

DATA ABSTRACTS FROM  
REPRODUCTIVE ECOLOGY OF GREEN TURTLES AT  
FRENCH FRIGATE SHOALS, NORTHWESTERN HAWAIIAN ISLANDS

MANUSCRIPT IN PREPARATION

BY

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Data abstract from REPRODUCTIVE  
 ECOLOGY OF GREEN TURTLES AT FRENCH  
 FRIGATE SHOALS, NORTHWESTERN HAWAIIAN ISLANDS

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February 1978

Study area: East Island, French Frigate Shoals (23°47'N, 166°13'W)

Dependent variable: number of eggs per clutch (y)

Sampling method: non-disturbing counts made during egg deposition

Sampling periods: 2-20 June; 27 June-18 July; 26 July-12 August 1974

Sample size: 50 egg clutches

Independent variables:

1. time - date of egg deposition within nesting season designated by consecutive numbers starting with day 1 for 2 June, and progressing through day 75 for 12 August
2. ratio of the curved and straight carapace widths - an index of thickness of the nesting female's carapace
3. straight carapace length - a direct measurement in centimeters of the nesting female's size

Results of multiple regression analysis:

Index	Mean	SD	Range
1-time	34.5	19.3	1-75
2-C/S ratio	1.28	0.04	1.19-1.36
3-length	93.1	2.9	86.4-97.8
y-no. eggs	104.4	23.4	38-145

Index	Partial regression coefficient (b)	t-ratio
0	-268.704	-1.724
by 1.23	-0.271	-1.685
by 2.13	93.768	1.124
by 3.12	2.819	2.626* p<.05
df = 46	.05 = 2.014	.01 = 2.690

Formula for predicting the number of eggs (y) in a clutch at East Island using time (x<sub>1</sub>), C/S ratio (x<sub>2</sub>) and length (x<sub>3</sub>)

$$y = -268.704 + (-0.271)x_1 + 93.768x_2 + 2.819x_3$$

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Study area: East Island, French Frigate Shoals (23°47'N, 166°13'W)

Dependent variables individually examined:

1. percent emergence of live hatchlings
2. percent of hatchlings found dead in nest
3. percent of eggs hatched
4. percent of eggs partially developed
5. percent of eggs with no apparent development

Sampling method: excavation and examination of previously counted egg clutches after cessation of natural hatchling and emergence

Sampling periods: 6-15 August; 19 September-10 October 1974

Sample size: 40 nests

Independent variables:

1. time - date of egg deposition within nesting season designated by consecutive numbers starting with day 1 for 2 June, and progressing through day 72 for 9 August 1974
2. type of nesting substrate - numerically assigned to one of five categories based on visual examination of particle size and composition: 1-fine; 2-fine/medium; 3-medium; 4-medium/coarse; 5-coarse
3. depth of nest - distance in centimeters from the substrate surface to the bottom of the egg clutch
4. straight carapace length - a direct measurement in centimeters of the nesting female's size

## Results of multiple regression analysis:

Index	Mean	SD	Range
1-time	33.8	19.4	1-72
2-substrate	2.7	1.1	1-5
3-depth	58.9	5.9	48-74
4-length	93.3	2.6	86.4-97.8
y - % emergence	70.8	24.0	0-97.6
y - % dead hatchlings	5.9	9.4	0-52.1
y - % hatch	76.7	24.2	0-100
y - % partially developed	10.8	9.9	0-50.0
y - % no development	12.5	22.4	0-100

## Percent emergence (y)

Index	Partial regression coefficient (b)	t-ratio
0	93.954	0.0697
time by 1.234	-0.408	-2.046* p<.05
substrate by 3.124	-0.415	-0.119
depth by 3.124	-1.405	-0.798
length by 4.123	-0.260	-0.173
df = 35    .05 = 2.030    .01 = 2.724		

## Percent dead hatchlings (y)

Index	Partial regression coefficient (b)	t-ratio
0	13.266	0.246
time by 1.234	0.105	1.320
substrate by 2.134	-0.144	-0.103
depth by 3.124	0.840	1.192
length by 4.123	-0.322	-0.533
df = 35    .05 = 2.030    .01 = 2.724		

## Percent of eggs hatched (y)

Index	Partial regression coefficient (b)	t-ratio
0	109.013	0.787
time by1.234	-0.339	-1.655
substrate by2.134	-1.154	-0.322
depth by3.124	-0.397	-0.219
length by4.123	-0.095	-0.062
df = 35    .05 = 2.030    .01 = 2.724		

## Percent partially developed eggs (y)

Index	Partial regression coefficient (b)	t-ratio
0	-16.775	-0.292
time by1.234	-0.042	-0.497
substrate by2.134	-1.241	-0.834
depth by3.124	0.352	0.468
length by4.123	0.259	0.403
df = 35    .05 = 2.030    .01 = 2.724		

## Percent no development (y)

Index	Partial regression coefficient (b)	t-ratio
0	9.473	0.075
time by1.234	0.345	1.840
substrate by2.134	1.799	0.549
depth by3.124	0.212	0.128
length by4.123	-0.197	-0.139
df = 35    .05 = 2.030    .01 = 2.724		

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Study area: East Island, French Frigate Shoals (23°47'N, 166°13'W)

Dependent variables examined:

1. percent emergence of live hatchlings
2. percent of eggs hatched

Sampling method: excavation and examination of egg clutches after cessation of natural hatching and emergence

Sampling periods: 6-15 August; 19 September-10 October 1974

Sample size: 40 nests

Independent variables:

1. time - date of egg deposition within nesting season designated by consecutive numbers starting with day 1 for 2 June, and progressing through day 72 for 9 August 1974
2. type of nesting substrate - numerically assigned to one of five categories based on visual examination of particle size and composition: 1-fine; 2-fine/medium; 3-medium; 4-medium/coarse; 5-coarse
3. depth of nest - distance in centimeters from the substrate surface to the bottom of the egg clutch
4. straight carapace length - a direct measurement in centimeters of the nesting female's size
5. number of eggs per clutch

## Results of multiple regression analysis:

Index	Mean	SD	Range
1-time	33.8	19.4	1-72
2-substrate	2.7	1.1	1-5
3-depth	58.9	5.9	48-74
4-length	93.3	2.6	86.4-97.8
5-no. eggs	102.4	26.1	38-145
y-% emergence	70.8	24.0	0-97.6
y-% hatch	76.7	24.2	0-100

## Percent emergence (y)

Index	Partial regression coefficient (b)	t-ratio
0	59.973	0.416
time by1.2345	-0.465	-2.148* p<.05
substrate by2.1345	-0.149	-0.042
depth by3.1245	-0.896	-0.468
length by4.1235	0.657	0.405
no. eggs by5.1234	-0.133	-0.702
df = 34	.05 = 2.030	.01 = 2.724

## Percent of eggs hatched (y)

Index	Partial regression coefficient (b)	t-ratio
0	72.850	0.492
time by1.2345	-0.399	-1.795
substrate by2.1345	-0.876	-0.241
depth by3.1245	0.140	0.071
length by4.1235	0.326	0.196
no. egg by5.1234	-0.140	-0.722
df = 34	.05 = 2.030	.01 = 2.724

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Study area: East Island, French Frigate Shoals (23°47'N, 166°13'W)

Dependent variables individually examined:

1. percent emergence of live hatchlings
2. percent of hatchlings found dead in nest
3. percent of eggs hatched
4. percent of eggs partially developed
5. percent of eggs with no apparent development

Sampling method: excavation and examination of egg clutches after cessation of natural hatching and emergence

Sampling periods: 2-15 August; 19 September-10 October 1974

Sample size: 143 comprised of 40 previously counted egg clutches and 103 uncounted clutches in which the original numbers of eggs (y) were calculated using the known values of date of egg deposition ( $x_1$ ), ratio of curved and straight carapace width ( $x_2$ ) and straight carapace length ( $x_3$ )

$$y = -268.704 + (-.271)x_1 + 93.768x_2 + 2.819x_3$$

Independent variables:

1. time - date of egg deposition within nesting season designated by consecutive numbers starting with day 1 for 2 June, and progressing through day 72 for 9 August 1974
2. type of nesting substrate - numerically assigned to one of five categories based on visual examination of particle size and composition: 1-fine; 2-fine/medium; 3-medium; 4-medium/coarse; 5-coarse
3. depth of nest - distance in centimeters from the substrate surface to the bottom of the egg clutch
4. straight carapace length - a direct measurement in centimeters of the nesting female's size



## Results of multiple regression analysis:

Index	Mean	SD	Range
1-time	33.4	18.3	1-72
2-substrate	2.6	1.3	1-5
3-depth	60.4	7.4	43-81
4-length	93.6	4.0	85.1-106.0
y - % emergence	71.5	23.1	0-99.0
y - % dead hatchlings	6.9	10.4	0-52.1
y - % hatch	78.4	23.0	0-100
y - % partially developed	8.4	9.8	0-53.9
y - % no development	13.2	21.4	0-100

## Percent emergence (y)

Index	Partial regression coefficient (b)	t-ratio
0	75.158	1.642
time by1.234	-0.288	-2.790** p<.01
substrate by2.134	-1.654	-1.138
depth by3.124	1.007	1.494
length by4.123	-0.146	-0.305
df = 138    .05 = 1.980    .01 = 2.617		

## Percent dead hatchlings (y)

Index	Partial regression coefficient (b)	t-ratio
0	-20.186	-0.988
time by1.234	0.123	2.675** p<.01
substrate by2.134	1.680	2.586* p<.05
depth by3.124	0.360	1.226
length by4.123	0.107	0.502
df = 138    .05 = 1.980    .01 = 2.617		

## Percent of eggs hatched (y)

Index	Partial regression coefficient (b)	t-ratio
0	52.741	1.133
time by1.234	-0.177	-1.687
substrate by2.134	-0.009	-0.006
depth by3.124	1.402	2.093* p<05
length by4.123	-0.019	-0.039
df = 138	.05 = 1.980	.01 = 2.617

## Percent partially developed eggs (y)

Index	Partial regression coefficient (b)	t-ratio
0	15.714	0.777
time by1.234	-0.031	-0.680
substrate by2.134	-0.653	-1.015
depth by3.124	-0.217	-0.746
length by4.123	-0.007	0.032
df = 138	.05 = 1.980	.01 = 2.617

## Percent no development (y)

Index	Partial regression coefficient (b)	t-ratio
0	25.030	0.577
time by1.234	0.197	2.020* p<.05
substrate by2.134	0.537	0.391
depth by3.124	-1.133	-1.810
length by4.123	0.076	0.167
df = 138	.05 = 1.980	.01 = 2.617

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February 1978

Study area: East Island, French Frigate Shoals (23°47'N, 166°13'W)

Dependent variables individually examined:

1. number of days to emergence of hatchlings from nest
2. percent emergence of live hatchlings
3. percent of hatchlings found dead in nest

Sampling methods: observations of surface substrate above egg clutch;  
excavation and examination of egg clutches after cessation  
of natural hatching and emergence

Sampling periods: 2-15 August; 19 September-10 October 1974

Sample size: 38 nests comprised of 13 previously counted egg clutches and 25 uncounted clutches in which the original numbers of eggs ( $y$ ) were calculated using the known values of date of egg deposition ( $x_1$ ), ratio of curved and straight carapace width ( $x_2$ ) and straight carapace length ( $x_3$ )

$$y = -268.704 + (-0.271)x_1 + 93.768x_2 + 2.819x_3$$

Independent variables:

1. time - date of egg deposition within nesting season designated by consecutive numbers starting with day 1 for 2 June, and progressing through day 72 for 9 August 1974
2. type of nesting substrate - numerically assigned to one of five categories based on visual examination of particle size and composition: 1-fine; 2-fine/medium; 3-medium; 4-medium/coarse; 5-coarse
3. depth of nest - distance in centimeters from the substrate surface to the bottom of the egg clutch

## Results of multiple regression analysis:

Index	Mean	SD	Range
1-time	36.1	26.1	1-72
2-substrate	2.7	1.4	1-5
3-depth	58.7	6.8	48.3-78.7
y-days to emergence	64.5	6.5	54-80
y-% emergence	71.6	16.0	28.5-96.0
y-% dead hatchlings	10.3	9.4	0-33.1

## Number of days to emergence (y)

Index	Partial regression coefficient (b)	t-ratio
0	70.929	6.665
time - by1.23	-0.042	-1.004
substrate - by2.13	-0.832	-1.009
depth - by3.12	-0.045	-0.269
df = 34	.05 = 2.030	.01 = 2.724

## Percent emergence (y)

Index	Partial regression coefficient (b)	t-ratio
0	121.3	3.059
time - by1.234	-0.146	-1.402
substrate -by2.134	-2.026	-0.986
depth - by3.124	-0.308	-0.752
days to emergence - by4.123	-0.322	-0.766
df = 33	.05 = 2.030	.01 = 2.724

## Percent dead hatchlings (y)

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Index	Partial regression coefficient (b)	t-ratio
0	11.601	0.555
time - by1.234	0.087	1.595
substrate - by2.134	1.692	1.562
depth - by3.124	0.271	1.256
days to emergence - by4.123	-0.387	-1.747

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df = 33    .05 = 2.030    .01 = 2.724

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Study area: East Island, French Frigate Shoals (23°47'N, 166°13'W)

Dependent variable: depth of nest in centimeters from the substrate surface  
to the bottom of the egg clutch

Sampling methods: excavation and measurement of nests after cessation of  
natural hatching and emergence

Sampling periods: 2-15 August; 19 September-10 October 1974

Sample size: 143 nests

Independent variables:

1. time - date of egg deposition within nesting season designated by consecutive numbers starting with day 1 for 2 June, and progressing through day 72 for 9 August 1974
2. type of nesting substrate - numerically assigned to one of five categories based on visual examination of particle size and composition: 1-fine; 2-fine/medium; 3-medium; 4-medium/coarse; 5-coarse
3. straight carapace length - a direct measurement in centimeters of the nesting female's size

## Results of multiple regression analysis:

Index	Mean	SD	Range
1-time	33.4	18.3	1-72
2-substrate	2.6	1.3	1-5
3-length	93.6	4.0	85.1-106.0
y-depth of nest	60.4	7.4	43-81

## Depth of nest (y)

Index	Partial regression coefficient (b)	t-ratio
0	18.323	3.221
time - by1.23	-0.001	-0.076
substrate - by2.13	-0.382	-2.067* p<.05
length - by3.12	0.069	1.131
df = 139	.05 = 1.980	.01 = 2.617

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Study area: East Island, French Frigate Shoals (23°47'N, 166°13'W)

Dependent variables examined:

1. width in meters of the area excavated by a nesting turtle
2. length in meters of the area excavated by a nesting turtle

Sampling method: direct measurements recorded several hours after nesting

Sampling period: 2-13 August 1974

Sample size: 19 excavations

Independent variable:

1. straight carapace length in centimeters of the nesting turtle

Results of regression analysis:

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Index	Mean	SD	Range
carapace length	94.3	4.2	88.3-106.0
y - excavation width	2.0	0.3	1.7- 2.7
y - excavation length	3.8	0.7	2.3- 5.0

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## Width of excavation (y)

Index	Partial regression coefficient (b)	t-ratio
0	-0.510	-0.370
carapace length	0.026	1.808
df = 17	.05 = 2.110	.01 = 2.898

## Length of excavation (y)

Index	Partial regression coefficient (b)	t-ratio
0	-1.058	-0.286
carapace length	0.051	1.300
df = 17	.05 = 2.110	.01 = 2.898