

Growth analysis of juvenile green sea turtles (*Chelonia mydas*) by gender.



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Problem

Will gender make a difference in the growth rates of juvenile green turtles (*Chelonia mydas*)?

Hypothesis

I think the female turtles will grow faster than the males in their juvenile stage because the females are larger in adulthood.

Background

There are seven different marine turtle species in the world. These are the Hawaiian green turtle, hawksbill, loggerhead, leatherback, flatback, olive ridley and Kemp's ridley. Of these seven species, the Hawaiian green turtle, hawksbill, loggerhead, olive ridley and leatherback are found in Hawaiian waters. The Hawaiian green turtle is the most common in Hawai'i.

Green turtles have three main stages in their life cycle. The first stage is the juvenile or pelagic stage. This is the stage where they are around one to five years of age. Second is pre-adult, which is similar to teens because they're maturing to adults. The age span of this is fifteen to thirty – five years. The third is the adult stage, where they're fully mature. Maturity occurs between twenty-five to thirty-five years of age. It is believed that turtles can live up to sixty-five years. (George Balazs, Personal Communication)

Hawaiian green turtles are found throughout the Hawaiian Island chain. The majority of green turtles are found in the main islands, because their main food, algae, is found in abundance. The juvenile green turtle, which lives in the open ocean, will eat jellyfish and other zooplankton (1).

In 1973, turtle biologists in Hawai'i began tagging and measuring turtles in the Northwestern Hawaiian Islands. Since that time, the project has expanded to include turtles throughout the entire Hawaiian Island chain. My school, Hawaii Preparatory Academy, has a program which involves students, teachers and scientists working together in various aspects of sea turtle research and conservation. H.P.A.'s Sea Turtle Research Program has been in existence for 20 years. The students work directly with National Oceanic and Atmospheric Administration's National Marine Fisheries Service scientists to collect sea turtle data and other interesting information. In order to maintain knowledge of a specific turtle, we tag turtles as a form of identification. Currently, PIT tags (passive integrated transponder) are used.

The Hawaiian green turtle is a threatened species under the Endangered Species Act. Under this act humans must not alter a sea turtle's behavior, including harassing or hunting. In 1975 it became both a federal and state offense to harass or hunt sea turtles. This early enforcement as well as their limited migration, has allowed the Hawaiian green turtle population to increase.

Prior to beginning this project, I participated in a number of turtle tagging and related community service events. For this experiment, I had the opportunity to work with juvenile green turtles that were hatched at Sea Life Park on O'ahu. Some of the hatchlings, as was the case with those I worked with, are loaned to nursery facilities such as the one at Mauna Lani Bay Hotel Resort and Bungalows.

Prior to arrival at the Mauna Lani Bay Hotel, veterinarians sexed the turtles through laparoscopy. They are currently being housed in the atrium ponds at Mauna Lani Bay Hotel where resident wildlife biologists care for them. The turtles are fed lettuce, protein pellets, and squid four-times a day by a timed automatic feeder. At some point in the future, the turtles will be released into the wild. This is typically done during Mauna Lani Bay Hotel's annual Sea Turtle Independent Day on the 4th of July.

Materials and Methods

Every two weeks I went to the Mauna Lani Bay Hotel and collected various measurements of the turtles in the company of resident wildlife biologists and student assistants. Each turtle was tagged with a PIT (passive integrated transponder) tag. I then assigned each turtle a name based on the turtle's gender. The female turtles were named, F1, F2, F3, and F4. The male turtles were named M1, M2, and M3.

I used a scoop net to collect the turtles. I weighed the turtles by placing them individually into a bin on a digital scale to the nearest 0.1 kg. The turtles' straight carapace length was measured using calipers to the nearest 0.1 cm. I then placed the turtles upright on a towel to make the various lateral measurements (L1, L2, and L3). Throughout the process, care was taken to maintain the health and safety of the turtles.

I ran a 95% confidence interval test on mean straight carapace length and weight growth at two week intervals for each turtle.

Data

Legend –

= Pit tag number in turtle.

SCL = Straight Carapace Length, measured in centimeters.

SW = Straight Width, measured in centimeters.

L1, L2, and L3 are body thickness measurements, measured laterally in centimeters.

L1 = Lateral Measurement. (Top section of turtle's body).

L2 = Lateral Measurement. (Middle section of turtle's body).

L3 = Lateral Measurement. (Bottom section of turtle's body).

WT. = Mass in pounds (lb) and kilograms (kg).

Table 1: Straight Carapace Length (cm) growth for all turtles over a 44 week period.

Date	F1	F2	F3	F4	M1	M2	M3
1/24/07	13.1	13.1	12.4	13.2	13.1	13.8	15.1
1/31/07	12.8	13.1	12.1	13.1	13	13.8	15.1
2/16/07	13.4	14.3	13.1	13.7	13.7	14.3	16.1
2/28/07	14.7	16	14	14.3	14.5	15.7	16.9
3/14/07	15.6	17.1	15	15	15.3	16.4	17.8
3/28/07	16.6	18.1	15.9	15.8	16.4	17.4	18.9
4/11/07	17.4	18.7	16.4	16.6	17.1	17.9	19.8
4/28/07	18.3	19.5	17	17.6	18.1	18.8	20.8
5/9/07	18.9	20.1	17.4	18.2	18.8	19.6	21.8
5/23/07	19.6	20.7	17.8	19.2	19.3	20.2	22.7
5/30/07	20	21	18.1	19.6	19.6	20.5	23.2
6/13/07	20.8	21.8	18.5	20.3	20.2	21.1	23.9
6/27/07	21.6	22.7	19.1	21	20.9	21.6	24.7
7/11/07	22.3	23.4	19.7	21.9	21.4	22	25.5
7/25/07	23	23.9	20.1	23	21.9	22.5	26
8/8/07	23.8	24.6	20.8	23.8	22.5	22.8	26.8
8/22/07	24.3	25.1	21.5	24.7	22.8	23.2	27.5
9/5/07	24.8	25.8	22	25.5	23.5	23.8	28.2
9/19/07	25.8	26.5	22.5	26.2	24.4	24.8	28.7
10/30/07	26.6	27	23.1	27	25.2	25.3	29.4
10/17/07	27.1	27.8	23.5	27.8	26	25.7	31.1
10/31/07	27.7	28.5	23.9	28.6	26.6	25.9	30.6
11/14/07	28.3	29.3	24.6	29.5	26.8	26	31.3
11/28/07	29.1	29.9	25.5	30.2	27.2	26.3	31.8

Table 2: Weight (kg) gained for all turtles over 44 week time period.

Date	F1	F2	F3	F4	M1	M2	M3
1/24/07	0.36	0.44	0.29	0.88	0.34	0.45	0.54
1/31/07	0.4	0.4	0.2	0.4	0.2	0.4	0.4
2/16/07	0.4	0.4	0.4	0.4	0.4	0.4	0.6
2/28/07	0.4	0.8	0.4	0.4	0.4	0.6	0.8
3/14/07	0.8	0.8	0.4	0.4	0.6	0.6	0.8
3/28/07	0.8	1	0.6	0.6	0.8	0.8	0.8
4/11/07	0.8	1.2	0.6	0.8	0.6	1	1
4/28/07	1	1.4	0.8	1	0.8	1	1.4
5/9/07	1.2	1.6	0.6	1	1	1.4	1.8
5/23/07	1.2	1.6	0.6	1	1	1.4	1.8
5/30/07	1.4	1.6	0.8	1.2	1	1.4	1.8
6/13/07	1.4	1.8	1	1.4	1	1.6	2
6/27/07	1.6	1.8	0.8	1.4	1.2	1.6	2.3
7/11/07	1.6	2	1	1.6	1	1.6	2.4
7/25/07	1.8	2.2	1.2	1.8	1.4	1.8	2.4
8/8/07	2	2.4	1.4	2	1.6	2	2.8
8/22/07	2	2.6	1.4	2.6	1.6	2.4	3
9/5/07	2.4	2.8	1.4	2.8	1.8	2	3.2
9/19/07	2.6	2.8	1.4	2.8	2.2	2.4	3.4
10/30/07	2.8	3.6	1.6	3.2	2.4	2.8	3.6
10/17/07	3.2	3.6	1.8	3.6	2.4	2.6	3.8
10/31/07	3.2	3.8	1.8	3.8	2.4	3.6	4.2
11/14/07	3.6	4.2	2.4	4.2	2.6	2.6	4.4
11/28/07	3.6	4.4	2.6	4.4	2.6	2.8	4.6

Table 3: Mean increase in straight carapace length (cm) at two week intervals.

Week	F1	F2	F3	F4	M1	M2	M3
2	0.6	1.2	1	0.6	0.7	0.5	1
4	1.3	1.7	0.9	0.6	0.8	1.4	0.8
6	0.9	1.1	1	0.7	0.8	0.7	0.9
8	1	1	0.9	0.8	1.1	1	1.1
10	0.8	0.6	0.5	0.8	0.7	0.5	0.9
12	0.9	0.8	0.6	1	1	0.9	1
14	0.6	0.6	0.4	0.6	0.7	0.8	1
16	0.7	0.6	0.4	1	0.5	0.6	0.9
18	0.4	0.3	0.3	0.4	0.3	0.3	0.5
20	0.8	0.8	0.4	0.7	0.6	0.9	0.7
22	0.8	0.9	0.6	0.7	0.7	0.5	0.8
24	0.7	0.7	0.6	0.9	0.5	0.4	0.8
26	0.7	0.5	0.4	1.1	0.5	0.5	0.5
28	0.8	0.7	0.7	0.8	0.6	0.3	0.8
30	0.5	0.5	0.7	0.9	0.3	0.4	0.7
32	0.5	0.7	0.5	0.8	0.7	0.6	0.7
34	1	0.7	0.5	0.7	0.9	1	0.5
36	0.8	0.5	0.6	0.8	0.8	0.5	0.7
38	0.5	0.8	0.4	0.8	0.8	0.4	1.7
40	0.6	0.7	0.4	0.8	0.6	0.2	-0.5
42	0.6	0.8	0.7	0.9	0.2	0.1	0.7
44	0.8	0.7	0.9	0.7	0.4	0.3	0.5
Mean	0.74	0.77	0.61	0.78	0.65	0.58	0.76
95% Confidence Interval	0.09	0.13	0.10	0.07	0.10	0.14	0.17

Table 4: Mean increase in weight (kg) at two week intervals.

Week	F1	F2	F3	F4	M1	M2	M3
2	0	0	0.2	0	0.2	0	0.2
4	0	0.2	0	0	0	0.2	0.2
6	0.4	0	0	0	0.2	0	0
8	0	0.2	0.2	0.2	0.2	0.2	0
10	0	0.2	0	0.2	-0.2	0.2	0.2
12	0.2	0.2	0.2	0.2	0.2	0	0.4
14	0.2	0.2	-0.2	0	0.2	0.4	0.4
16	0	0	0	0	0	0	0
18	0.2	0	0.2	0.2	0	0	0
20	0	0.2	0.2	0.2	0	0.2	0.2
22	0.2	0	-0.2	0	0.2	0	0.3
24	0	0.2	0.2	0.2	-0.2	0	0.1
26	0.2	0.2	0.2	0.2	0.4	0.2	0
28	0.2	0.2	0.2	0.2	0.2	0.2	0.4
30	0	0.2	0	0.6	0	0.4	0.2
32	0.4	0.2	0	0.2	0.2	-0.4	0.2
34	0.2	0	0	0	0.4	0.4	0.2
36	0.2	0.8	0.2	0.4	0.2	0.4	0.2
38	0.4	0	0.2	0.4	0	-0.2	0.2
40	0	0.2	0	0.2	0	1	0.4
42	0.4	0.4	0.6	0.4	0.2	-1	0.2
44	0	0.2	0.2	0.2	0	0.2	0.2
Mean	0.15	0.17	0.11	0.18	0.11	0.11	0.18
95% Confidence Interval	0.07	0.08	0.07	0.07	0.07	0.16	0.06

Table 5: Mean increases in straight carapace length (cm) and weight (kg) at two week intervals.

	Turtle	F1	F2	F3	F4	M1	M2	M3
Straight Carapace Length (cm)	Mean	0.74	0.77	0.61	0.78	0.65	0.58	0.76
	95% Confidence Interval	0.09	0.13	0.10	0.07	0.10	0.14	0.17
Weight (kg)	Mean	0.15	0.17	0.11	0.18	0.11	0.11	0.18
	95% Confidence Interval	0.07	0.08	0.07	0.07	0.07	0.16	0.06

Figure 1: Change in straight carapace length (cm) of male and female juvenile turtles over a 44 week period.

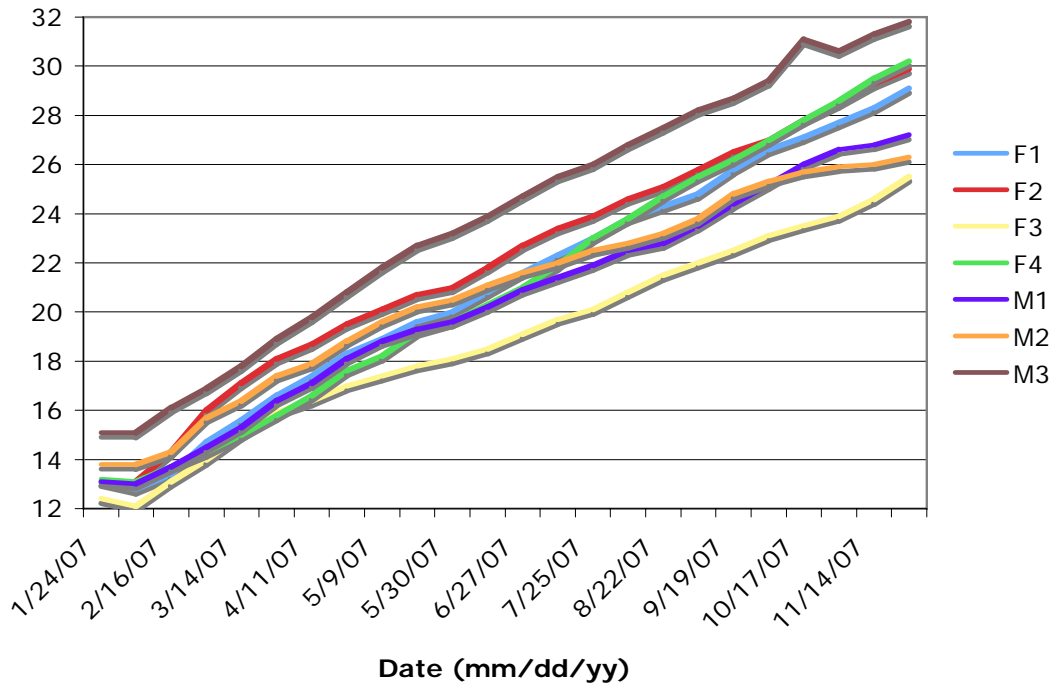


Figure 2: Weight (kg) of male and female juvenile turtles over a 44 week period.

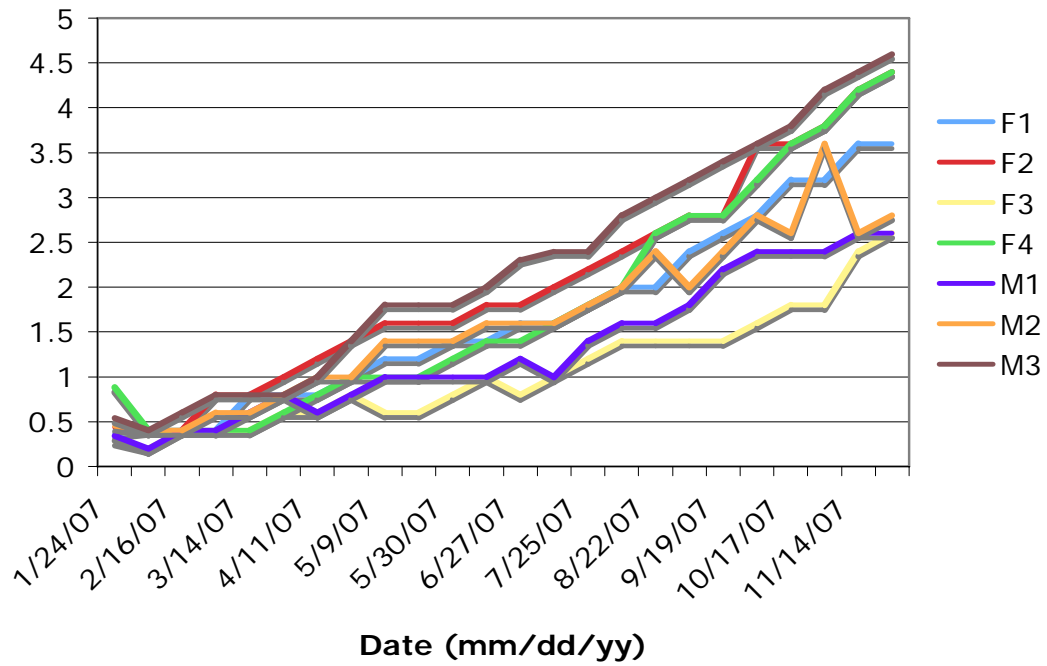
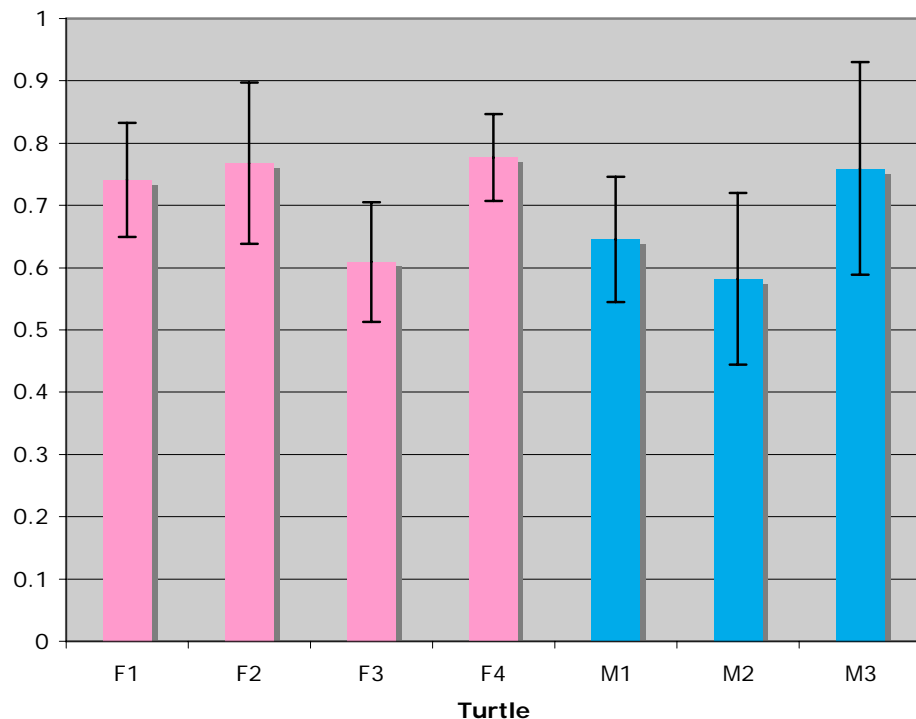
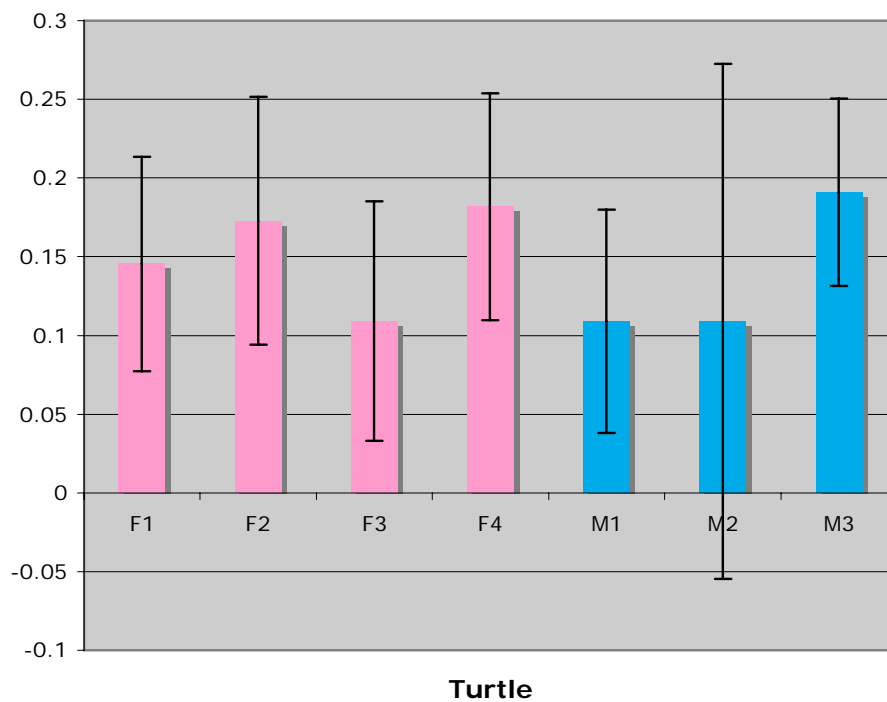


Figure 3: Mean increase in straight carapace length (cm) at two week intervals.



QuickTime™ and a TIFF (LZW) decompressor are needed to see this picture.

Figure 4 : Mean increase in weight (kg) at two week intervals.



QuickTime™ and a TIFF (LZW) decompressor are needed to see this picture.

Results

The mean straight carapace length (SCL) increases at two week intervals for the female turtles, (F1, F2, F3, and F4) were 0.74, 0.75, 0.61, and 0.78 cm, respectively. For the male turtles, (M1, M2, and M3) the straight carapace length increases at two week intervals were 0.65, 0.58, and 0.76 cm, respectively.

The 95% confidence interval for the female turtles' (F1, F2, F3, and F4) mean straight carapace length growth over a two week period were 0.09, 0.13, 0.10, and 0.07 cm respectively. For the male turtles, (M1, M2, and M3) the mean straight carapace length growth CI (Confidence Interval) was, 0.10, 0.14 and 0.17 cm respectively. (See Figure 3 for the diagrammatical representation of this parametric mean).

The mean weight increases at two week intervals for the female turtles, (F1, F2, F3, and F4) were 0.15, 0.17, 0.11, and 0.18 kg, respectively. For the male turtles, (M1, M2, and M3) the weight increases at two week intervals were 0.11, 0.11, and 0.19 kg, respectively.

The 95% confidence interval for the female turtles' (F1, F2, F3, and F4) mean weight change over a two week period were 0.07, 0.08, 0.07, and 0.07 kg respectively. For the male turtles, (M1, M2, and M3) the mean change in weight CI 0.07, 0.16, and 0.06 kg respectively. (See figure 4 for the diagrammatical representation of this parametric mean).

Conclusion

Before my project began, I thought the female turtles would grow faster. Based on my project, there is no significant data showing one gender grows faster. Given my small sample I cannot definitively answer my problem.

I am grateful for the opportunity to work on this project with threatened Hawaiian green turtles. As primary researcher, I consistently performed all measurements and successfully managed the data. I would be very interested in continuing data collection on these turtles to adulthood if possible, to see their changes in growth, for their continuing life cycle.

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