noting the “actual temperature” and the “actual humidity”, press the “max” and “min” buttons in turn, noting these readings (since the last observation) then press the “reset”. Always double check the RESET. When replacing this unit always ensure it will be kept out of the direct sunlight as this will interfere with the accuracy of the data.

6. All the information is written into a logbook. At the end of each day the data need to be entered into the computer Excel spreadsheet (see Annex). At the beginning of the season the diameter of the rainfall funnel needs to be entered into the spreadsheet, so that the millimetres of rain falling can be accurately calculated for the rainfall volumes recorded.

IMPORTANT. WIND AND WAVE Conditions. These conditions seem to have effects on turtle nesting behaviour. It is important to log when unusually strong wind or wave conditions occur. On windy days/nights, try to make observations hourly.

ANNEX

NEST TEMPERATURE DATA INPUT EXCEL SHEET

Funnel
diameter

T1 through 5 are thermistor
sensor sets. They can be
buried at sites A- H

Hora y fecha – hour & date

Día – day

Mes – month

Empezar - start

Condiciones – Weather

Cobertura de nubes – cloud cover

Viento/fuerza - wind force

Viento/max – wind maximum (gust)

Viento/dirección – wind direction °

Lluvia – rainfall

Temperatura – temperature

Humedad – humidity

Aire – air

y - and

arriba – top

medio – middle

bajo – bottom

Ubicación – location (of nest)

Profundidad – depth (of sensor)

		Dia de empezar		1/7/05	1/7/05
		01/07/2005			
Hora y fecha	Dia	1-31		1	
	Mes	1-12		7	
	Hora	0-24		6	
Condiciones	Cobertura de nubes	0-8		5	
	Viento/fuerza	0-20m/s		2	
	Viento/max	0-20 m/s		3	
[Dia. mm EMBUDO]	Viento/dirección/gradas	0-359		180	
	125	Lluvia	ml	34	
	TyH Aire	Temperatura Actual	° C	32	
		Temperatura Max	° C	33	
		Temperatura Min	° C	30	
		Humedad Actual	%	81	
		Humedad Max	%	84	
		Humedad Min	%	70	
T1 arriba	Ubicación	A-H		A	
	Profundidad	cm		200	
	Temperatura Actual	ohms		3.7	
T1 medio	Ubicación	A-H		A	
	Profundidad	cm		325	
	Temperatura Actual	ohms		3.8	
T1 bajo	Ubicación	A-H		A	
	Profundidad	cm		400	
	Temperatura Actual	ohms		3.9	
T2 arriba	Ubicación	A-H		A	
	Profundidad	cm		200	
	Temperatura Actual	ohms		3.7	
T2 medio	Ubicación	A-H		A	
	Profundidad	cm		325	
	Temperatura Actual	ohms		3.8	
T2 bajo	Ubicación	A-H		A	
	Profundidad	cm		400	
	Temperatura Actual	ohms		3.9	
T3 arriba	Ubicación	A-H		A	
T4 arriba	Ubicación	A-H		A	
	Profundidad	cm		200	
	Temperatura Actual	ohms		3.7	
T5 medio	Ubicación	A-H		A	
	Profundidad	cm		325	
	Temperatura Actual	ohms		3.8	
T5 BAJO	Ubicación	A-H		A	
	Profundidad	cm		400	
	Temperatura Actual	ohms		3.9	
◀ ▶ FILA					
Operadores:	Descripción de Ubicación	A	WW	1	A
		B			B
		C			C
		D			D
		E			E
		F			F
		G			G
		H			H