

Name(s): Answer Key

## **Hawksbill Turtle Math Puzzle**

*Can you predict the future of Hawksbill Turtles in Palau?*

### **Data**

Current estimate of the number of female Hawksbill Turtles breeding in Palau each year	<b>20-50</b> turtles <sub>1</sub>
Estimate of Hawksbill Turtle generation time (age a female begins laying eggs, producing a new generation of turtles)	<b>25-35</b> years <sub>2</sub>
Estimated global decline in the number of female Hawksbill Turtle nesting annually over the past 3 generations	<b>84-87%</b> decline <sub>1</sub>

Sources: <sub>1</sub>IUCN Red List, <http://www.iucnredlist.org/>  
<sub>2</sub>World Wise Schools, <http://www.peacecorps.gov/wws>

**1. Use the data above to find the following averages:**

- Average of the high and low estimates of the number of breeding female Hawksbills in Palau.
- Average Hawksbill Turtle generation time (average of the lowest and highest ages for females Hawksbills to begin laying eggs)
- Average of the high and low estimates of the percent decline in Hawksbill Turtle females nesting annually over the last 3 generations

**35**  
turtles

**30**  
years

**85.5%**

**2. Three generations ago, the number of nesting female Hawksbills was greater than its current level. Note: Answers to this problem will vary depending on the current year\*.**

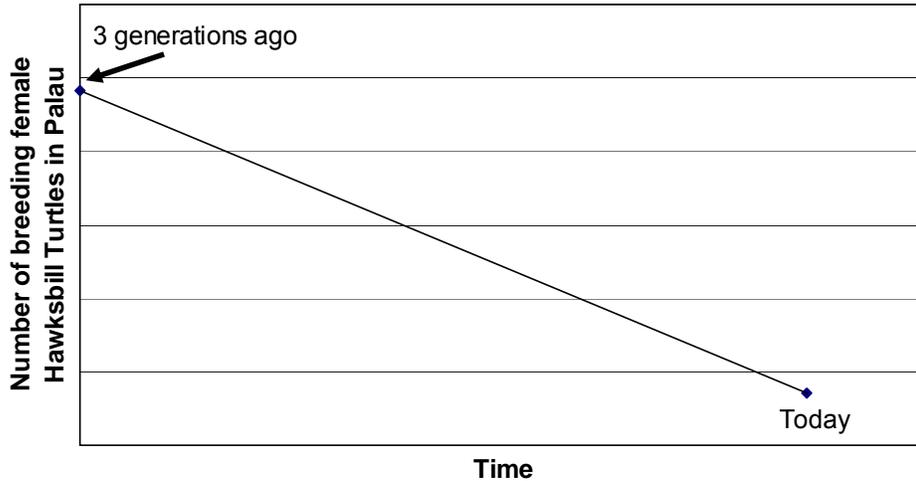
- How many years ago was this? (hint: use your answer from 1b).  
**3 generations x 30 year generation time = 90 years ago**
- What year was it three generations ago?  
**Current year – 90 years (e.g. 2009\* – 90 years = 1919)**

**90**  
years

**~1919**

3. Assume that there has been a steady decline in breeding female Hawksbill Turtles over the past three generations (see graph).

Decline in breeding female Hawksbill Turtles in Palau over the last three generations



Review your answer from 1c (the average % decline in breeding female Hawksbill Turtles over the last three generations)

85.5%

Review your answer from 1a (the average estimated number of female Hawksbill Turtles currently nesting in Palau)

35 turtles

Review your answer from 1b (the average Hawksbill generation time)

30 years

a. Use the numbers above to calculate the estimated number of Hawksbill females nesting in Palau three generations ago. Round your answer to the nearest whole turtle.

*If needed, provide this hint to students:*

90 years ago, there were 85.5% more turtles nesting than there are today. This means that the current number (35 turtles) is 14.5% of what it used to be ( $100\% - 85.5\% = 14.5\%$ ).

Use algebra to find  $x$  (the number of turtles nesting 90 years ago).

$$0.145x = 35$$

Where 0.145 = the fraction of the previous population size that still exists, and 35 = the number of turtles nesting today

$$x = 241.38$$

Number of breeding females in Palau three generations ago:

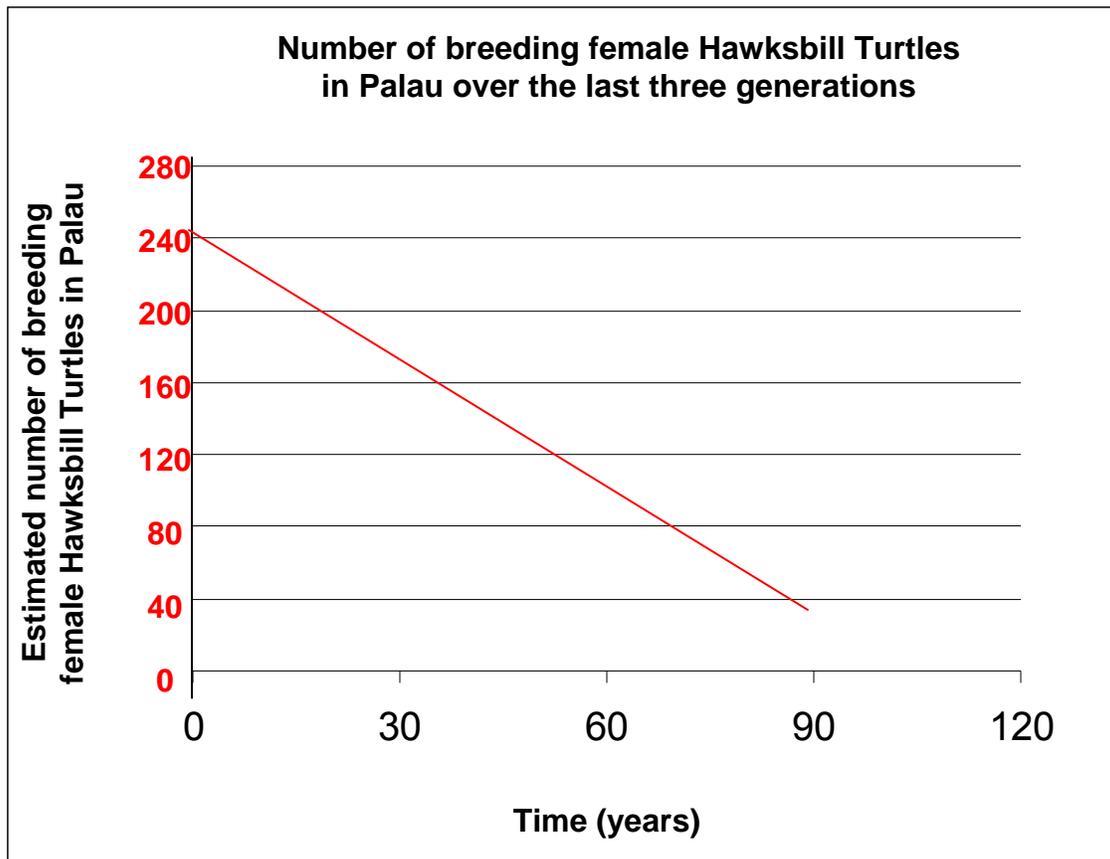
≈ 241

b. Complete this statement:

Approximately  (answer from 3a) *female Hawksbill Turtles were nesting in Palau in the year*  (answer from 2b). *Today, in the year* , *approximately*  (answer from 1a) *female Hawksbill Turtles are nesting in Palau.*

4. On the axes below, graphically represent the paragraph you completed in 3b. Designate your answer from 2b as "Year 0" on the x-axis, and the current year as "Year 90" on the x-axis.

*Be sure to add number labels to the y-axis.*



5. Draw a line between the points you added at Year 0 (three generations ago) and Year 90 (present).

a. Find the slope of the line ( $m$ ). Use 90 and 0 as your  $x$ -values.

*If needed, provide this hint to students:*

To find the slope of a line between two points, use the equation:  $m = (y_2 - y_1)/(x_2 - x_1)$  where  $(x_1, y_1)$  is (0, 241) and  $(x_2, y_2)$  is (90, 35).

$$m = (35 - 241) / (90 - 0) = -2.29$$

$$m = \boxed{-2.29}$$

**6. If the decline in breeding female Hawksbill Turtles continues at this rate in Palau, how much longer will Hawksbill Turtles breed in Palau?**

(Hint: What year will it be when  $y = 0$ ?)

Review your answer from 5a ( $m$ : the slope of the line representing turtle decline).

$$\boxed{-2.29}$$

Review your answer from 2a ( $y$ -intercept or  $b$ : the number of female Hawksbills nesting 3 generations ago in "Year 0").

$$\boxed{241 \text{ turtles}}$$

a. Calculate the year when the number of breeding female Hawksbill Turtles in Palau would reach zero.

*If needed, provide this hint to students:*

To find the year when the number of breeding turtles is zero, use the equation  $y = mx + b$ , where the  $y$ -value (number of breeding turtles) = 0;  $m$  = the slope of the line (-2.29, found in 5a); and  $b$  = the number of female turtles nesting three generations ago (241, found in 2a)

$$y = mx + b$$

$$0 = (-2.29)x + 241; \text{ solve for } x \text{ to get } x = 105$$

*Breeding Hawksbill Turtles in Palau would reach zero in the year:*

$$\boxed{105}$$

b. How many years from now would it be?

Recall that we are now in year 90;  $105 - 90 = 15$  years from now

Years from now:

$$\boxed{15 \text{ years}}$$

c. *In what year does this estimate predict there will be no more breeding female Hawksbills in Palau?*

Current year (2009\*) + 15 years = 2024\*

*Hawksbill Turtle would no longer breed in Palau in the year:*

$$\boxed{2024^*}$$