

BOTANY 455

ANALYSIS OF BIOLOGICAL DATA

FINAL PROJECT

DR. KENT BRIDGES

George, 12/17/91
let me know what
you think. This wasn't
the final I've changed
some but same rough
format. I've turned
my pass, keys and
will be taken off the lamp.
until a future date

Set up by you
IF you think this
paper is worth
the effort for publication

Best Regards

KBB

**A COMPARISON OF GROWTH RATES FOR THE TURTLE BARNACLE
CHELONIBIA TESTUDINARIA FROM THE CARAPACE OF HEALTHY AND
TUMORED GREEN SEA TURTLES *CHELONIA MYDAS* IN HAWAIIAN WATERS**

Karl B. Bromwell

INTRODUCTION

This project involves the statistical analysis of barnacle growth data collected during green sea turtle field operations in Kaneohe Bay, Hawaii. *Chelonibia testudinaria*, (Darwin, 1854) from the coronulid family of cirripedes is widely distributed around the world, but reported to be found only attached to turtles (Edmondson, 1933). Kaneohe Bay proved to be an ideal site for capture of resting and foraging sea turtle populations and obtaining data for turtles as well as the numerous barnacles of my target species attached to each.

The green sea turtle populations is currently afflicted by a debilitating disease called fibropapiloma. The cause of this disease is unknown, in the last 10 years has spread to epidemic proportions in areas as far apart as Florida and here in Hawaii. In Kaneohe Bay alone, 56% of 200 sea turtles

sampled in 1989 had this disease in varying degrees of severity ranging #1 - #4, (#1 being pea size "tumor like" growths on an eye lid or flipper area to a #4 classification having several the size of large grapefruits inner mixed with smaller ones, sometimes totally blocking vision or the glottis making feeding and breathing almost impossible.

Barnacles seemed more prevalent on the tumored turtles, some having in excess on 150 on their shell and limbs, compared to the healthy one which were usually just scattered on the shell (this may have been an interesting comparison?). Removal of barnacles became a standard procedure initially to allow for easy measurement of the shell, later all barnacles were removed to relieve the sea turtles of excess weight and drag. This was the case especially in the diseased weaker animals where shell damage was observed on several accounts and actual peeling up the scutes creating areas of stagnation and eventually formation of a black H₂S smelling liquid under the shells thin cuticle layer.

METHODS

The data used in this study were collected through out the 1991 Kaneohe Bay field operations of tag and release studies. All turtles were tagged on the trailing edge of each front flipper and one hind flipper with a alloyed metal tag. During each initial capture, the size and location of *C. testudinaria* on the turtles was recorded before removed. (I could have possibly improved on this method by leaving the barnacles on after measurement and recording the absolute increased growth when recaptured, though you still wouldn't know the absolute age of the barnacles). Location varied greatly to all parts of the body including tags, but in this experiment I only collected data from settlements on the carapace. I focused on the larger barnacle diameters to represent the closest to primary settlement on the clean shell. [The absolute day of initial settlement was of course actually unknown.

What I would do if more time and energy was available, (and had received this article earlier, it was misplaced? and off the shelf for over 3 weeks at Hamilton) would be to research the possibility of fitting my data to Fabens' (1965) growth interval equation: $L_r = a - (a - L_c)e^{-kd}$ where L_r is the diameter length at recapture, a is maximum (asymptotic) length, L_c is the diameter length at first capture, e is the base of the natural logarithm, k is the

intrinsic growth rate, and d is the capture-recapture interval in weeks. The von Bertalanffy growth model from which the previous was derived, would be more comparable to previous data (also more related to Bot 455), and would use a Statistical Analysis System (SAS) nonlinear least-squares regression procedure to obtain estimates of parameters a and k . The estimates would allow me to use the more general von Bertalanffy equation: $L = a(1 - be^{-kt})$ where L is the diameter length, b is a parameter related to the size of the barnacle at settlement, and t is age in weeks].

Between 1989 and the early months of 1991, sampling on the average of once a month, 18 recaptures of sea turtles and 160 *C. testudinaria* were recorded off marine turtle specimens previously removed of all barnacles. After randomizing the sample effort by taking the 10 largest measurements, I ended up with $n = 130$ for a barnacle sample size ($n = 40$ being healthy and $n = 90$ being tumored turtle growths (the randomization was done after the fact because data collection began before an actual objective or project was initiated for the data).

RESULTS

Data points were sorted by condition "COND" and "GROWTH" of the turtles so normality could be checked with univariate command for each of the data sets. COND=0 (healthy turtle/barnacle growths) had a mean of .4822 mm growth/week. W:Normal = .9574; this value for the test statistic is large indicating the sample is from a normal distribution, Prob< W = .1931; this is the probability value describing how doubtful the idea of normality is. A p-value of .1931 > than .05 indicating normal distribution. Skewness and Kurtosis both showing (-) numbers and in the vicinity of 1 indicating values to the left of the mean are more spread out and some tails present in that direction. The box plot for COND=0 also indicates normal distribution. For COND=1 (representing tumored turtle/barnacle growths), had a mean of .5256 mm growth/week. W:Normal = .8631 and a p-value of .0001 < .05, indicating the data are not from a normal distribution. Skewness and Kurtosis are both (+) and well over 1.0 for a value, showing distribution of values to the right of the mean with heavy tails. the box plot shows outlier.

In caparison of the two groups variance, by use of the SAS TEST procedure we find that Prob> F' = 0.00, indicating that the curve-widths, or variances, are significantly different. Using the row labeled unequal in representation

of our variances, I found an approximate two-sample t-test value of .1548, which is larger than 0.05 and indicates the growth rate averages for barnacles measured on carapaces from tumored and healthy turtles are not significantly different from each other at the 5% significance level.

DISCUSSION

There are no published estimates of growth rates for *C. testudinaria* that I could find. The mean estimate predicted by this study of 0.51 mm/week, taking the average between both studies since they were found to be not significantly different, would be quite modest considering the growth rates were calculated on the basis that settlement occurred the same day the original barnacles were removed and the animal was released, which is highly unlikely. Neither barnacle age nor the time interval over which growth rate was calculated are consistently reported, so as mentioned before, if barnacles were measured at capture, then a random sample of sizes left on at specific sites on the carapace, and then re-measured upon recapture you would have an absolute growth increase for each barnacle in reference to its initial size measurement, running into a problem of course with still not knowing the actual age of the barnacle

at the initial measurement, but could compare rates representing different life stages of the barnacles.

The variance differences for the growth conditions could have been a representation of chance due to insufficient sample number of turtles. In the case of the tumored turtles where more than twice the sample size was taken, the chance for uneven settlement of barnacles and having an outlier is greater. Another late suggestion to improve my study would be instead of a random sample number from each turtle, a random ratio number or percentage could be derived which would take the total number barnacles present on each separate turtle in to consideration..

Considering activity differences of tumored turtles, depending on the severity of the disease which are classified # 1 - #4, #4 being the worst case scenario (as mentioned in the introduction), a sick more lethargic turtle could have an effect on settlement, growth rate and reproduction of barnacles in several different ways. In my study, though a standard #3 was targeted, a #1 and a #2 classification were used in the data set for tumored turtles which may have affected my results. Finally, my results suggest caution when seeking to measure growth parameters from one population to another, and most of all set your objectives and procedures of your project before data collection of any sort and the write up will flow much easier.

ACKNOWLEDGEMENTS

The data for this project was collected during green sea turtle field operations in Kaneohe Bay, Hawaii, while employed with the National Marine Fisheries Service, Endangered Species Investigation Program, Honolulu Lab. Supervision and assistance in data collection from George H. Balazs, green sea turtle leader is appreciated.

LITERATURE CITED

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OBS	TURT_ID	RECAPT	DIAMETER	CAPTURE	WEEKINT	GROWTH
1	N395	06AUG1991	25	27SEP1990	45	0.55556
2	N395	06AUG1991	19	27SEP1990	45	0.42222
3	N395	06AUG1991	17	27SEP1990	45	0.37778
4	N395	06AUG1991	9	27SEP1990	45	0.20000
5	N395	06AUG1991	25	27SEP1990	45	0.55556
6	N395	06AUG1991	7	27SEP1990	45	0.15556
7	N395	06AUG1991	20	27SEP1990	45	0.44444
8	N395	06AUG1991	19	27SEP1990	45	0.42222
9	N395	06AUG1991	21	27SEP1990	45	0.46667
10	N395	06AUG1991	17	27SEP1990	45	0.37778
11	Z197	20SEP1990	34	01MAY1989	72	0.47222
12	Z197	20SEP1990	37	01MAY1989	72	0.51389
13	Z197	20SEP1990	37	01MAY1989	72	0.51389
14	Z197	20SEP1990	39	01MAY1989	72	0.54167
15	Z197	20SEP1990	36	01MAY1989	72	0.50000
16	Z197	20SEP1990	27	01MAY1989	72	0.37500
17	Z197	20SEP1990	29	01MAY1989	72	0.40278
18	Z197	20SEP1990	25	01MAY1989	72	0.34722
19	Z197	20SEP1990	22	01MAY1989	72	0.30556
20	Z197	20SEP1990	29	01MAY1989	72	0.40278
21	Z65	03SEP1991	29	15JUN1990	64	0.45312
22	Z65	03SEP1991	29	15JUN1990	64	0.45312
23	Z65	03SEP1991	25	15JUN1990	64	0.39062
24	Z65	03SEP1991	31	15JUN1990	64	0.48437
25	Z65	03SEP1991	33	15JUN1990	64	0.51563
26	Z65	03SEP1991	32	15JUN1990	64	0.50000
27	Z65	03SEP1991	22	15JUN1990	64	0.34375
28	Z65	03SEP1991	21	15JUN1990	64	0.32812
29	Z65	03SEP1991	22	15JUN1990	64	0.34375
30	Z65	03SEP1991	25	15JUN1990	64	0.39062
31	Y850	01SEP1991	28	01JUN1990	66	0.42424
32	Y850	01SEP1991	29	01JUN1990	66	0.43939
33	Y850	01SEP1991	24	01JUN1990	66	0.36364
34	Y850	01SEP1991	25	01JUN1990	66	0.37879
35	Y850	01SEP1991	21	01JUN1990	66	0.31818
36	Y850	01SEP1991	23	01JUN1990	66	0.34848
37	Y850	01SEP1991	20	01JUN1990	66	0.30303
38	Y850	01SEP1991	29	01JUN1990	66	0.43939
39	Y850	01SEP1991	18	01JUN1990	66	0.27273
40	Y850	01SEP1991	23	01JUN1990	66	0.34848
41	N505	25JUN1991	29	24AUG1990	44	0.65909
42	N505	25JUN1991	26	24AUG1990	44	0.59091
43	N505	25JUN1991	30	24AUG1990	44	0.68182
44	N505	25JUN1991	26	24AUG1990	44	0.59091
45	N505	25JUN1991	25	24AUG1990	44	0.56818

OBS	TURT_ID	RECAPT	DIAMETER	CAPTURE	WEEKINT	GROWTH	2
46	N505	25JUN1991	28	24AUG1990	44	0.63636	
47	N505	25JUN1991	27	24AUG1990	44	0.61364	
48	N505	25JUN1991	26	24AUG1990	44	0.59091	
49	N505	25JUN1991	28	24AUG1990	44	0.63636	
50	N505	25JUN1991	27	24AUG1990	44	0.61364	
51	Y833	24MAY1991	21	15JUN1990	49	0.42857	
52	Y833	24MAY1991	25	15JUN1990	49	0.51020	
53	Y833	24MAY1991	21	15JUN1990	49	0.42857	
54	Y833	24MAY1991	22	15JUN1990	49	0.44898	
55	Y833	24MAY1991	25	15JUN1990	49	0.51020	
56	Y833	24MAY1991	21	15JUN1990	49	0.42857	
57	Y833	24MAY1991	20	15JUN1990	49	0.40816	
58	Y833	24MAY1991	20	15JUN1990	49	0.40816	
59	Y833	24MAY1991	25	15JUN1990	49	0.51020	
60	Y833	24MAY1991	23	15JUN1990	49	0.46939	
61	N599	24MAY1991	9	02JAN1991	20	0.45000	
62	N599	24MAY1991	10	02JAN1991	20	0.50000	
63	N599	24MAY1991	2	02JAN1991	20	0.10000	
64	N599	24MAY1991	9	02JAN1991	20	0.45000	
65	N599	24MAY1991	10	02JAN1991	20	0.50000	
66	N599	24MAY1991	8	02JAN1991	20	0.40000	
67	N599	24MAY1991	2	02JAN1991	20	0.10000	
68	N599	24MAY1991	8	02JAN1991	20	0.40000	
69	N599	24MAY1991	4	02JAN1991	20	0.20000	
70	N599	24MAY1991	6	02JAN1991	20	0.30000	
71	Y898	01APR1991	17	15JUN1990	42	0.40476	
72	Y898	01APR1991	19	15JUN1990	42	0.45238	
73	Y898	01APR1991	21	15JUN1990	42	0.50000	
74	Y898	01APR1991	22	15JUN1990	42	0.52381	
75	Y898	01APR1991	16	15JUN1990	42	0.38095	
76	Y898	01APR1991	20	15JUN1990	42	0.47619	
77	Y898	01APR1991	18	15JUN1990	42	0.42857	
78	Y898	01APR1991	20	15JUN1990	42	0.47619	
79	Y898	01APR1991	18	15JUN1990	42	0.42857	
80	Y898	01APR1991	17	15JUN1990	42	0.40476	
81	Y898	01APR1991	21	15JUN1990	42	0.50000	
82	Y898	01APR1991	29	15JUN1990	42	0.69048	
83	Y898	01APR1991	26	15JUN1990	42	0.61905	
84	Y898	01APR1991	17	15JUN1990	42	0.40476	
85	Y898	01APR1991	21	15JUN1990	42	0.50000	
86	Y898	01APR1991	23	15JUN1990	42	0.54762	
87	Y898	01APR1991	23	15JUN1990	42	0.54762	
88	Y898	01APR1991	24	15JUN1990	42	0.57143	
89	Y898	01APR1991	19	15JUN1990	42	0.45238	
90	Y898	01APR1991	18	15JUN1990	42	0.42857	

OBS	TURT_ID	RECAPT	DIAMETER	CAPTURE	WEEKINT	GROWTH	3
91	Y889	31JAN1991	16	15JUN1990	33	0.48485	
92	Y889	31JAN1991	17	15JUN1990	33	0.51515	
93	Y889	31JAN1991	9	15JUN1990	33	0.27273	
94	Y889	31JAN1991	20	15JUN1990	33	0.60606	
95	Y889	31JAN1991	10	15JUN1990	33	0.30303	
96	Y889	31JAN1991	8	15JUN1990	33	0.24242	
97	Y889	31JAN1991	15	15JUN1990	33	0.45455	
98	Y889	31JAN1991	9	15JUN1990	33	0.27273	
99	Y889	31JAN1991	12	15JUN1990	33	0.36364	
100	Y889	31JAN1991	15	15JUN1990	33	0.45455	
101	N374	27AUG1991	31	24AUG1990	53	0.58491	
102	N374	27AUG1991	31	24AUG1990	53	0.58491	
103	N374	27AUG1991	30	24AUG1990	53	0.56604	
104	N374	27AUG1991	29	24AUG1990	53	0.54717	
105	N374	27AUG1991	24	24AUG1990	53	0.45283	
106	N374	27AUG1991	22	24AUG1990	53	0.41509	
107	N374	27AUG1991	24	24AUG1990	53	0.45283	
108	N374	27AUG1991	25	24AUG1990	53	0.47170	
109	N374	27AUG1991	27	24AUG1990	53	0.50943	
110	N374	27AUG1991	27	24AUG1990	53	0.50943	
111	N849	07OCT1991	27	29APR1991	23	1.17391	
112	N849	07OCT1991	26	29APR1991	23	1.13043	
113	N849	07OCT1991	23	29APR1991	23	1.00000	
114	N849	07OCT1991	23	29APR1991	23	1.00000	
115	N849	07OCT1991	24	29APR1991	23	1.04348	
116	N849	07OCT1991	23	29APR1991	23	1.00000	
117	N849	07OCT1991	24	29APR1991	23	1.04348	
118	N849	07OCT1991	28	29APR1991	23	1.21739	
119	N849	07OCT1991	24	29APR1991	23	1.04348	
120	N849	07OCT1991	23	29APR1991	23	1.00000	
121	N684	07OCT1991	29	28FEB1991	32	0.90625	
122	N684	07OCT1991	25	28FEB1991	32	0.78125	
123	N684	07OCT1991	24	28FEB1991	32	0.75000	
124	N684	07OCT1991	20	28FEB1991	32	0.62500	
125	N684	07OCT1991	20	28FEB1991	32	0.62500	
126	N684	07OCT1991	20	28FEB1991	32	0.62500	
127	N684	07OCT1991	21	28FEB1991	32	0.65625	
128	N684	07OCT1991	21	28FEB1991	32	0.65625	
129	N684	07OCT1991	22	28FEB1991	32	0.6875	
130	N684	07OCT1991	16	28FEB1991	32	0.5000	

DATA RAW SPLIT INTO TUMORED AND HEALTHY TURTLES

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OBS	TURT_ID	RECAPT	DIAMETER	CAPTURE	WEEKINT	GROWTH	COND
1	N374	27AUG1991	31	24AUG1990	53	0.58491	HEALTHY
2	N374	27AUG1991	31	24AUG1990	53	0.58491	HEALTHY
3	N374	27AUG1991	30	24AUG1990	53	0.56604	HEALTHY
4	N374	27AUG1991	29	24AUG1990	53	0.54717	HEALTHY
5	N374	27AUG1991	24	24AUG1990	53	0.45283	HEALTHY
6	N374	27AUG1991	22	24AUG1990	53	0.41509	HEALTHY
7	N374	27AUG1991	24	24AUG1990	53	0.45283	HEALTHY
8	N374	27AUG1991	25	24AUG1990	53	0.47170	HEALTHY
9	N374	27AUG1991	27	24AUG1990	53	0.50943	HEALTHY
10	N374	27AUG1991	27	24AUG1990	53	0.50943	HEALTHY
11	N395	06AUG1991	25	27SEP1990	45	0.55556	TUMOR
12	N395	06AUG1991	19	27SEP1990	45	0.42222	TUMOR
13	N395	06AUG1991	17	27SEP1990	45	0.37778	TUMOR
14	N395	06AUG1991	9	27SEP1990	45	0.20000	TUMOR
15	N395	06AUG1991	25	27SEP1990	45	0.55556	TUMOR
16	N395	06AUG1991	7	27SEP1990	45	0.15556	TUMOR
17	N395	06AUG1991	20	27SEP1990	45	0.44444	TUMOR
18	N395	06AUG1991	19	27SEP1990	45	0.42222	TUMOR
19	N395	06AUG1991	21	27SEP1990	45	0.46667	TUMOR
20	N395	06AUG1991	17	27SEP1990	45	0.37778	TUMOR
21	N505	25JUN1991	29	24AUG1990	44	0.65909	HEALTHY
22	N505	25JUN1991	26	24AUG1990	44	0.59091	HEALTHY
23	N505	25JUN1991	30	24AUG1990	44	0.68182	HEALTHY
24	N505	25JUN1991	26	24AUG1990	44	0.59091	HEALTHY
25	N505	25JUN1991	25	24AUG1990	44	0.56818	HEALTHY
26	N505	25JUN1991	28	24AUG1990	44	0.63636	HEALTHY
27	N505	25JUN1991	27	24AUG1990	44	0.61364	HEALTHY
28	N505	25JUN1991	26	24AUG1990	44	0.59091	HEALTHY
29	N505	25JUN1991	28	24AUG1990	44	0.63636	HEALTHY
30	N505	25JUN1991	27	24AUG1990	44	0.61364	HEALTHY
31	N599	24MAY1991	9	02JAN1991	20	0.45000	TUMOR
32	N599	24MAY1991	10	02JAN1991	20	0.50000	TUMOR
33	N599	24MAY1991	2	02JAN1991	20	0.10000	TUMOR
34	N599	24MAY1991	9	02JAN1991	20	0.45000	TUMOR
35	N599	24MAY1991	10	02JAN1991	20	0.50000	TUMOR
36	N599	24MAY1991	8	02JAN1991	20	0.40000	TUMOR
37	N599	24MAY1991	2	02JAN1991	20	0.10000	TUMOR
38	N599	24MAY1991	8	02JAN1991	20	0.40000	TUMOR
39	N599	24MAY1991	4	02JAN1991	20	0.20000	TUMOR
40	N599	24MAY1991	6	02JAN1991	20	0.30000	TUMOR
41	N684	07OCT1991	29	28FEB1991	32	0.90625	TUMOR
42	N684	07OCT1991	25	28FEB1991	32	0.78125	TUMOR
43	N684	07OCT1991	24	28FEB1991	32	0.75000	TUMOR
44	N684	07OCT1991	20	28FEB1991	32	0.62500	TUMOR
45	N684	07OCT1991	20	28FEB1991	32	0.62500	TUMOR

OBS	TURT_ID	RECAPT	DIAMETER	CAPTURE	WEEKINT	GROWTH	COND	5
46	N684	07OCT1991	20	28FEB1991	32	0.62500	TUMOR	
47	N684	07OCT1991	21	28FEB1991	32	0.65625	TUMOR	
48	N684	07OCT1991	21	28FEB1991	32	0.65625	TUMOR	
49	N684	07OCT1991	22	28FEB1991	32	0.68750	TUMOR	
50	N684	07OCT1991	16	28FEB1991	32	0.50000	TUMOR	
51	N849	07OCT1991	27	29APR1991	23	1.17391	TUMOR	
52	N849	07OCT1991	26	29APR1991	23	1.13043	TUMOR	
53	N849	07OCT1991	23	29APR1991	23	1.00000	TUMOR	
54	N849	07OCT1991	23	29APR1991	23	1.00000	TUMOR	
55	N849	07OCT1991	24	29APR1991	23	1.04348	TUMOR	
56	N849	07OCT1991	23	29APR1991	23	1.00000	TUMOR	
57	N849	07OCT1991	24	29APR1991	23	1.04348	TUMOR	
58	N849	07OCT1991	28	29APR1991	23	1.21739	TUMOR	
59	N849	07OCT1991	24	29APR1991	23	1.04348	TUMOR	
60	N849	07OCT1991	23	29APR1991	23	1.00000	TUMOR	
61	Y833	24MAY1991	21	15JUN1990	49	0.42857	TUMOR	
62	Y833	24MAY1991	25	15JUN1990	49	0.51020	TUMOR	
63	Y833	24MAY1991	21	15JUN1990	49	0.42857	TUMOR	
64	Y833	24MAY1991	22	15JUN1990	49	0.44898	TUMOR	
65	Y833	24MAY1991	25	15JUN1990	49	0.51020	TUMOR	
66	Y833	24MAY1991	21	15JUN1990	49	0.42857	TUMOR	
67	Y833	24MAY1991	20	15JUN1990	49	0.40816	TUMOR	
68	Y833	24MAY1991	20	15JUN1990	49	0.40816	TUMOR	
69	Y833	24MAY1991	25	15JUN1990	49	0.51020	TUMOR	
70	Y833	24MAY1991	23	15JUN1990	49	0.46939	TUMOR	
71	Y850	01SEP1991	28	01JUN1990	66	0.42424	HEALTHY	
72	Y850	01SEP1991	29	01JUN1990	66	0.43939	HEALTHY	
73	Y850	01SEP1991	24	01JUN1990	66	0.36364	HEALTHY	
74	Y850	01SEP1991	25	01JUN1990	66	0.37879	HEALTHY	
75	Y850	01SEP1991	21	01JUN1990	66	0.31818	HEALTHY	
76	Y850	01SEP1991	23	01JUN1990	66	0.34848	HEALTHY	
77	Y850	01SEP1991	20	01JUN1990	66	0.30303	HEALTHY	
78	Y850	01SEP1991	29	01JUN1990	66	0.43939	HEALTHY	
79	Y850	01SEP1991	18	01JUN1990	66	0.27273	HEALTHY	
80	Y850	01SEP1991	23	01JUN1990	66	0.34848	HEALTHY	
81	Y889	31JAN1991	16	15JUN1990	33	0.48485	TUMOR	
82	Y889	31JAN1991	17	15JUN1990	33	0.51515	TUMOR	
83	Y889	31JAN1991	9	15JUN1990	33	0.27273	TUMOR	
84	Y889	31JAN1991	20	15JUN1990	33	0.60606	TUMOR	
85	Y889	31JAN1991	10	15JUN1990	33	0.30303	TUMOR	
86	Y889	31JAN1991	8	15JUN1990	33	0.24242	TUMOR	
87	Y889	31JAN1991	15	15JUN1990	33	0.45455	TUMOR	
88	Y889	31JAN1991	9	15JUN1990	33	0.27273	TUMOR	
89	Y889	31JAN1991	12	15JUN1990	33	0.36364	TUMOR	
90	Y889	31JAN1991	15	15JUN1990	33	0.45455	TUMOR	

OBS	TURT_ID	RECAPT	DIAMETER	CAPTURE	WEEKINT	GROWTH	COND	6
91	Y898	01APR1991	17	15JUN1990	42	0.40476	TUMOR	
92	Y898	01APR1991	19	15JUN1990	42	0.45238	TUMOR	
93	Y898	01APR1991	21	15JUN1990	42	0.50000	TUMOR	
94	Y898	01APR1991	22	15JUN1990	42	0.52381	TUMOR	
95	Y898	01APR1991	16	15JUN1990	42	0.38095	TUMOR	
96	Y898	01APR1991	20	15JUN1990	42	0.47619	TUMOR	
97	Y898	01APR1991	18	15JUN1990	42	0.42857	TUMOR	
98	Y898	01APR1991	20	15JUN1990	42	0.47619	TUMOR	
99	Y898	01APR1991	18	15JUN1990	42	0.42857	TUMOR	
100	Y898	01APR1991	17	15JUN1990	42	0.40476	TUMOR	
101	Y898	01APR1991	21	15JUN1990	42	0.50000	TUMOR	
102	Y898	01APR1991	29	15JUN1990	42	0.69048	TUMOR	
103	Y898	01APR1991	26	15JUN1990	42	0.61905	TUMOR	
104	Y898	01APR1991	17	15JUN1990	42	0.40476	TUMOR	
105	Y898	01APR1991	21	15JUN1990	42	0.50000	TUMOR	
106	Y898	01APR1991	23	15JUN1990	42	0.54762	TUMOR	
107	Y898	01APR1991	23	15JUN1990	42	0.54762	TUMOR	
108	Y898	01APR1991	24	15JUN1990	42	0.57143	TUMOR	
109	Y898	01APR1991	19	15JUN1990	42	0.45238	TUMOR	
110	Y898	01APR1991	18	15JUN1990	42	0.42857	TUMOR	
111	Z197	20SEP1990	34	01MAY1989	72	0.47222	HEALTHY	
112	Z197	20SEP1990	37	01MAY1989	72	0.51389	HEALTHY	
113	Z197	20SEP1990	37	01MAY1989	72	0.51389	HEALTHY	
114	Z197	20SEP1990	39	01MAY1989	72	0.54167	HEALTHY	
115	Z197	20SEP1990	36	01MAY1989	72	0.50000	HEALTHY	
116	Z197	20SEP1990	27	01MAY1989	72	0.37500	HEALTHY	
117	Z197	20SEP1990	29	01MAY1989	72	0.40278	HEALTHY	
118	Z197	20SEP1990	25	01MAY1989	72	0.34722	HEALTHY	
119	Z197	20SEP1990	22	01MAY1989	72	0.30556	HEALTHY	
120	Z197	20SEP1990	29	01MAY1989	72	0.40278	HEALTHY	
121	Z65	03SEP1991	29	15JUN1990	64	0.45312	TUMOR	
122	Z65	03SEP1991	29	15JUN1990	64	0.45312	TUMOR	
123	Z65	03SEP1991	25	15JUN1990	64	0.39062	TUMOR	
124	Z65	03SEP1991	31	15JUN1990	64	0.48437	TUMOR	
125	Z65	03SEP1991	33	15JUN1990	64	0.51563	TUMOR	
126	Z65	03SEP1991	32	15JUN1990	64	0.50000	TUMOR	
127	Z65	03SEP1991	22	15JUN1990	64	0.34375	TUMOR	
128	Z65	03SEP1991	21	15JUN1990	64	0.32812	TUMOR	
129	Z65	03SEP1991	22	15JUN1990	64	0.34375	TUMOR	
130	Z65	03SEP1991	25	15JUN1990	64	0.39062	TUMOR	

NORMALITY TEST: BARNACLES GROWTH RATES BETWEEN TURTLES HEALTH CONDITION

----- COND=0 HEALTHY TURTLES -----

UNIVARIATE PROCEDURE

Variable=GROWTH

Moments

N	40	Sum Wgts	40
Mean	0.482188	Sum	19.28752
Std Dev	0.111648	Variance	0.012465
Skewness	-0.08932	Kurtosis	-1.07796
USS	9.786357	CSS	0.486145
CV	23.15442	Std Mean	0.017653
T:Mean=0	27.31468	Prob>|T|	0.0001
Sgn Rank	410	Prob>|S|	0.0001
Num ^ = 0	40		
W:Normal	0.957363	Prob<W	0.1931

Quantiles(Def=5)

100% Max	0.681818	99%	0.681818
75% Q3	0.584906	95%	0.647727
50% Med	0.486111	90%	0.625
25% Q1	0.390783	10%	0.332702
0% Min	0.272727	5%	0.304293
		1%	0.272727
Range	0.409091		
Q3-Q1	0.194123		
Mode	0.590909		

UNIVARIATE PROCEDURE

Variable=GROWTH

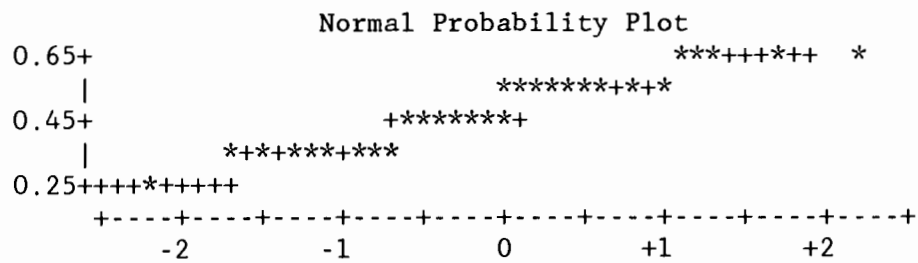
Extremes

Lowest	Obs	Highest	Obs
0.272727(	29)	0.613636(	20)
0.303030(	27)	0.636364(	16)
0.305556(	39)	0.636364(	19)
0.318182(	25)	0.659091(	11)
0.347222(	38)	0.681818(	13)

Stem	Leaf	#	Boxplot
6	114468	6	|
5	01111457788999	14	+-----+
4	0022445577	10	*--+-*
3	012555688	9	+-----+
2	7	1	|

-----+-----+-----+-----+

Multiply Stem.Leaf by 10**-1



NORMALITY TEST: BARNACLES GROWTH RATES BETWEEN TURTLES HEALTH CONDITION

-----COND=1 TUMORED TURTLES-----

UNIVARIATE PROCEDURE

Variable=GROWTH

Moments

N	90	Sum Wgts	90
Mean	0.525604	Sum	47.30439
Std Dev	0.234064	Variance	0.054786
Skewness	1.213613	Kurtosis	1.396061
USS	29.73934	CSS	4.875952
CV	44.53237	Std Mean	0.024673
T:Mean=0	21.30323	Prob>|T|	0.0001
Sgn Rank	2047.5	Prob>|S|	0.0001
Num ^= 0	90		
W:Normal	0.863126	Prob<W	0.0001

Quantiles(Def=5)

100% Max	1.217391	99%	1.217391
75% Q3	0.571429	95%	1.043478
50% Med	0.468027	90%	1
25% Q1	0.404762	10%	0.301515
0% Min	0.1	5%	0.2
		1%	0.1
Range	1.117391		
Q3-Q1	0.166667		
Mode	0.5		

UNIVARIATE PROCEDURE

Variable=GROWTH

Extremes

Lowest	Obs	Highest	Obs
0.1(	17)	1.043478(	37)
0.1(	13)	1.043478(	39)
0.155556(	6)	1.130435(	32)
0.2(	19)	1.173913(	31)
0.2(	4)	1.217391(	38)

Histogram	#	Boxplot
1.3+*	1	*
.*****	9	0
.*	1	0
0.7+*****	11	|
.*****	49	+---+---+
.*****	16	|
0.1+**	3	0

-----+-----+-----+-----+-----+

* may represent up to 2 counts

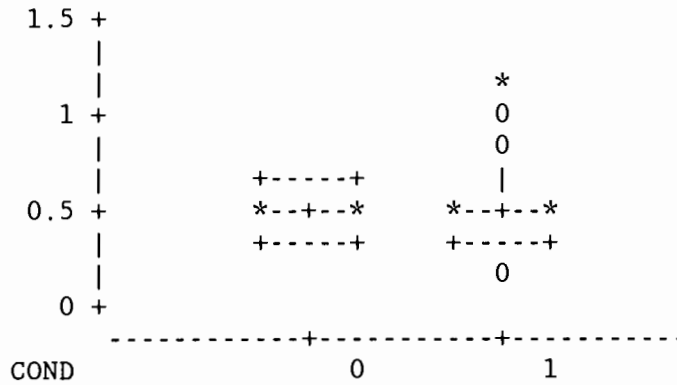
Normal Probability Plot

1.3+ | *
| ***** * * *+++++
| *+++++++
0.7+ | +++++*
| *****
| *** *+++++
0.1+* | ++++++
+-----+-----+-----+-----+-----+
-2 -1 0 +1 +2

BARNACLES GROWTH RATES BETWEEN TURTLES HEALTH CONDITION
 TEST NORMALITY - COND=0 (HEALTHY), COND=1 (TUMORED)

UNIVARIATE PROCEDURE
 Schematic Plots

Variable=GROWTH



FREQ. DIST. OF BARN GROWTH RATES FOR TURTLE CONDITION:

0= BARNACLES MEASURED ON HEALTHY TURTLES
 1= BARNACLES MEASURED ON TUMORED TURTLES

FREQUENCY OF GROWTH GROUPED BY COND

COND	GROWTH MIDPOINT		FREQ	CUM FREQ	PERCENT	CUM PERCENT
0	0.15	|	0	0	0.00	0.00
	0.30	|****	8	8	6.15	6.15
	0.45	|*****	17	25	13.08	19.23
	0.60	|*****	14	39	10.77	30.00
	0.75	|*	1	40	0.77	30.77
	0.90	|	0	40	0.00	30.77
	1.05	|	0	40	0.00	30.77
	1.20	|	0	40	0.00	30.77
1	0.15	|***	5	45	3.85	34.62
	0.30	|*****	9	54	6.92	41.54
	0.45	|*****	49	103	37.69	79.23
	0.60	|*****	12	115	9.23	88.46
	0.75	|**	4	119	3.08	91.54
	0.90	|*	1	120	0.77	92.31
	1.05	|****	7	127	5.38	97.69
	1.20	|**	3	130	2.31	100.00

TEST DIFFERENCE IN GROWTH

TTEST PROCEDURE

Variable: GROWTH

COND	N	Mean	Std Dev	Std Error
0	40	0.48218804	0.11164786	0.01765308
1	90	0.52560433	0.23406404	0.02467252

Variances	T	DF	Prob>|T|
Unequal	-1.4311	127.3	0.1548
Equal	-1.1163	128.0	0.2664

For H0: Variances are equal, $F' = 4.40$ DF = (89,39)
 Prob>F' = 0.0000

N P A R I W A Y P R O C E D U R E

Wilcoxon Scores (Rank Sums) for Variable GROWTH
 Classified by Variable COND

COND	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
0	40	2596.50000	2620.0	198.193541	64.9125000
1	90	5918.50000	5895.0	198.193541	65.7611111