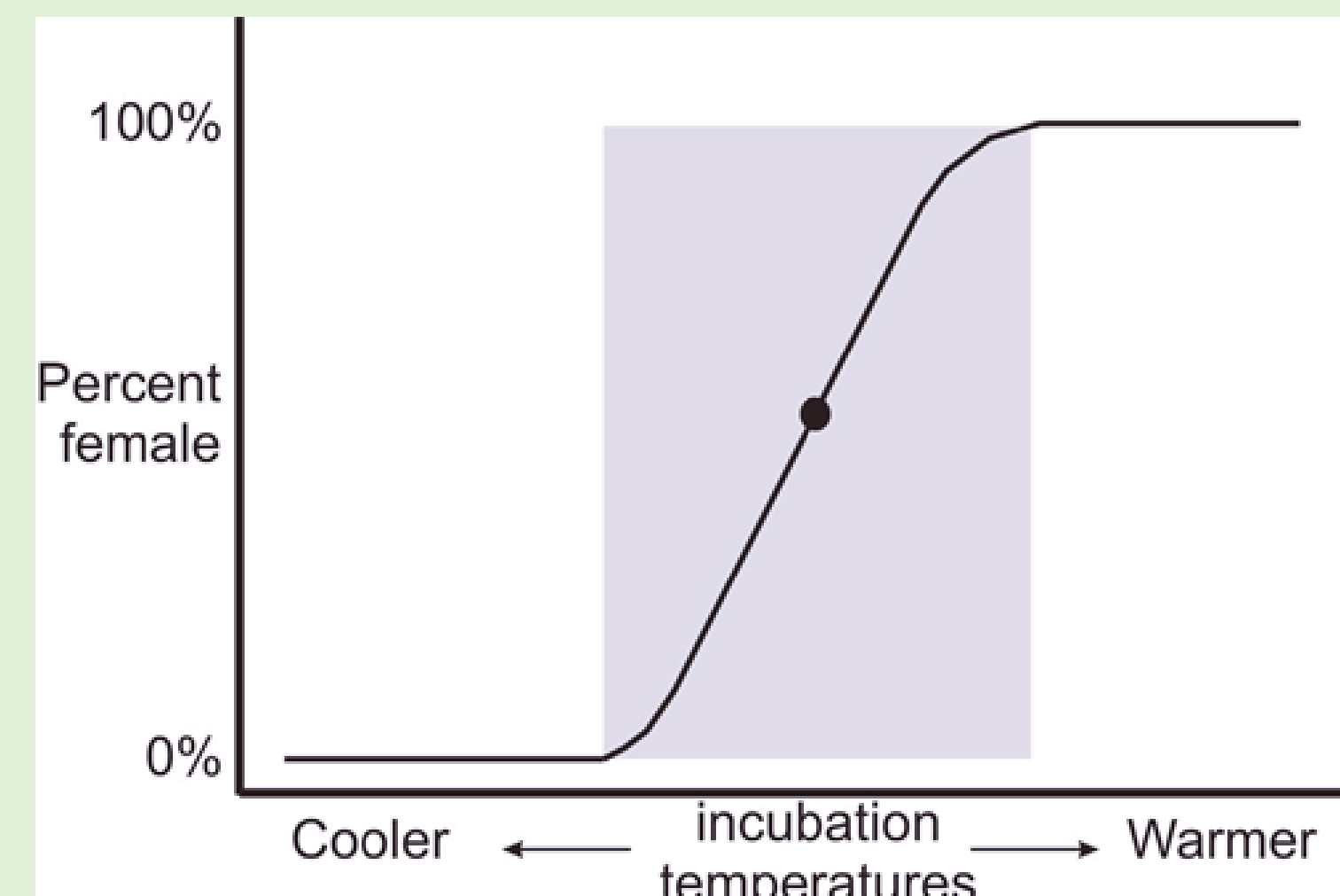


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Background

- Sea turtles are subject to **temperature-dependent sex determination**, meaning their gender is determined by the temperature of the eggs during incubation.
- Literature shows that gender is determined during the middle one-third of egg development / incubation.¹
- **Hot chicks, cool dudes** – **warmer** incubation temperatures result in more female sea turtles, and **cooler** incubation temperatures result in more male sea turtles.
- The threshold temperatures are 27.7°C and 31.0°C, where turtles hatch as either male below or female above these thresholds.²
- The pivotal temperature is 29.4°C, the point at which the most probable sea turtle gender alternates between male and female.



³Mrosovsky and Godfrey, 2010

Monitoring

- Five soil temperature monitoring stations were installed along Bald Head Island beaches. Locations are shown by Figure 2 (analysis). Setup is shown in the images to the right.
- Each station was comprised of an enclosure box housing a datalogger and a battery, two soil temperature sensors, and a solar panel.
- The soil temperature sensors were installed at two different depths, one at 20-30cm and one at 60-70cm below the surface, to represent the upper and lower depths of a natural sea turtle nest.

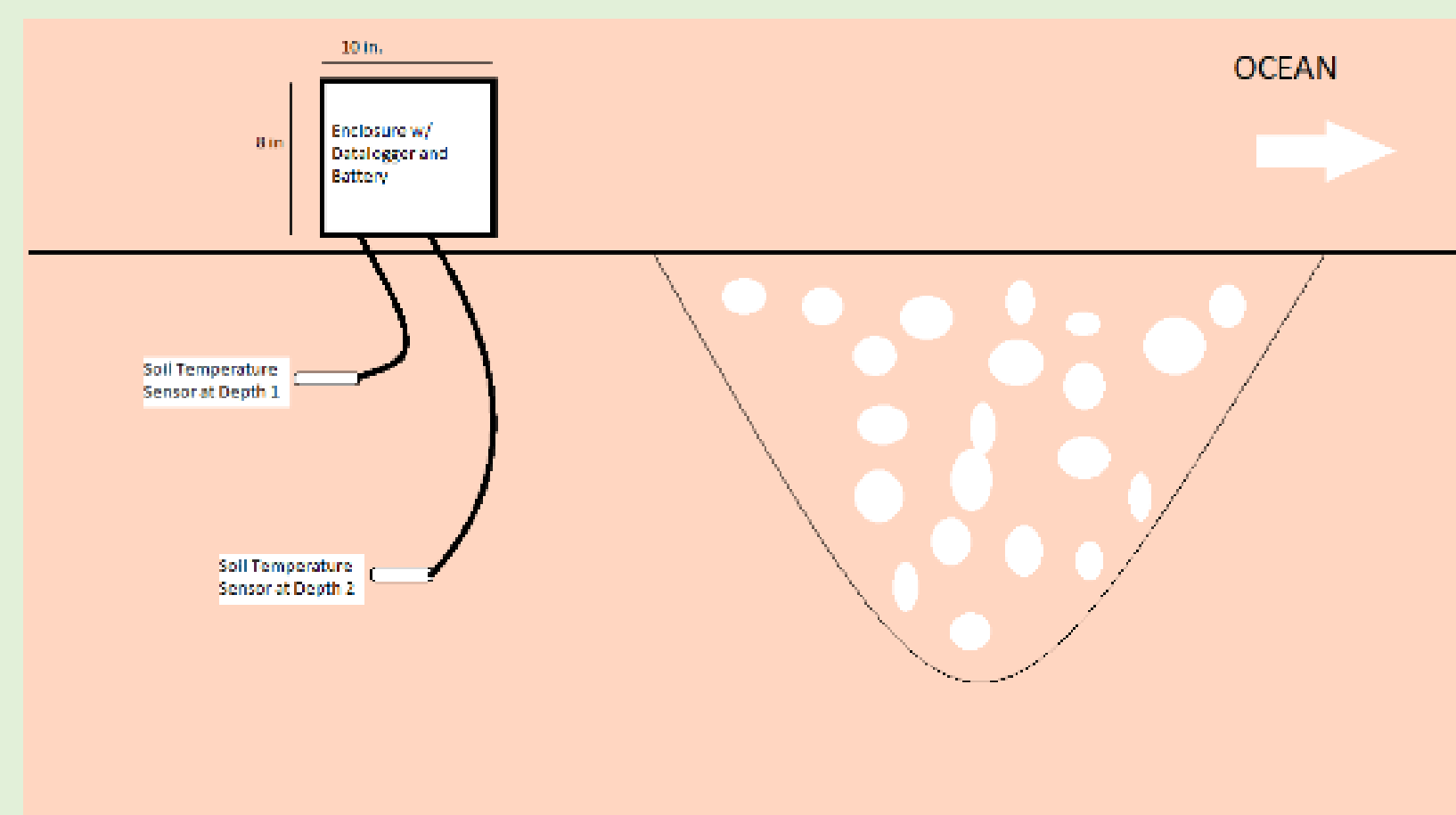


Figure 1: Horizontal schematic of soil temperature sensor setup

- Soil temperature was monitored May through August of 2019, recording temperatures once every 15 minutes. The project was originally designed to last through September, however was cut short due to the impact of Hurricane Dorian on Bald Head Island.
- Four of the five stations collected data over 70% of the project duration, while one station only collected data 25% of the duration.

Analysis

- For the 2019 nesting season, a total of 170 turtle nests were laid on Bald Head Island beaches.
- Of these 170, only 107 of the nests were used in analysis. The remaining 63 nests were excluded from analysis for the following reasons:
 - Nest was dug up prior to Hurricane Dorian (8)
 - Nest was lost to Hurricane Dorian (28)
 - Nest had few or no hatchlings (19)
 - Nest was lost to coyotes (8)
- The temperature time series at each turtle nest location was determined by the closest soil temperature monitoring station to each individual nest.
- The temperature time series at each soil temperature monitoring station was determined by averaging the observed temperature of the shallow and deep sensors to create one "nest average" incubation temperature every 15 minutes.

- **Red dots** represent locations of the five soil temperature monitoring stations.
- **Blue dots** represent locations of the 107 sea turtle nests analyzed.



Figure 2: Locations of soil temperature monitoring stations and sea turtle nests on Bald Head Island.



Enclosure box with solar panel



Turtle nest cage protecting the enclosure box

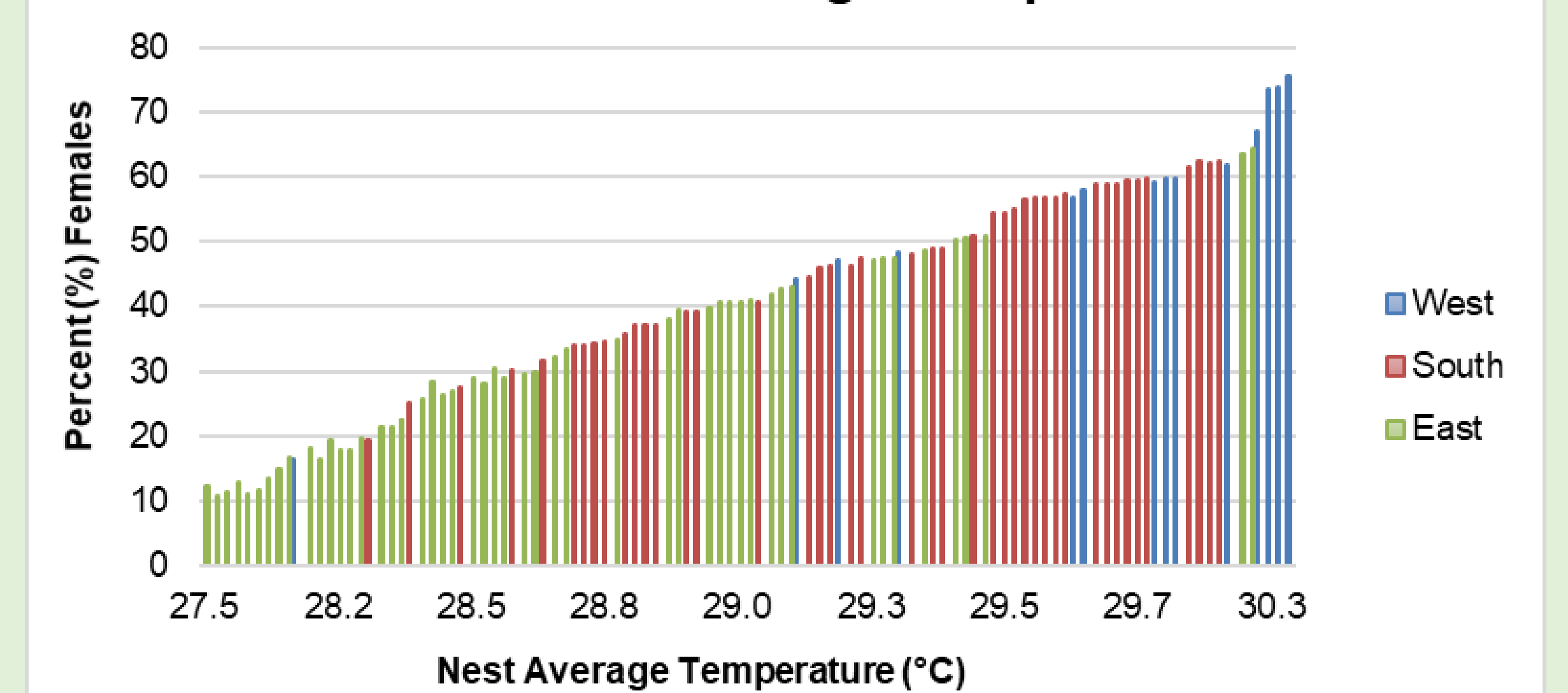
Challenges

- One of the soil temperature monitoring stations (SBeach2) became waterlogged early on in the experiment due to a combination of being placed too close to the incoming tide and the enclosure box not being fully water tight. This caused a loss of data from that station for a significant portion of the experiment.
- Data was manually collected an average of once per month, which caused delay in realizing when a station was malfunctioning.
- Future projects should involve water-tight enclosures and should strive to collect data daily to maximize efficiency of data collection.

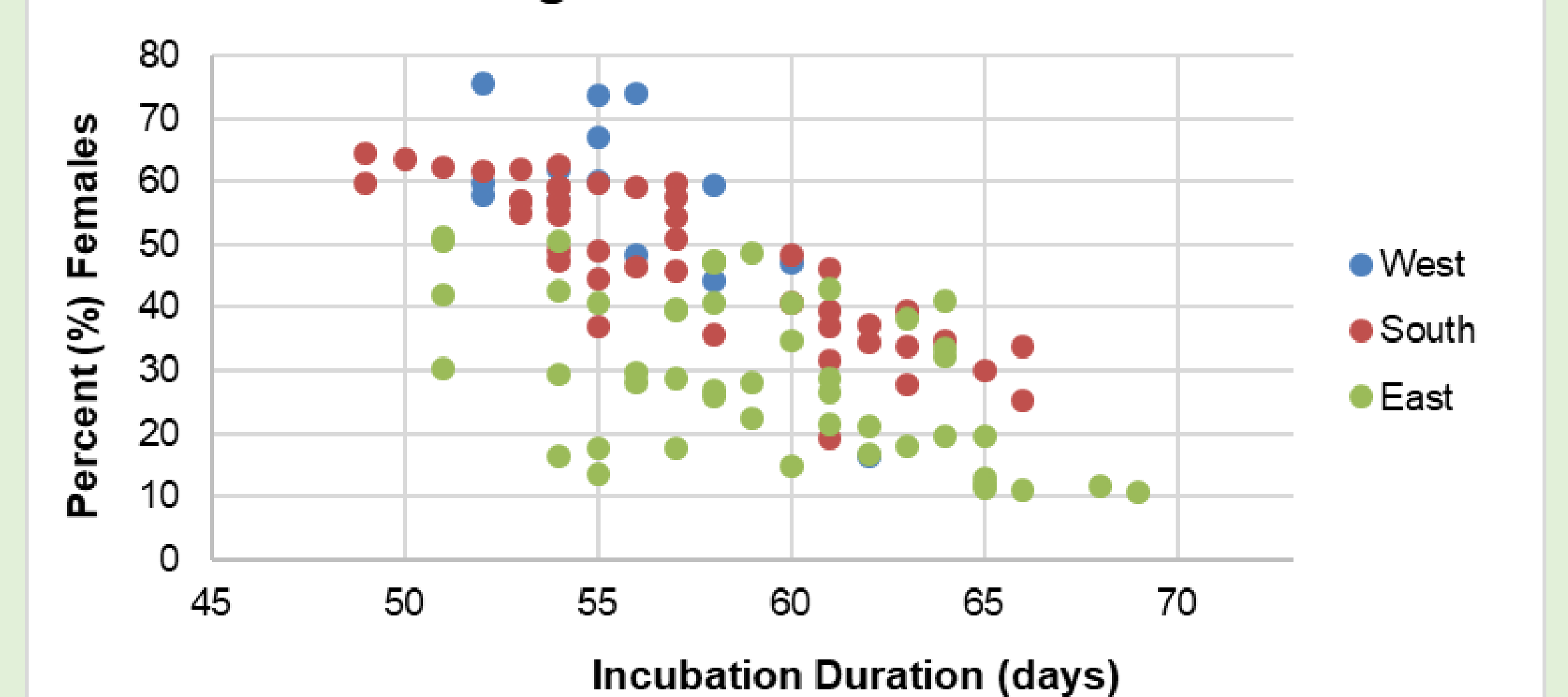
Results

	West Beach (course)	South Beach (fine)	East Beach (fine)
Nests (%)	13	42	45
Female (%)	57.3	47.7	29.7
Male (%)	42.7	52.3	70.3

Estimated Percentage of Female Hatchlings vs. Nest Average Temperature



Estimated Percentage of Female Hatchlings vs. Incubation Duration



Acknowledgements

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References

- ¹ Standora, E., and J. Spotila, 1985. Temperature Dependent Sex Determination in Sea Turtles, *Copeia*, 1985, 3, 711-722, doi:10.2307/1444765
- ² NOAA. What causes a sea turtle to be born male or female? National Ocean Service website, <https://oceanservice.noaa.gov/facts/temperature-dependent.html>, accessed on 01/07/2020.
- ³ Mrosovsky, N., and M. H. Godfrey, 2010: Editorial: Thoughts on Climate Change and Sex Ratio of Sea Turtles. Marine Turtle Newsletter, Accessed 5 January 2020, <http://www.seaturtle.org/mtn/archives/mtn128/mtn128p7.shtml>.