Assignment #8: Lizard Energy Budget

Timmy Nguyen

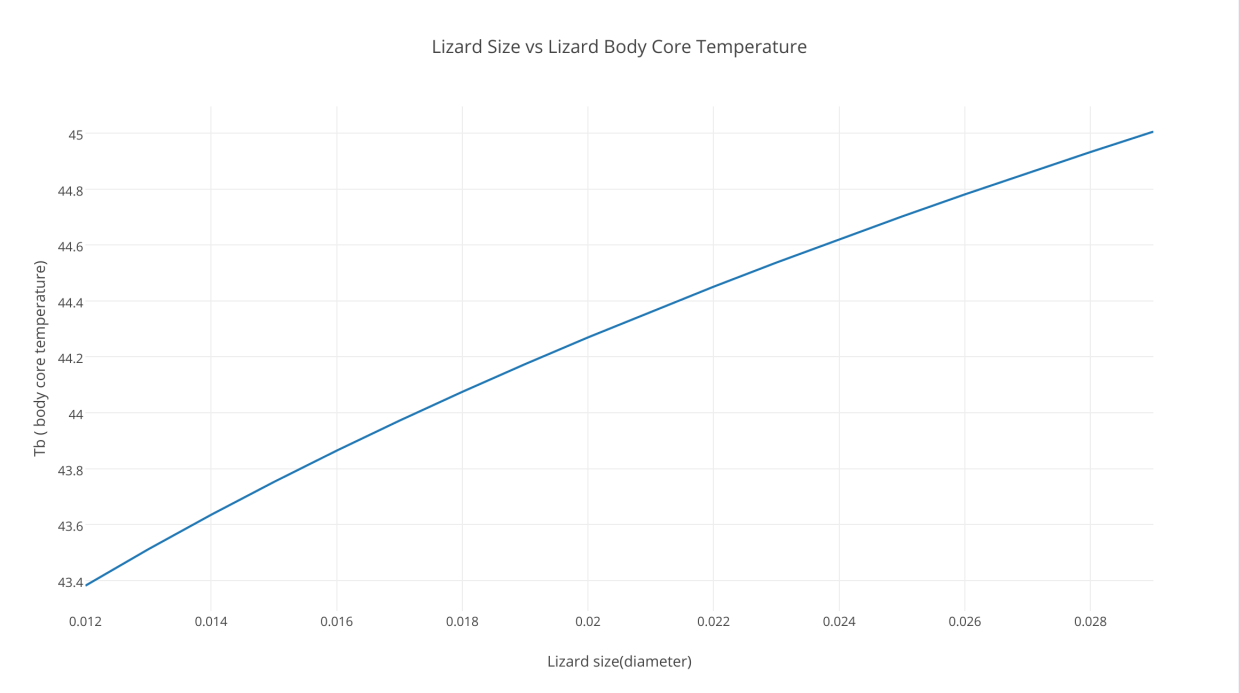
March 29, 2017

1 Introduction

In this lab, I am to utilize the lizard energy budget to determine how large a lizard can be out in the sun without going above a max body core temperature of 45C.

2 Results

2.0.1 Graph



3 Conclusion

From the results, the larger the lizard therefore the more heat absorbed resulting in an increase in Tb. Thus the largest size lizard from my simulation that stay under the max body core temperature is approximately 0.028 m.

4 Appendix

4.0.1 C Code

```c
/**
 * Name: Timmy Nguyen
 * Lab Exercise 8: Lizard Budget
 * BIO 480 Spring 2017
 * Date: 3-30 -17
 */

#include <stdio.h>
#include <string.h>
#include <math.h>


// Global Constants
double x1, x2;
double e = 0.00001;
double k1 = 3.49;


// Euler's number
double e_ = 2.71828182845904523536028747135 27;

// Stefan - Boltzmann Constant
double q_ = 0.0000000567;

/**
 * -- Lizard Budget Variables --
 *
 * Qa -> radiation inflow
 * Qout -> radiation outflow
 * V -> Wind speed
 * D -> lizard diameter
 * I -> insulation resistance
 * C -> Convection term
 * M -> Metabolic term
 * Hc -> convection coefficient
 * Ta -> air temperature
 * Tb -> lizard body core temp
 *
 */


```

```
42 double Qa, V, D, I_, emissitivity, Ta;
43 double  Tb, Qout, C, lamda_e, M, Hc;
44
45 double lizard_budget;
46 double lizard_mass, lizard_sa;
47
48 // Create function f(x) -> Lizard Budget
49 // Solving for Tb
50 double f(double x)
51 {
52   Tb = x;
53
54   Qout = emissitivity
55          * q_
56          * pow(Tb + 273.15 - I_ * ( M - lamda_e), 4);
57
58
59   M = 0.0258 * pow(e_, (Tb / 10));
60
61
62   Hc = k1 * sqrt(V / D);
63
64
65
66   if (Tb <= 20)
67   {
68     lamda_e = 0.27;
69   }
70   else if (20 < Tb && Tb < 36)
71   {
72     lamda_e = 0.08 * pow(e_, 0.0586 * Tb);
73   }
74   else
75   {
76     lamda_e = 0.00297 * pow(e_, 0.1516 * Tb );
77   }
78
79   C = Hc * ( Tb - Ta - I_ * ( M - lamda_e));
80
81
82   lizard_budget = M - lamda_e + Qa - Qout - C;
83
84   return lizard_budget;
85 }
86
```

```
87 // Finds the derivative of f(x)
88 double fderiv(double x)
89 {
90   double h = 0.0001;
91
92   // Difference Quotient
93   double diff_q =  ( f(x + h) - f(x - h) ) / (2 * h);
94   return diff_q;
95 }
96
97
98 double solve(double x)
99 {
100   int steps = 100;
101   for (int i = 0; i < steps; ++i)
102   {
103     x2 = x1 - f(x1) / fderiv(x1);
104
105     // When tolerance condition is met, end the loop
106     if (fabs(x2 - x1) < e)
107     {
108       break;
109     }
110
111     x1 = x2;
112
113   }
114
115   return x;
116 }
117
118 int main(int argc, char const *argv[])
119 {
120
121 // Prompt user inputs
122
123   /*  printf("Enter Qa: \n");
124     // scanf("%lf", &Qa );
125
126     printf("Enter Wind Speed(V): \n");
127     // scanf("%lf", &V );
128
129     printf("Enter Lizard Size(D): \n");
130     // scanf("%lf", &D );
131
```

```
132     printf("Enter Lizard Mass: \n");
133     // scanf("%lf", &lizard_mass );
134
135     printf("Enter Lizard Area: \n");
136     // scanf("%lf", &lizard_sa );
137
138
139     printf("Enter Insulation Resistance(I): \n");
140     // scanf("%lf", &I_ );
141
142     printf("Enter emissitivity: \n");
143     // scanf("%lf", &emissitivity );
144
145     printf("Enter air temperature(Ta): \n");
146     // scanf("%lf", &Ta );*/
147
148   // Init variables
149   Qa = 700;
150   V = 2.0;
151   D = 0.01;
152   I_ = 0.002;
153   emissitivity = 0.95;
154   Ta = 40;
155   lizard_mass = 0.067;
156   lizard_sa = 0.018;
157
158   printf("Input variables: \n");
159   printf("Qa: %lf\n", Qa);
160   printf("V: %lf\n", V);
161   printf("D: %lf\n", D);
162   printf("I_: %lf\n", I_);
163   printf("emissitivity: %lf\n", emissitivity);
164   printf("Ta: %lf\n", Ta);
165   printf("lizard mass: %lf\n", lizard_mass);
166   printf("lizard area: %lf\n", lizard_sa);
167
168   printf("\n");
169
170   // Settings maximum body core temp
171   x1 = 45;
172
173
174   // Saving file
175
176   char text[100];
```

```
177   char filename[100];
178   FILE *outfile;
179
180   printf( "Save data to disk file ? (y/n) : " );
181   scanf( "%s", text );
182   if ( strcmp( text, "y" ) == 0 )
183   {
184     printf( "Enter filename for first dataset : " );
185     scanf( "%s", filename );
186     outfile = fopen( filename, "w" );
187
188     while (x2 < 45)
189     {
190       solve(x1);
191       D = D + 0.001;
192       fprintf(outfile, "%lf \t %lf\n", D, x2);
193     }
194
195     fclose( outfile );
196
197   }
198
199   double lizard_ratio = lizard_mass / lizard_sa;
200
201   // Output to console
202
203   printf("Energy Terms: \n");
204   printf("Qa = %lf\n", Qa);
205   printf("Tb = %lf\n", Tb);
206   printf("Qout = %lf\n", Qout);
207   printf("C = %lf\n", C);
208
209   lamda_e = lamda_e * lizard_ratio;
210   M = M * lizard_ratio;
211
212   printf("E = %lf\n", lamda_e);
213   printf("M = %lf\n", M);
214
215
216   return 0;
217 }
```