GROWTH CURVE FOR MATURE AND IMMATURE DOLPHINS (SPLITTING BY SEX)
VON BERTALANFFY GROWTH MODEL

Stranded common dolphins 2065
Dolphins with length data 1283
Dolphins with sex data 1646
Dolphins with age data 440
Dolphins with maturity data 256
Dolphins with all the data 144

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von Bertalanffy growth model (All)

```
Formula: length ~ Linf * (1 - exp(-K * (age - to)))

Parameters:
       Estimate Std. Error t value Pr(>|t|)
Linf 204.49512    2.57864  79.303  < 2e-16 ***
K      0.23275    0.02557   9.101 8.11e-16 ***
to    -4.10388    0.51631  -7.948 5.66e-13 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 12 on 140 degrees of freedom

Number of iterations to convergence: 5
Achieved convergence tolerance: 2.606e-06
```

von Bertalanffy growth model (All mature)

```
Formula: length ~ Linf * (1 - exp(-K * (age - to)))

Parameters:
      Estimate Std. Error t value Pr(>|t|)
Linf 207.0479    17.1032  12.106 3.39e-16 ***
K      0.1241     0.3264   0.380    0.705
to   -15.3536    51.4824  -0.298    0.767
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 10.44 on 48 degrees of freedom

Number of iterations to convergence: 5
Achieved convergence tolerance: 3.665e-06
```

von Bertalanffy growth model (All immature)

```
Formula: length ~ Linf * (1 - exp(-K * (age - to)))

Parameters:
       Estimate Std. Error t value Pr(>|t|)
Linf 193.01469    6.13496  31.461  < 2e-16 ***
K      0.31286    0.06555   4.773 7.07e-06 ***
to    -3.29847    0.64775  -5.092 1.96e-06 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 12.74 on 89 degrees of freedom
```

```
Number of iterations to convergence: 7
Achieved convergence tolerance: 4.374e-06
```

von Bertalanffy growth model (Mature males)

```
Formula: length ~ Linf * (1 - exp(-K * (age - to)))

Parameters:
      Estimate Std. Error t value Pr(>|t|)
Linf 217.5755    16.6832  13.042 6.11e-10 ***
K      0.1904     0.2841   0.670    0.512
to    -3.8654    14.6079  -0.265    0.795
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 11.4 on 16 degrees of freedom

Number of iterations to convergence: 72
Achieved convergence tolerance: 5.907e-07
```

von Bertalanffy growth model (Immature males)

```
Formula: length ~ Linf * (1 - exp(-K * (age - to)))

Parameters:
      Estimate Std. Error t value Pr(>|t|)
Linf 194.8224    10.7939  18.049 4.63e-12 ***
K      0.4623     0.1624   2.847   0.0117 *
to    -1.6475     0.7130  -2.311   0.0345 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 14.05 on 16 degrees of freedom

Number of iterations to convergence: 8
Achieved convergence tolerance: 4.387e-06
```

von Bertalanffy growth model (Mature females)

```
Formula: length ~ Linf * (1 - exp(-K * (age - to)))

Parameters:
      Estimate Std. Error t value Pr(>|t|)
Linf 267.0915   755.8075   0.353    0.726
K      0.0183     0.1929   0.095    0.925
to   -57.9264   335.5022  -0.173    0.864

Residual standard error: 9.273 on 29 degrees of freedom

Number of iterations to convergence: 89
Achieved convergence tolerance: 0.7
```

von Bertalanffy growth model (Immature females)

```
Formula: length ~ Linf * (1 - exp(-K * (age - to)))


Parameters:
       Estimate Std. Error t value Pr(>|t|)
Linf 192.30003    6.80946  28.240  < 2e-16 ***
K      0.29254    0.06914   4.231 6.93e-05 ***
```

```
to    -3.69370    0.79259  -4.660 1.46e-05 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 12.11 on 70 degrees of freedom

Number of iterations to convergence: 7
Achieved convergence tolerance: 9.389e-06
```

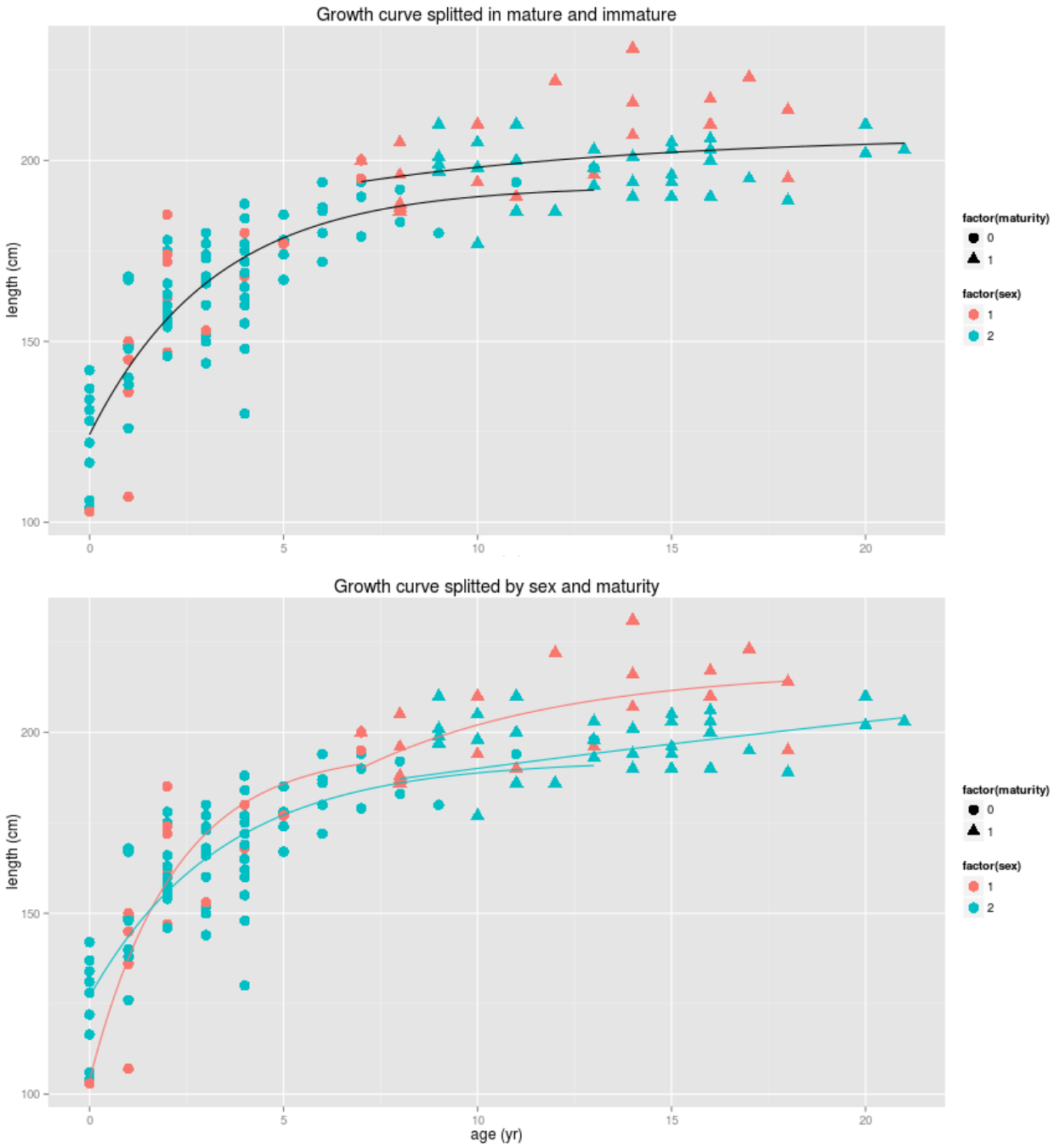

Figure: von Bertalanffy growth model: Males and Females (red, blue). Matures and immatures (filled circle, filled triangle).

Fixing to = 0 (mature and immature)

von Bertalanffy growth model (All)

```
Formula: length ~ Linf * (1 - exp(-K * (age - to)))

Parameters:
      Estimate Std. Error t value Pr(>|t|)
Linf 189.1503     3.8800  48.750  < 2e-16 ***
K      1.0854     0.1414   7.675 2.49e-12 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 36.67 on 141 degrees of freedom

Number of iterations to convergence: 13
Achieved convergence tolerance: 9.374e-06
```

von Bertalanffy growth model (All mature)

```
Formula: length ~ Linf * (1 - exp(-K * (age - to)))

Parameters:
       Estimate Std. Error t value Pr(>|t|)
Linf 202.67957    2.08251  97.325  < 2e-16 ***
K      0.40913    0.06708   6.099 1.65e-07 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 10.4 on 49 degrees of freedom

Number of iterations to convergence: 7
Achieved convergence tolerance: 1.442e-06
```

von Bertalanffy growth model (All immature)

```
Formula: length ~ Linf * (1 - exp(-K * (age - to)))

Parameters:
      Estimate Std. Error t value Pr(>|t|)
Linf 174.0094     6.0004  28.999  < 2e-16 ***
K      1.5708     0.3681   4.267 4.89e-05 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 43.21 on 90 degrees of freedom

Number of iterations to convergence: 9
Achieved convergence tolerance: 9.644e-06
```

von Bertalanffy growth model (Mature males)

```
Formula: length ~ Linf * (1 - exp(-K * (age - to)))

Parameters:
       Estimate Std. Error t value Pr(>|t|)
Linf 213.92939    4.58816  46.626  < 2e-16 ***
K      0.30070    0.04293   7.005 2.12e-06 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

```
Residual standard error: 11.15 on 17 degrees of freedom

Number of iterations to convergence: 4
Achieved convergence tolerance: 6.934e-06
```

von Bertalanffy growth model (Immature males)

```
Formula: length ~ Linf * (1 - exp(-K * (age - to)))

Parameters:
      Estimate Std. Error t value Pr(>|t|)
Linf 180.7143    10.4027  17.372 2.95e-12 ***
K      1.2953     0.3363   3.852  0.00128 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 29.04 on 17 degrees of freedom

Number of iterations to convergence: 9
Achieved convergence tolerance: 7.585e-06
```

von Bertalanffy growth model (Mature females)

```
Formula: length ~ Linf * (1 - exp(-K * (age - to)))

Parameters:
      Estimate Std. Error t value Pr(>|t|)
Linf 197.2835     1.9429 101.538  < 2e-16 ***
K      0.4662     0.1399   3.333  0.00229 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 8.04 on 30 degrees of freedom

Number of iterations to convergence: 3
Achieved convergence tolerance: 0.2524
```

von Bertalanffy growth model (Immature females)

```
Formula: length ~ Linf * (1 - exp(-K * (age - to)))

Parameters:
      Estimate Std. Error t value Pr(>|t|)
Linf 172.5837     6.9522  24.824  < 2e-16 ***
K      1.6982     0.5481   3.099  0.00279 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 46.45 on 71 degrees of freedom

Number of iterations to convergence: 10
Achieved convergence tolerance: 6.033e-06
```

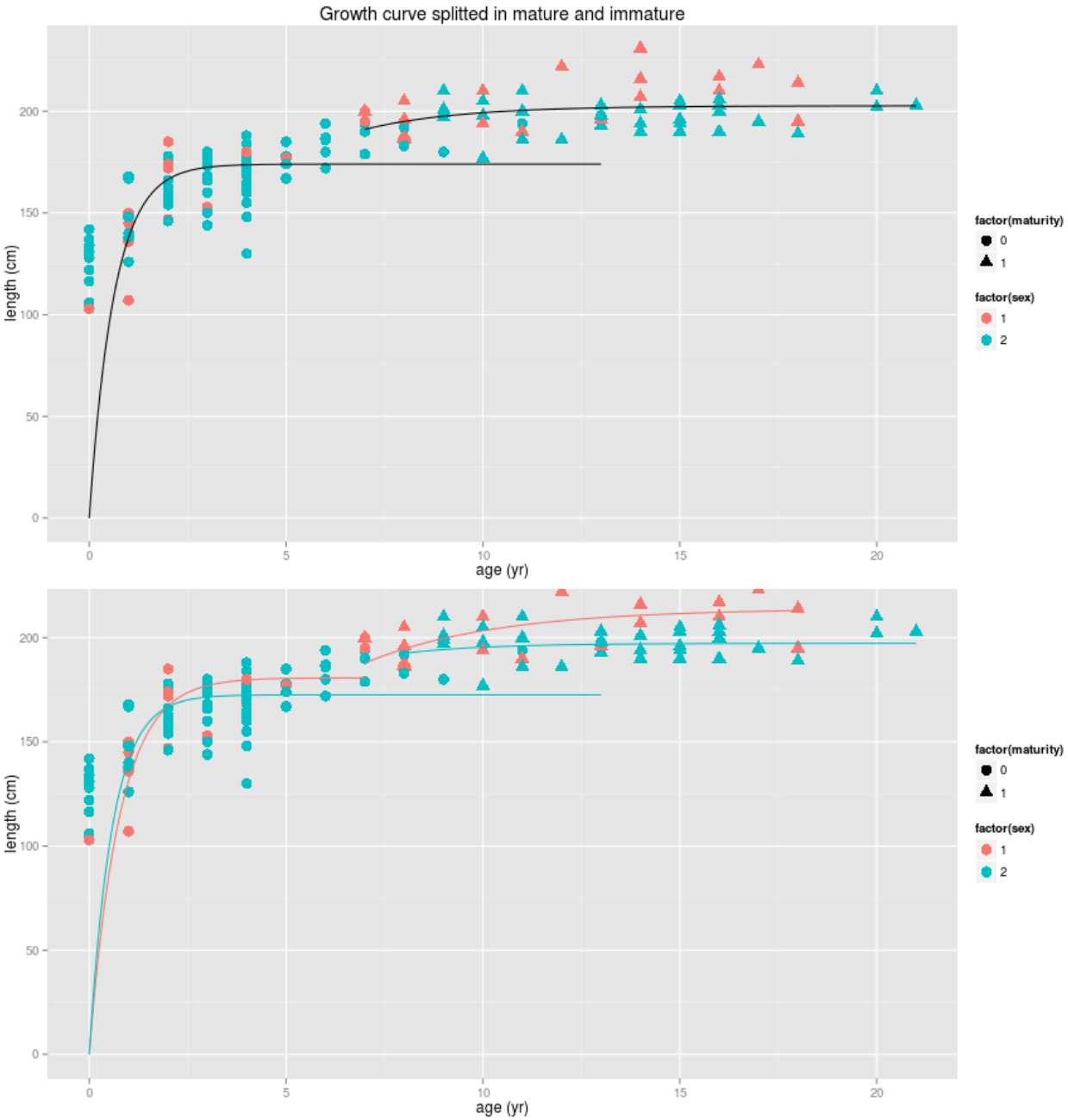

Figure: von Bertalanffy growth model: Males and Females (red, blue). Matures and inmatures (filled circle, filled triangle).