Supplementary Data

Vervoort R., Schmaltz L.E., Hooijmeijer, J.C.E.W., Verkuil Y.I., Kempenaers B. & Piersma T. 2022. Within- and between-year variation in the presence of individually marked Ruff *Calidris pugnax* at a stopover site during northward migration. Ardea 110: ###–###. doi:10.5253/arde.v110i1.a1

Number of male Ruffs never seen in 2005–2019, compared with number ringed 2004–2012

```
prop.trend.test (x = c(576,422,305,313,225,278,139,221,247),
                 n = c(908,730,603,531,401,471,281,411,420))
Chi-squared Test for Trend in Proportions using scores: 1 2 3 4 5 6 7 8 9
X-squared = 5.6794, df = 1, P = 0.01717
```

Number of female Ruffs never seen in 2005–2019, compared with number ringed 2004–2012

```
prop.trend.test (x = c(80,126,107,119,62,37,11,57,15),
                 n = c(106,156,145,153,77,46,21,68,17))
Chi-squared Test for Trend in Proportions using scores: 1 2 3 4 5 6 7 8 9
X-squared = 0.5009, df = 1, P = 0.4791
```

Proportion of individuals ringed in 2004–2012 never seen again in years after ringing, comparison between sexes

```
wilcox.test(PropNull_S$F, PropNull_S$M, paired = TRUE)
        Wilcoxon signed rank test
data:  PropNull_S$F and PropNull_S$M
V = 45, P = 0.003906
alternative hypothesis: true location shift is not equal to 0
```

Number of transient male Ruffs compared with total number of individuals resighted 2006–2013, by year

```
prop.trend.test (x = c(212,219,242,186,203,169,183,102),
                 n = c(405,403,433,345,367,346,386,256))
Chi-squared Test for Trend in Proportions using scores: 1 2 3 4 5 6 7 8
X-squared = 13.534, df = 1, P = 0.0002342
```

Number of transient male Ruffs compared with total number of individuals resighted 2006–2013, by ring age

```
prop.trend.test (x = c(528,477,259,140,57,35,12,7,1),
                 n = c(1128,883,470,249,112,64,23,9,1))
Chi-squared Test for Trend in Proportions using scores: 1 2 3 4 5 6 7 8 9
X-squared = 10.126, df = 1, P = 0.001462

As above, restricted to n ≥ 20
prop.trend.test (x = c(528,477,259,140,57,35,12), n =
c(1128,883,470,249,112,64,12))
Chi-squared Test for Trend in Proportions using scores: 1 2 3 4 5 6 7
X-squared = 13.492, df = 1, P = 0.0002396
```

Number of transient female Ruffs compared with total number of females resighted 2006–2013, by year

```
prop.trend.test (x = c(20,37,38,18,14,20,17,6), n = c(23,43,45,22,17,26,24,10))
Chi-squared Test for Trend in Proportions using scores: 1 2 3 4 5 6 7 8
X-squared = 5.3814, df = 1, P = 0.02035
```

Number of transient female Ruffs compared with total number of females resighted 2006–2013, by ring age

```
prop.trend.test (x = c(75,43,21,15,12,2,2,0), n = c(86,53,28,20,14,3,2,1))
Chi-squared Test for Trend in Proportions using scores: 1 2 3 4 5 6 7 8
X-squared = 2.4939, df = 1, P = 0.1143

As above, restricted to n ≥ 20
prop.trend.test (x = c(75,43,21,15), n = c(86,53,28,20))
data:  c(75, 43, 21, 15) out of c(86, 53, 28, 20) ,
 using scores: 1 2 3 4
X-squared = 3.0137, df = 1, P = 0.08257
```

Proportion of transient Ruffs (of number resighted) for 2006–2013, compared between sexes

```
wilcox.test(PropSingle_S$F, PropSingle_S$M, paired = TRUE)
        Wilcoxon signed rank test
data:  PropSingle_S$F and PropSingle_S$M
V = 36, P = 0.007813
alternative hypothesis: true location shift is not equal to 0
```

Logistic model to investigate the relationship between "transient or staging" (SeenSM, scored as 0 or 1 respectively) and sex (Sex2), year of resighting (Year), wintering in Europe (EULS2, scored as 0 and 1), and number of years after ringing (RingAge2). In this analysis all marked individuals were included, also individuals marked in June–February

```
glm(formula = SeenSM ~ Sex2 + Year + RingAge2 + EULS2, family = "binomial",
    data = CatchAll)
Deviance Residuals:
    Min       1Q   Median       3Q      Max
-1.8140  -1.0785  -0.6096   1.2005   2.1042
Coefficients:
             Estimate Std. Error z value Pr(>|z|)
(Intercept) -187.99244   34.51438  -5.447 5.13e-08
Sex2          -1.44513    0.18793  -7.690 1.47e-14
Year           0.09361    0.01719   5.447 5.12e-08
RingAge2      -0.12629    0.02830  -4.462 8.11e-06
EULS2          1.10635    0.12781   8.656  < 2e-16
    Null deviance: 4344.7  on 3145  degrees of freedom
Residual deviance: 4153.0  on 3141  degrees of freedom
AIC: 4163
Number of Fisher Scoring iterations: 4
```

Number returning in the first year after ringing, ringed in 2004–2012

```
prop.trend.test (x = c(127,201,166,142,108,58,97,132,97),
                 n = c(979,931,738,536,420,479,281,413,420))
Chi-squared Test for Trend in Proportions using scores: 1 2 3 4 5 6 7 8 9
X-squared = 39.21, df = 1, P = 3.806e-10
```

Number wintering in Europe, among staging adult male Ruffs 2006–2012

```
prop.trend.test(x = c(38,29,31,27,29,21,27,16),
                n = c(155,155,160,132,135,156,176,138))
Chi-squared Test for Trend in Proportions using scores: 1 2 3 4 5 6 7 8
X-squared = 9.2622, df = 1, P = 0.002339
```

Number wintering in Europe, among transient adult male Ruffs 2006–2012

```
prop.trend.test(x = c(11,15,31,13,11,5,5,3),
                n = c(232,261,280,204,217,189,201,108))
Chi-squared Test for Trend in Proportions using scores: 1 2 3 4 5 6 7 8
X-squared = 6.8521, df = 1, P = 0.008854
```

Proportion of Ruffs wintering in Europe, comparing transient and staging males

```
wilcox.test(PropEU_C$Single,PropEU_C$Multiple, paired = TRUE)
        Wilcoxon signed rank test
data:  PropEU_C$Single and PropEU_C$Multiple
V = 0, P = 0.007813
alternative hypothesis: true location shift is not equal to 0
```

Fitting distributions to the date of arrival of staging males

Goodness-of-fit statistics

	norm	pois	weibull	nbinom	gamma	lnorm	llogis	pareto
Kolmogorov-Smirnov statistic	0.04945646	0.07041132	0.07926198	0.03550564	0.03704723	0.03043492	0.04417717	0.5193393
Cramer-von Mises statistic	0.38793413	1.45447427	1.99933698	0.28251683	0.15729893	0.15258707	0.31629721	108.2080074
Anderson-Darling statistic	2.37011644	14.22920399	13.18985846	2.08505479	0.96508690	0.97528795	2.23538164	502.4626989

Goodness-of-fit criteria

	norm	pois	weibull	nbinom	gamma	lnorm	llogis	pareto
Akaike's Information Criterion	10838.93	10900.68	10980.94	10825.20	10821.71	10823.27	10866.40	15549.68
Bayesian Information Criterion	10849.45	10905.94	10991.46	10835.72	10832.23	10833.79	10876.92	15560.20

Fitting distributions to the date of departure of staging males

Goodness-of-fit statistics

	norm	pois	weibull	nbinom	gamma	lnorm	llogis	pareto
Kolmogorov-Smirnov statistic	0.06981156	0.09708053	0.04306487	0.09561267	0.08357652	0.09013685	0.0629145	0.5231606
Cramer-von Mises statistic	1.13408746	3.02750088	0.23590684	2.61724881	1.84487342	2.27273855	1.2608152	113.4761866
Anderson-Darling statistic	6.25033830	15.82829642	1.82573541	12.34223609	10.26536975	12.73786124	10.2758748	525.5499972

Goodness-of-fit criteria

	norm	pois	weibull	nbinom	gamma	lnorm	llogis	pareto
Akaike's Information Criterion	10850.22	10885.21	10825.02	10873.09	10894.91	10924.79	10937.29	16080.06
Bayesian Information Criterion	10860.74	10890.47	10835.54	10883.61	10905.43	10935.31	10947.81	16090.59

Fitting distributions to the minimal stopover duration of staging males

Goodness-of-fit statistics

	norm	pois	weibull	nbinom	gamma	lnorm	llogis	pareto
Kolmogorov-Smirnov statistic	0.04926211	0.07050689	0.07931463	0.03562907	0.03684158	0.03022422	0.04368136	0.5198613
Cramer-von Mises statistic	0.38765155	1.45952305	2.00119019	0.28360858	0.15751099	0.15340869	0.31640325	108.7493823
Anderson-Darling statistic	2.36879293	14.26690496	13.20451769	2.08973784	0.96678075	0.98046159	2.24237227	504.8619694

Goodness-of-fit criteria

	norm	pois	weibull	nbinom	gamma	lnorm	llogis	pareto
Akaike's Information Criterion	10876.33	10938.12	11018.79	10862.56	10859.05	10860.61	10904.05	15604.02
Bayesian Information Criterion	10886.86	10943.38	11029.31	10873.08	10869.58	10871.14	10914.57	15614.55

Date of arrival of staging male Ruffs, all wintering areas

```
quantile(Arrival2_M$MinMD, probs = c(0, 0.1, 0.5, 0.9, 1))
   0%   10%   50%   90%  100%
 61.0  73.0  86.0 101.8 123.0
```

Date of arrival of staging male Ruffs, wintering in Europe

```
quantile(Catch2_M_E$MinMD, probs = c(0, 0.1, 0.5, 0.9, 1))
  0%  10%  50%  90% 100%
  61   69   84   97  116
```

Date of arrival of staging male Ruffs, mixed wintering areas

```
quantile(Catch2_M_M$MinMD, probs = c(0, 0.1, 0.5, 0.9, 1))
  0%  10%  50%  90% 100%
  61   74   87  102  123
```

LMM assuming a normal distribution to investigate the relationship between date of arrival of marked Ruffs (MinMD), and sex (Sex2), year (Year), and years after ringing (RingAge2), including individual identity (CC) as a random effect

```
Linear mixed model fit by maximum likelihood  ['lmerMod']
Formula: MinMD ~ Sex2 + Year + RingAge2 + (1 | CC) Data: Catch2
     AIC      BIC   logLik deviance df.resid
 11029.9  11061.6  -5508.9  11017.9     1453
Scaled residuals:
    Min      1Q  Median      3Q     Max
-2.8249 -0.6506 -0.0764  0.5632  3.2225
Random effects:
 Groups   Name        Variance Std.Dev.
 CC       (Intercept) 20.54    4.532
 Residual             92.37    9.611
Number of obs: 1459, groups:  CC, 1034
Fixed effects:
             Estimate Std. Error t value
(Intercept) 2115.4481   258.4189   8.186
Sex2           6.4273     1.8255   3.521
Year          -1.0091     0.1287  -7.843
RingAge2      -0.4214     0.2191  -1.923

> anova(LMER,LMER.nullS)
           npar   AIC   BIC  logLik deviance  Chisq df Pr(>Chisq)
LMER.nullS    5 11040 11067 -5515.1    11030
LMER          6 11030 11062 -5508.9    11018 12.323  1  0.0004474
> anova(LMER,LMER.nullY)
           npar   AIC   BIC  logLik deviance  Chisq df Pr(>Chisq)
LMER.nullY    5 11088 11114 -5539.0    11078
LMER          6 11030 11062 -5508.9    11018 60.089  1  9.067e-15
> anova(LMER,LMER.nullR)
           npar   AIC   BIC  logLik deviance  Chisq df Pr(>Chisq)
LMER.nullR    5 11032 11058 -5510.8    11022
LMER          6 11030 11062 -5508.9    11018 3.6894  1    0.05476
```

LMM assuming a normal distribution to investigate the relationship between date of arrival of marked male Ruffs (MinMD), and year (Year), wintering area (EULS2), and years elapsed after ringing (RingAge2), including individual identity (CC) as a random effect

```
Linear mixed model fit by maximum likelihood  ['lmerMod']
Formula: MinMD ~ Year + EULS2 + RingAge2 + (1 | CC) Data: Catch2_M
     AIC      BIC   logLik deviance df.resid
 10712.0  10743.6  -5350.0  10700.0     1416
Scaled residuals:
    Min      1Q  Median      3Q     Max
-2.5112 -0.6478 -0.0422  0.5752  3.2256
Random effects:
 Groups   Name        Variance Std.Dev.
 CC       (Intercept) 18.90    4.348
 Residual             90.87    9.532
Number of obs: 1422, groups:  CC, 1003
Fixed effects:
             Estimate Std. Error t value
(Intercept) 2189.8578   258.1511   8.483
Year          -1.0459     0.1285  -8.137
EULS2         -3.6971     0.8419  -4.392
RingAge2      -0.4053     0.2204  -1.839

> anova(Catch3,Catch3.nullY)
             npar   AIC   BIC  logLik deviance  Chisq df Pr(>Chisq)
Catch3.nullY    5 10774 10801 -5382.2    10764
Catch3          6 10712 10744 -5350.0    10700 64.478  1  9.764e-16
> anova(Catch3,Catch3.nullE)
             npar   AIC   BIC  logLik deviance  Chisq df Pr(>Chisq)
Catch3.nullE    5 10729 10755 -5359.5    10719
Catch3          6 10712 10744 -5350.0    10700 18.935  1  1.352e-05
> anova(Catch3,Catch3.nullR)
             npar   AIC   BIC  logLik deviance  Chisq df Pr(>Chisq)
Catch3.nullR    5 10713 10740 -5351.7    10703
Catch3          6 10712 10744 -5350.0    10700 3.3764  1    0.06614
```

Date of departure of staging male Ruffs, all males

```
quantile(Arrival2_M$MaxMD, probs = c(0, 0.1, 0.5, 0.9, 1))
  0%  10%  50%  90% 100%
  67   89  106  117  133
```

Date of departure of staging male Ruffs, wintering in Europe

```
quantile(Catch2_M_E$MaxMD, probs = c(0, 0.1, 0.5, 0.9, 1))
  0%  10%  50%  90% 100%
  71   88  105  118  133
```

Date of departure of staging male Ruffs, mixed wintering areas

```
quantile(Catch2_M_M$MaxMD, probs = c(0, 0.1, 0.5, 0.9, 1))
  0%  10%  50%  90% 100%
  67   89  106  117  132
```

LMM, to investigate the relationship between in the date of departure (MaxMD) of staging Ruffs, and sex (Sex2), year (Year), including individual identify (CC) as a random effect

```
Linear mixed model fit by maximum likelihood  ['lmerMod']
Formula: MaxMD ~ Sex2 + Year + RingAge2 + (1 | CC) Data: Catch2
     AIC      BIC   logLik deviance df.resid
 11101.5  11133.2  -5544.7  11089.5     1453
Scaled residuals:
    Min      1Q  Median      3Q     Max
-3.0647 -0.5724  0.1166  0.6573  2.2273
Random effects:
 Groups   Name        Variance Std.Dev.
 CC       (Intercept) 21.47    4.633
 Residual             97.10    9.854
Number of obs: 1459, groups:  CC, 1034
Fixed effects:
             Estimate Std. Error t value
(Intercept) 1133.8646   264.7948   4.282
Sex2           4.5311     1.8705   2.422
Year          -0.5120     0.1318  -3.884
RingAge2      -0.3272     0.2245  -1.457

> anova(LMER,LMER.nullS)
           npar   AIC   BIC  logLik deviance  Chisq df Pr(>Chisq)
LMER.nullS    5 11105 11132 -5547.7    11095
LMER          6 11102 11133 -5544.7    11090 5.8419  1    0.01565
> anova(LMER,LMER.nullY)
           npar   AIC   BIC  logLik deviance  Chisq df Pr(>Chisq)
LMER.nullY    5 11114 11141 -5552.2    11104
LMER          6 11102 11133 -5544.7    11090 14.987  1  0.0001083
> anova(LMER,LMER.nullR)
           npar   AIC   BIC  logLik deviance  Chisq df Pr(>Chisq)
LMER.nullR    5 11102 11128 -5545.8    11092
LMER          6 11102 11133 -5544.7    11090 2.1214  1     0.1453
```

LMM assuming a normal distribution to investigate the relationship between the date of departure of staging male Ruffs (MaxMD), and year (Year), wintering area (EULS2), and years after ringing (RingAge2), including individual identity (CC) as a random effect

```
Linear mixed model fit by REML ['lmerMod']
Formula: MaxMD ~ Year + EULS2 + RingAge2 + (1 | CC), Data: Catch2_M
REML criterion at convergence: 10802.5
Scaled residuals:
    Min      1Q  Median      3Q     Max
-3.0779 -0.5781  0.1175  0.6538  2.2351
Random effects:
 Groups   Name        Variance Std.Dev.
 CC       (Intercept) 21.17    4.602
 Residual             97.05    9.851
Number of obs: 1422, groups:  CC, 1003
Fixed effects:
             Estimate Std. Error t value
(Intercept) 1148.0037   268.1675   4.281
Year          -0.5191     0.1335  -3.888
EULS2         -0.2792     0.8758  -0.319
RingAge2      -0.3289     0.2288  -1.438

> anova(LMER,LMER.nullY)
           npar   AIC   BIC  logLik deviance  Chisq df Pr(>Chisq)
LMER.nullY    5 10825 10852 -5407.6    10815
LMER          6 10812 10844 -5400.1    10800 15.064  1  0.0001039
> anova(LMER,LMER.nullE)
           npar   AIC   BIC  logLik deviance  Chisq df Pr(>Chisq)
LMER.nullE    5 10810 10837 -5400.1    10800
LMER          6 10812 10844 -5400.1    10800 0.1027  1     0.7486
> anova(LMER,LMER.nullR)
           npar   AIC   BIC  logLik deviance  Chisq df Pr(>Chisq)
LMER.nullR    5 10812 10839 -5401.1    10802
LMER          6 10812 10844 -5400.1    10800 2.0712  1     0.1501
```

Date of observation of transient male Ruffs, all wintering areas

```
quantile(Catch1_M$MinMD, probs = c(0, 0.1, 0.5, 0.9, 1))
  0%  10%  50%  90% 100%
  62   80   95  113  132
```

Date of observation of transient male Ruffs, wintering in Europe

```
quantile(Catch1_M_E$MinMD, probs = c(0, 0.1, 0.5, 0.9, 1))
   0%   10%   50%   90%  100%
 65.0  77.0  92.0 109.8 122.0
```

Date of observation of transient male Ruffs, mixed wintering areas

```
quantile(Catch1_M_M$MinMD, probs = c(0, 0.1, 0.5, 0.9, 1))
  0%  10%  50%  90% 100%
  62   80   96  113  132
```

LMM to investigate the relationship between the observation date of transient Ruffs (MinMD), and sex (Sex2), year (Year), wintering area (EULS2), and years after ringing (RingAge2), including individual identity (CC) as a random effect

```
lmer(MinMD ~ Sex2 + Year + RingAge2 + (1|CC), data = Catch1, REML=FALSE)
Linear mixed model fit by REML ['lmerMod']
Formula: MinMD ~ Sex2 + Year + RingAge2 + (1 | CC), Data: Catch1
REML criterion at convergence: 13320.8
Scaled residuals:
     Min       1Q   Median       3Q      Max
-2.54561 -0.69273 -0.04723  0.69522  2.55312
Random effects:
 Groups   Name        Variance Std.Dev.
 CC       (Intercept)  23.39    4.837
 Residual             134.80   11.610
Number of obs: 1687, groups:  CC, 1404
Fixed effects:
             Estimate Std. Error t value
(Intercept) 1158.7223   304.7498   3.802
Sex2           3.6448     1.0399   3.505
Year          -0.5288     0.1518  -3.484
RingAge2      -0.2145     0.2350  -0.913

> anova(LMER,LMER.nullS)
           npar   AIC   BIC  logLik deviance  Chisq df Pr(>Chisq)
LMER.nullS    5 13341 13368 -6665.7    13331
LMER          6 13331 13364 -6659.6    13319 12.269  1  0.0004606
> anova(LMER,LMER.nullY)
           npar   AIC   BIC  logLik deviance  Chisq df Pr(>Chisq)
LMER.nullY    5 13341 13368 -6665.6    13331
LMER          6 13331 13364 -6659.6    13319 12.107  1  0.0005024
> anova(LMER,LMER.nullR)
           npar   AIC   BIC  logLik deviance Chisq df Pr(>Chisq)
LMER.nullR    5 13330 13357 -6660.0    13320
LMER          6 13331 13364 -6659.6    13319 0.835  1     0.3608
```

LMM to investigate the relationship between the observation date of transient males (MinMD), and year(Year), wintering area (EULS2), and years after ringing (RingAge2), including individual identity (CC) as a random effect

```
Formula: MinMD ~ Year + EULS2 + RingAge2 + (1 | CC) Data: Catch1_M
REML criterion at convergence: 11966.5
Scaled residuals:
     Min       1Q   Median       3Q      Max
-2.57296 -0.68849 -0.05329  0.68481  2.55450

Random effects:
 Groups   Name        Variance Std.Dev.
 CC       (Intercept)  22.68    4.763
 Residual             134.37   11.592
Number of obs: 1517, groups:  CC, 1257
Fixed effects:
             Estimate Std. Error t value
(Intercept) 1164.3155   317.0013   3.673
Year          -0.5315     0.1579  -3.367
EULS2         -3.1110     1.3813  -2.252
RingAge2      -0.2003     0.2462  -0.814

         (Intr) Year   EULS2
Year     -1.000
EULS2    -0.077  0.077
RingAge2  0.316 -0.318 -0.040
```

```
> anova(LMER,LMER.nullY)
           npar   AIC   BIC  logLik deviance  Chisq df Pr(>Chisq)
LMER.nullY    5 11987 12014 -5988.5    11977
LMER          6 11978 12010 -5982.8    11966 11.298  1   0.000776
> anova(LMER,LMER.nullE)
           npar   AIC   BIC  logLik deviance  Chisq df Pr(>Chisq)
LMER.nullE    5 11981 12007 -5985.4    11971
LMER          6 11978 12010 -5982.8    11966 5.0758  1    0.02426
> anova(LMER,LMER.nullR)
           npar   AIC   BIC  logLik deviance  Chisq df Pr(>Chisq)
LMER.nullR    5 11976 12003 -5983.2    11966
LMER          6 11978 12010 -5982.8    11966 0.6647  1     0.4149
```

Comparison of the mean date of arrival of staging males, and mean of the first peak of observations of transient males, paired by year of observation

```
wilcox.test(Peaks12$MinMD, Peaks12$Peak1, paired = TRUE)
        Wilcoxon signed rank test
data:  Peaks12$MinMD and Peaks12$Peak1
V = 9, P = 0.25
alternative hypothesis: true location shift is not equal to 0
```

Comparison of the mean date of departure of staging males, and mean of the second peak of observations of transient males, paired by year of observation

```
wilcox.test(Peaks12$MaxMD, Peaks12$Peak2, paired = TRUE)
        Wilcoxon signed rank test with continuity correction
data:  Peaks12$MaxMD and Peaks12$Peak2
V = 14, P = 0.6406
alternative hypothesis: true location shift is not equal to 0
```

GLS to investigate the relationship of the mean of the first peak (Peak1) of observations of transient males and year of the study period (Year)

```
gls(Peak1 ~ Year, data = Peaks12, method="REML")
Generalized least squares fit by REML
  Model: Peak1 ~ Year
  Data: Peaks12
       AIC      BIC    logLik
  45.77764 45.15292 -19.88882
Coefficients:
               Value Std.Error   t-value P
(Intercept) 3826.643 1271.4492  3.009670  0.0237
Year          -1.861    0.6327 -2.940824  0.0259
Standardized residuals:
        Min          Q1         Med          Q3         Max
-1.20107705 -0.72051558  0.04441982  0.76667735  1.12443108
Residual standard error: 4.100486
Degrees of freedom: 8 total; 6 residual
```

GLS to investigate the relationship of the mean of the second peak (Peak2) of observations of transient males and year of the study period (Year)

```
gls(Peak2 ~ Year, data = Peaks12, method="REML")
Generalized least squares fit by REML
  Model: Peak2 ~ Year
  Data: Peaks12
       AIC      BIC    logLik
  45.37487 44.75015 -19.68743
Coefficients:
               Value Std.Error    t-value P
(Intercept) -889.8060 1229.4822 -0.7237241  0.4965
Year           0.4952    0.6118  0.8094315  0.4492
Standardized residuals:
       Min         Q1        Med         Q3        Max
-1.8503517 -0.4281359  0.4248333  0.5989699  0.8469645
Residual standard error: 3.965141
Degrees of freedom: 8 total; 6 residual
```

A GLMM assuming a gamma distribution to investigate the relationship between minimal stopover duration (MinST) and sex (Sex2), and year (Year), and years after ringing (RingAge2), including individual identity (CC) as a random effect results in an error message. Therefore, a GLM assuming a gamma distribution and a LMM were included.

```
glm(MinST ~ Sex2 + Year + RingAge2, family = Gamma, data = Catch2)
Deviance Residuals:
    Min       1Q   Median       3Q      Max
-2.0448  -0.7539  -0.1035   0.4251   1.5513
Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)  3.2035537  0.9029115   3.548  0.00040
Sex2         0.0063490  0.0070255   0.904  0.36630
Year        -0.0015655  0.0004495  -3.483  0.00051
RingAge2    -0.0005508  0.0007318  -0.753  0.45178
(Dispersion parameter for Gamma family taken to be 0.4630293)
    Null deviance: 998.57  on 1458  degrees of freedom
Residual deviance: 991.41  on 1455  degrees of freedom
AIC: 11141
Number of Fisher Scoring iterations: 6

lmer(MinST ~ Sex2 + Year + RingAge2 + (1|CC), data = Catch2, REML=TRUE)
Linear mixed model fit by REML ['lmerMod']
Formula: MinST ~ Sex2 + Year + RingAge2 + (1 | CC)
REML criterion at convergence: 11383.7
Scaled residuals:
    Min      1Q  Median      3Q     Max
-2.0259 -0.7789 -0.1350  0.6804  2.8920
Random effects:
 Groups   Name        Variance Std.Dev.
 CC       (Intercept)  18.92    4.35
 Residual             125.67   11.21
Number of obs: 1459, groups:  CC, 1034
Fixed effects:
             Estimate Std. Error t value
(Intercept) -976.7959   290.2715  -3.365
Sex2          -1.8675     2.0510  -0.911
Year           0.4947     0.1445   3.423
RingAge2       0.1076     0.2471   0.435

> anova(LMER,LMER.nullS)
          npar   AIC   BIC  logLik deviance  Chisq df Pr(>Chisq)
LMER.nullS    5 11394 11421 -5692.2    11384
LMER          6 11396 11427 -5691.8    11384 0.8309  1      0.362
```

```
> anova(LMER,LMER.nullY)
           npar   AIC   BIC  logLik deviance  Chisq df Pr(>Chisq)
LMER.nullY    5 11405 11432 -5697.6    11395
LMER          6 11396 11427 -5691.8    11384 11.702  1  0.0006242
> anova(LMER,LMER.nullR)
           npar   AIC   BIC  logLik deviance  Chisq df Pr(>Chisq)
LMER.nullR    5 11394 11420 -5691.9    11384
LMER          6 11396 11427 -5691.8    11384 0.1908  1     0.6622
```

A GLMM assuming a gamma distribution to investigate the relationship between minimal stopover duration of staging males (MinST) and year (Year), wintering area (EULS2), and years after ringing (RingAge2), including individual identity (CC) as a random effect results in an error message. Therefore, a GLM assuming a gamma distribution and a LMM were included.

```
glm(formula = MinST ~ Year + EULS2 + RingAge2, family = Gamma, data = Catch2_M)
Deviance Residuals:
    Min       1Q   Median       3Q      Max
-2.0970  -0.7285  -0.1018   0.4302   1.5982
Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  3.3851850  0.9082346   3.727 0.000201
Year        -0.0016552  0.0004521  -3.661 0.000260
EULS2       -0.0098181  0.0025113  -3.910 9.68e-05
RingAge2    -0.0004064  0.0007403  -0.549 0.583085
(Dispersion parameter for Gamma family taken to be 0.4577852)
    Null deviance: 961.17  on 1421  degrees of freedom
Residual deviance: 948.16  on 1418  degrees of freedom
AIC: 10848
Number of Fisher Scoring iterations: 6

lmer(MinST ~ Year + EULS2 + RingAge2 + (1|CC), data = Catch2_M, REML=TRUE)
Linear mixed model fit by REML ['lmerMod']
Formula: MinST ~ Year + EULS2 + RingAge2 + (1 | CC)
   Data: Catch2_M
REML criterion at convergence: 11076.4
Scaled residuals:
    Min      1Q  Median      3Q     Max
-2.1553 -0.7959 -0.1353  0.6662  2.8491
Random effects:
 Groups   Name        Variance Std.Dev.
 CC       (Intercept)  17.82    4.222
 Residual             124.67   11.166
Number of obs: 1422, groups:  CC, 1003
Fixed effects:
             Estimate Std. Error t value
(Intercept) -1.038e+03  2.920e+02  -3.553
Year         5.248e-01  1.454e-01   3.609
EULS2        3.420e+00  9.419e-01   3.631
RingAge2     8.581e-02  2.502e-01   0.343

> anova(LMER,LMER.nullY)
           npar   AIC   BIC  logLik deviance  Chisq df Pr(>Chisq)
LMER.nullY    5 11098 11124 -5543.8    11088
LMER          6 11087 11118 -5537.3    11075 13.004  1  0.0003108
> anova(LMER,LMER.nullE)
           npar   AIC   BIC  logLik deviance  Chisq df Pr(>Chisq)
LMER.nullE    5 11098 11124 -5543.9    11088
LMER          6 11087 11118 -5537.3    11075 13.116  1  0.0002928
> anova(LMER,LMER.nullR)
           npar   AIC   BIC  logLik deviance  Chisq df Pr(>Chisq)
LMER.nullR    5 11085 11111 -5537.4    11075
LMER          6 11087 11118 -5537.3    11075 0.1188  1     0.7303
```

Males classified by wintering area based on feather isotope composition as European (A) or mixed (C), returning in 2013: comparison of date of arrival (MinMD), departure (MaxMD) and minimal stopover duration (MinST)

```
> kruskal.test(MinMD ~ Isoclass, data = IsotopeACD_2013)
        Kruskal-Wallis rank sum test
data:  MinMD by Isoclass
Kruskal-Wallis chi-squared = 0.50278, df = 1, P = 0.4783

> kruskal.test(MaxMD ~ Isoclass, data = IsotopeACD_2013)
        Kruskal-Wallis rank sum test
data:  MaxMD by Isoclass
Kruskal-Wallis chi-squared = 0.63645, df = 1, P = 0.425

> kruskal.test(MinST ~ Isoclass, data = IsotopeACD_2013)
        Kruskal-Wallis rank sum test
data:  MinST by Isoclass
Kruskal-Wallis chi-squared = 1.3797, df = 1, P = 0.2402
```

Males classified by wintering area based on feather isotope composition as European (A) or sub-Saharan (C), returning in 2013: comparison of date of arrival (MinMD), departure (MaxMD) and minimal stopover duration (MinST), among staging males

```
> kruskal.test(MinMD ~ Isoclass, data = Isotope2ACD_2013)
        Kruskal-Wallis rank sum test
data:  MinMD by Isoclass
Kruskal-Wallis chi-squared = 0.032154, df = 1, P = 0.8577

> kruskal.test(MaxMD ~ Isoclass, data = Isotope2ACD_2013)
        Kruskal-Wallis rank sum test
data:  MaxMD by Isoclass
Kruskal-Wallis chi-squared = 0.072283, df = 1, P = 0.788

> kruskal.test(MinST ~ Isoclass, data = Isotope2ACD_2013)
        Kruskal-Wallis rank sum test
data:  MinST by Isoclass
Kruskal-Wallis chi-squared = 0.022261, df = 1, P = 0.8814
```

Number of males wintering in Europe, by number of males ringed per year (March–May, in the study area)

```
prop.trend.test (x = c(37,36,22,30,19,12,11,8,11),
                 n = c(908,730,603,531,401,471,281,411,420))
using scores: 1 2 3 4 5 6 7 8 9
X-squared = 6.0052, df = 1, P = 0.01426
```

LMM to investigate the relationship between the date of arrival (standardized within observation year; MinMD_S) of males returning more than one year, and number of years elapsed since the first that the individual returned (Period_B; 0 in the first year returning), wintering area (EULS2), including individual identity (CC) as a random effect. A second LMM, with a random slope for individual, is also included.

```
Formula: MinMD_S ~ Period_B + EULS2 + (1 | CC) Data: Period_M_Scaled_B
REML criterion at convergence: 4460.9
Scaled residuals:
    Min      1Q  Median      3Q     Max
-2.7061 -0.6526 -0.0878  0.5849  3.2399
Random effects:
 Groups   Name        Variance Std.Dev.
 CC       (Intercept) 0.1818   0.4263
 Residual             0.7827   0.8847
Number of obs: 1605, groups:  CC, 629
Fixed effects:
            Estimate Std. Error t value
(Intercept) -0.033049   0.035959  -0.919
Period_B    -0.000675   0.018524  -0.036
EULS2       -0.396852   0.084909  -4.674

> anova(LMER,LMER.nullP)
           npar    AIC    BIC  logLik deviance  Chisq df Pr(>Chisq)
LMER.nullP    4 4454.4 4475.9 -2223.2   4446.4
LMER          5 4456.4 4483.3 -2223.2   4446.4 0.0015  1     0.9695

Formula: MinMD_S ~ Period_B + EULS2 + (Period_B | CC) Data: Period_M_Scaled_B
REML criterion at convergence: 4457.9
Scaled residuals:
    Min      1Q  Median      3Q     Max
-2.8009 -0.6602 -0.0879  0.5798  3.3396
Random effects:
 Groups   Name        Variance Std.Dev. Corr
 CC       (Intercept) 0.141455 0.37610
          Period_B    0.002055 0.04533  1.00
 Residual             0.780519 0.88347
Number of obs: 1605, groups:  CC, 629
Fixed effects:
             Estimate Std. Error t value
(Intercept) -0.0336872  0.0351945  -0.957
Period_B     0.0003183  0.0193772   0.016
EULS2       -0.3897101  0.0851254  -4.578
Boundary (singular) fit: see ?isSingular

> anova(LMER,LMER.nullP) (fixed effect Period_B)
           npar    AIC    BIC  logLik deviance Chisq df Pr(>Chisq)
LMER.nullP    6 4455.5 4487.7 -2221.7   4443.5
LMER          7 4457.5 4495.1 -2221.7   4443.5 2e-04  1      0.989

> anova(LMER,LMER.nullP) (random effect Period_B)
           npar    AIC    BIC  logLik deviance  Chisq df Pr(>Chisq)
LMER.nullP    5 4456.4 4483.3 -2223.2   4446.4
LMER          7 4457.5 4495.1 -2221.7   4443.5 2.9111  2     0.2333
```

LMM to investigate the relationship between the date of departure (standardized within observation year, i.e. subtracting the mean and dividing by the standard deviation; MaxMD_S) of males returning more than one year, and number of years elapsed since the first that the individual returned (Period_B; 0 in the first year returning), wintering area (EULS2), including individual identity (CC) as a random effect

```
Formula: MaxMD_S ~ Period_B + EULS2 + (1 | CC) Data: Period_M_Scaled_B
REML criterion at convergence: 4465.2
Scaled residuals:
     Min       1Q   Median       3Q      Max
-3.00816 -0.68375  0.07443  0.69943  2.41472
Random effects:
 Groups   Name        Variance Std.Dev.
 CC       (Intercept) 0.2209   0.4700
 Residual             0.7581   0.8707
Number of obs: 1605, groups:  CC, 629
Fixed effects:
            Estimate Std. Error t value
(Intercept)  0.051011   0.036563   1.395
Period_B    -0.007144   0.018396  -0.388
EULS2        0.068212   0.087673   0.778

> anova(LMER,LMER.nullP)
           npar    AIC    BIC  logLik deviance  Chisq df Pr(>Chisq)
LMER.nullP    4 4458.9 4480.4 -2225.5   4450.9
LMER          5 4460.8 4487.7 -2225.4   4450.8 0.1508  1     0.6978
```

LMM to investigate the relationship between minimal stopover duration (standardized within observation year, i.e. subtracting the mean and dividing by the standard deviation; MinST_S) of males returning more than one year, and number of years elapsed since the first that the individual returned (Period_B; 0 in the first year returning), wintering area (EULS2), including individual identity (CC) as a random effect

```
Formula: MinST_S ~ Period_B + EULS2 + (1 | CC) Data: Period_M_Scaled_B
REML criterion at convergence: 4653
Scaled residuals:
    Min      1Q  Median      3Q     Max
-2.0051 -0.5961 -0.4138  0.5736  3.5513
Random effects:
 Groups   Name        Variance Std.Dev.
 CC       (Intercept) 0.2656   0.5153
 Residual             0.8411   0.9171
Number of obs: 1605, groups:  CC, 629
Fixed effects:
            Estimate Std. Error t value
(Intercept)  0.08921    0.03901   2.287
Period_B    -0.00879    0.01944  -0.452
EULS2        0.46108    0.09406   4.902

> anova(LMER,LMER.nullP)
           npar    AIC    BIC  logLik deviance  Chisq df Pr(>Chisq)
LMER.nullP    4 4647.2 4668.7 -2319.6   4639.2
LMER          5 4649.0 4675.9 -2319.5   4639.0 0.2031  1     0.6522
```

LMM to investigate the relationship between date of first observation of marked males outside the study area in the period 1 March – 15 May, and latitude (Lat) of the observation site and wintering area (EULS2), including individual identity (CC) and the year (Year) as a random effects

```
Formula: MinMD ~ Lat + EULS2 + (1 | CC) + (1 | Year) Data: Latitude_M
REML criterion at convergence: 3802.2
Scaled residuals:
     Min       1Q   Median       3Q      Max
-1.97999 -0.70204  0.07666  0.71850  1.85632
Random effects:
 Groups   Name        Variance Std.Dev.
 CC       (Intercept)  82.39    9.077
 Year     (Intercept)  14.70    3.834
 Residual             257.03   16.032
Number of obs: 439, groups:  CC, 387; Year, 9
Fixed effects:
            Estimate Std. Error t value
(Intercept) -49.2702    11.8108  -4.172
Lat           2.8648     0.2192  13.067
EULS2       -16.1187     2.6077  -6.181

> anova(LMER,LMER.nullL)
           npar    AIC    BIC  logLik deviance  Chisq df Pr(>Chisq)
LMER.nullL    5 3970.3 3990.7 -1980.1   3960.3
LMER          6 3827.1 3851.7 -1907.6   3815.1 145.13  1  < 2.2e-16
> anova(LMER,LMER.nullE)
           npar    AIC    BIC  logLik deviance  Chisq df Pr(>Chisq)
LMER.nullE    5 3860.2 3880.6 -1925.1   3850.2
LMER          6 3827.1 3851.7 -1907.6   3815.1 35.048  1  3.216e-09
```

GLMM assuming a binomial distribution to investigate the relationship between 'transient or staging in the study area' (Seen_SM, scored as 0 and 1 respectively) and catch location of male Ruffs (CatchLoc; Wommels or study area, scored respectively as W and S), with individual identity (CC) and year (Year) as random effects

```
Formula: SeenSM ~ CatchLoc + (1 | CC) + (1 | Year) Data: Catch_M_O
Generalized linear mixed model fit by maximum likelihood (Laplace
  Approximation) [glmerMod]
 Family: binomial  ( logit )
Formula: SeenSM ~ CatchLoc + (1 | CC) + (1 | Year)
   Data: Catch_M_O
     AIC      BIC   logLik deviance df.resid
  4445.6   4470.0  -2218.8   4437.6     3267
Scaled residuals:
    Min      1Q  Median      3Q     Max
-1.4940 -0.7780 -0.6510  0.8774  1.4282
Random effects:
 Groups Name        Variance Std.Dev.
 CC     (Intercept) 0.77364  0.8796
 Year   (Intercept) 0.04202  0.2050
Number of obs: 3271, groups:  CC, 2164; Year, 10
Fixed effects:
            Estimate Std. Error z value Pr(>|z|)
(Intercept)   0.6758     0.2016   3.353    8e-04 ***
CatchLocS    -0.9025     0.1949  -4.629 3.67e-06 ***
```

LMM to investigate the relationship between date of arrival in the study area (MinMD) of staging male Ruffs, and catch location (CatchLoc; Wommels or study area, scored respectively as W and S), year (Year), wintering area (EULS2), and years after ringing (RingAge2), including individual identity (CC) as a random effect

```
Formula: MinMD ~ Year + EULS2 + RingAge2 + CatchLoc + (1 | CC) Data: Catch2_M_O
REML criterion at convergence: 11609.5
Scaled residuals:
    Min      1Q  Median      3Q     Max
-2.4969 -0.6396 -0.0378  0.5698  3.2129
Random effects:
 Groups   Name        Variance Std.Dev.
 CC       (Intercept) 20.35    4.511
 Residual             90.42    9.509
Number of obs: 1542, groups:  CC, 1075
Fixed effects:
             Estimate Std. Error t value
(Intercept) 2176.7822   256.5736   8.484
Year          -1.0386     0.1279  -8.122
EULS2         -3.8017     0.8206  -4.633
RingAge2      -0.4359     0.2103  -2.072
CatchLocS     -1.5081     1.1256  -1.340

> anova(LME,LME.nullLoc)
            npar   AIC   BIC  logLik deviance  Chisq df Pr(>Chisq)
LME.nullLoc    6 11622 11654 -5805.2    11610
LME            7 11623 11660 -5804.3    11609 1.7861  1     0.1814
```

LMM to investigate the relationship between date of departure from the study area (MaxMD) of staging male Ruffs, and catch location (CatchLoc; Wommels or study area, scored respectively as W and S), year (Year), wintering area (EULS2), and years after ringing (RingAge2), including individual identity (CC) as a random effect

```
Formula: MaxMD ~ Year + EULS2 + RingAge2 + CatchLoc + (1 | CC) Data: Catch2_M_O
REML criterion at convergence: 11715.9
Scaled residuals:
    Min      1Q  Median      3Q     Max
-3.0826 -0.5948  0.1112  0.6614  2.2654
Random effects:
 Groups   Name        Variance Std.Dev.
 CC       (Intercept) 20.33    4.509
 Residual             98.17    9.908
Number of obs: 1542, groups:  CC, 1075
Fixed effects:
             Estimate Std. Error t value
(Intercept) 1096.8484   264.9132   4.140
Year          -0.4924     0.1320  -3.730
EULS2         -0.4542     0.8449  -0.538
RingAge2      -0.2939     0.2175  -1.351
CatchLocS     -2.3520     1.1590  -2.029

> anova(LME,LME.nullLoc)
            npar   AIC   BIC  logLik deviance  Chisq df Pr(>Chisq)
LME.nullLoc    6 11731 11764 -5859.7    11719
LME            7 11729 11767 -5857.7    11715 4.1279  1    0.04218
```

LMM to investigate the relationship between minimal stopover duration in the study area (MinST) of staging male Ruffs, and catch location (CatchLoc; Wommels or study area, scored respectively as W and S), year (Year), wintering area (EULS2), and years after ringing (RingAge2), including individual identity (CC) as a random effect

```
Formula: MinST ~ Year + EULS2 + RingAge2 + CatchLoc + (1 | CC) Data: Catch2_M_O
REML criterion at convergence: 12033.8
Scaled residuals:
    Min      1Q  Median      3Q     Max
-2.1507 -0.7916 -0.1393  0.6603  3.4297
Random effects:
 Groups   Name        Variance Std.Dev.
 CC       (Intercept)  17.25    4.153
 Residual             127.58   11.295
Number of obs: 1542, groups:  CC, 1075
Fixed effects:
             Estimate Std. Error t value
(Intercept) -1074.1007   290.4765  -3.698
Year            0.5433     0.1448   3.753
EULS2           3.3664     0.9139   3.684
RingAge2        0.1554     0.2395   0.649
CatchLocS      -0.9466     1.2545  -0.755

> anova(LMER,LMER.nullL)
LMER.nullL: MinST ~ Year + EULS2 + RingAge2 + (1 | CC)
           npar   AIC   BIC  logLik deviance  Chisq df Pr(>Chisq)
LMER.nullL    6 12047 12079 -6017.3    12035
LMER          7 12048 12086 -6017.1    12034 0.5743  1     0.4485
```

LMM to investigate the relationship between date of observation in the study area (MinMD) of transient male Ruffs, and catch location (CatchLoc; Wommels or study area, scored respectively as W and S), year (Year), wintering area (EULS2), and years after ringing (RingAge2), including individual identity (CC) as a random effect

```
Formula: MinMD ~ Year + EULS2 + RingAge2 + CatchLoc + (1 | CC) Data: Catch1_MO
REML criterion at convergence: 13612.9
Scaled residuals:
     Min       1Q   Median       3Q      Max
-2.64978 -0.68192 -0.04277  0.68455  2.64760
Random effects:
 Groups   Name        Variance Std.Dev.
 CC       (Intercept)  19.4     4.404
 Residual             135.4    11.637
Number of obs: 1729, groups:  CC, 1419
Fixed effects:
             Estimate Std. Error t value
(Intercept) 1284.2267   301.7429   4.256
Year          -0.5908     0.1503  -3.932
EULS2         -3.1710     1.2769  -2.483
RingAge2      -0.3604     0.2328  -1.548
CatchLocS     -0.2181     1.5992  -0.136

> anova(LME,LME.nullL)
          npar   AIC   BIC  logLik deviance  Chisq df Pr(>Chisq)
LME.nullL    6 13626 13659 -6807.1    13614
LME          7 13628 13666 -6807.1    13614 0.0191  1     0.8899
```

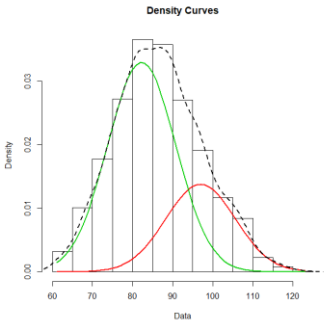
Fitting a number (k) of normal distributions with normalmixEM to variables, for different groups of individuals. Summary of 1000 repetitions, listing the number of fits that included one distribution with mixing proportion (lambda) smaller than 0.1, the number of fits with distributions having similar means ('nested'), parameters and plot (histogram of observed data in black in black, density curve in dashed line, and fitted normal distributions is color) of the fits selected for visual inspection. The fit selected for further analysis is marked in Grey.

Arrival, staging males, k=2

one lambda < 0.1: 0/1000
nested peaks: 0/1000
fit 1: 1000/1000

	comp 1	comp 2
lambda	0.699946	0.300054
mu	82.261866	96.941876
sigma	8.478987	8.685947

loglik at estimate: -5400.059

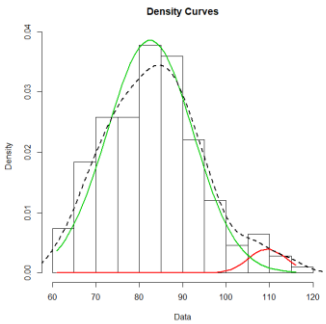


Arrival, staging males, wintering in Europe, k=2

one lambda < 0.1: 1000/1000
nested peaks: 82/1000
fit 1: 917/1000

	comp 1	comp 2
lambda	0.042989	0.957011
mu	109.516885	82.497438
sigma	4.290790	9.893563

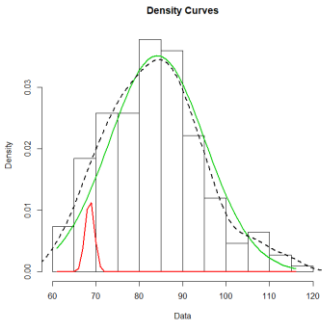
loglik at estimate: -827.3353



fit 2: 1/1000

	comp 1	comp 2
lambda	0.0313889	0.968611
mu	68.6079379	84.146735
sigma	1.0356268	10.996458

loglik at estimate: -829.8843

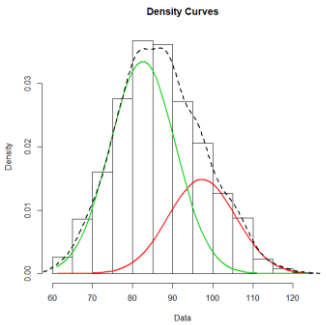


Arrival, staging males, mixed wintering areas, k=2

one lambda < 0.1: 1/1000
nested peaks: 0/1000
fit 1: 999/1000

	comp 1	comp 2
lambda	0.654172	0.345828
mu	82.232139	96.621218
sigma	8.112478	8.548662

loglik at estimate: -4559.503

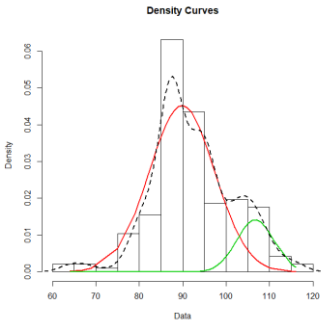


Arrival, staging males, 2006 k=2

one lambda <0.1: 76/1000
nested peaks: 656/1000
fit 1: 268/1000

	comp 1	comp 2
lambda	0.848507	0.151493
mu	89.847536	106.689289
sigma	7.488634	4.264320

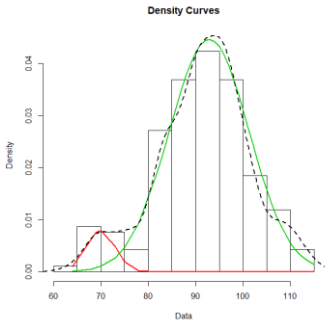
loglik at estimate: -700.9636



Arrival, staging males, 2007, k=2

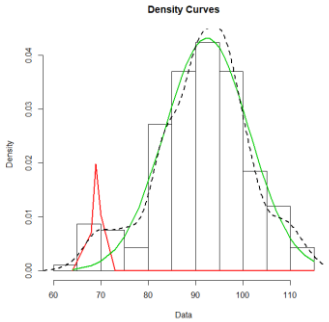
one lambda < 0.1: 339/1000
nested peaks: 661/1000
fit 1: 300/1000

	comp 1	comp 2
lambda	0.0597575	0.940242
mu	70.0441908	92.880998
sigma	2.9899743	8.396129
loglik at estimate:	-675.1002	



fit 2: 8/1000

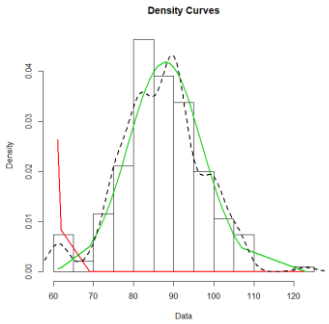
	comp 1	comp 2
lambda	0.0597575	0.940242
mu	70.0441908	92.880998
sigma	2.9899743	8.396129
loglik at estimate:	-675.1002	



Arrival, staging males, 2008, k=2

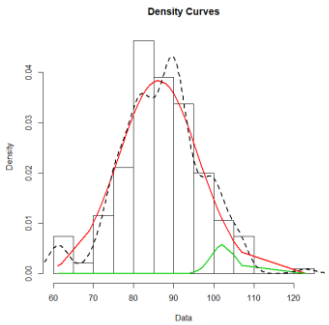
one lambda < 0.1: 48/1000
nested peaks: 952/1000
fit 1: 26/1000 (selected visually)

	comp 1	comp 2
lambda	0.0353316	0.964668
mu	61.2715199	87.844114
sigma	0.4447443	9.194945
loglik at estimate:	-698.7176	



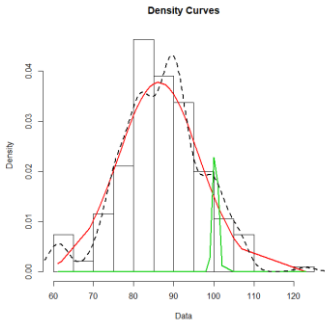
fit 2: 14/1000

	comp 1	comp 2
lambda	0.956937	0.0430627
mu	86.213713	102.2725755
sigma	9.944256	2.9554707
loglik at estimate:	-711.7196	



fit 3: 8/1000

	comp 1	comp 2
lambda	0.955682	0.0443181
mu	86.279997	100.3884444
sigma	10.084182	0.6482493
loglik at estimate:	-708.953	

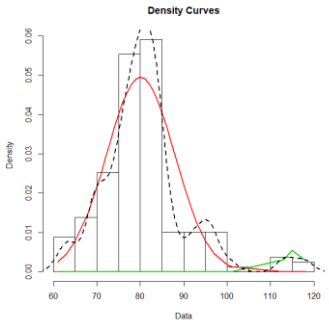


Arrival, staging males, 2009, k=2

one lambda < 0.1: 36
nested peaks: 687
fit 1: 35/1000 (selected visually)

	comp 1	comp 2
lambda	0.968585	0.031415
mu	80.059529	115.401984
sigma	7.815139	2.244923

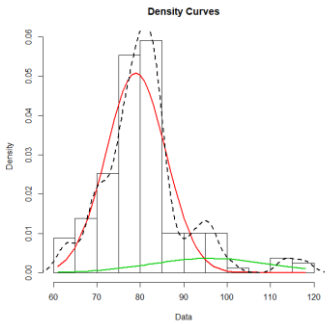
loglik at estimate: -568.4579



fit 2: 277/1000

	comp 1	comp 2
lambda	0.872582	0.127418
mu	78.997721	96.044551
sigma	6.856350	13.722640

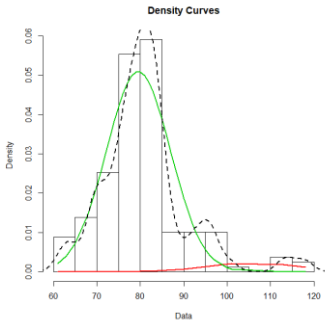
loglik at estimate: -572.028



fit 3: 1/1000

	comp 1	comp 2
lambda	0.0607107	0.939289
mu	105.9825663	79.566015
sigma	10.4437399	7.361879

loglik at estimate: -572.0776

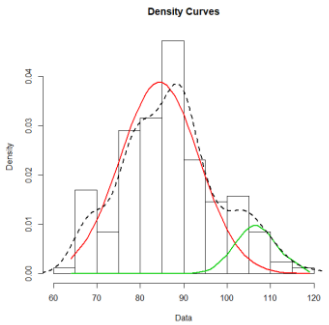


Arrival, staging males, 2010, k=2

one lambda < 0.1: 2/1000
nested peaks: 46/1000
fit 1: 952/1000

	comp 1	comp 2
lambda	0.882162	0.117838
mu	84.454384	106.519762
sigma	9.061862	4.803955

loglik at estimate: -628.9857

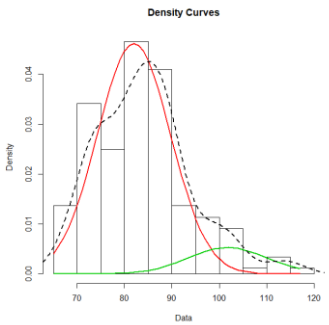


Arrival, staging males, 2011, k=2

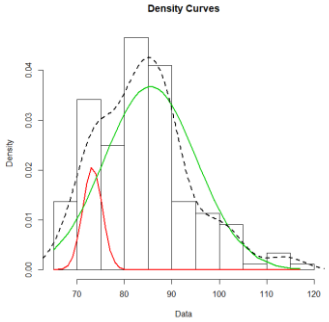
one lambda <0.1: 10/1000
nested peaks: 80/1000
fit 1: 796/1000

	comp 1	comp 2
lambda	0.889934	0.110066
mu	81.994450	101.815811
sigma	7.698618	8.320623

loglik at estimate: -647.0106

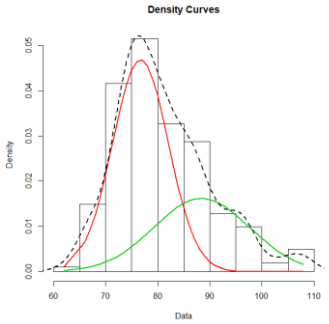


```
fit 2: 114/1000
          comp 1    comp 2
lambda  0.106515  0.893485
mu     73.240470 85.479824
sigma   2.061492  9.704180
loglik at estimate:  -650.3465
```



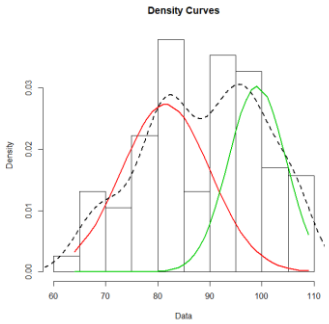
Arrival, staging males, 2012, k=2

```
one lambda <0.1: 8/1000
nested peaks: 0/1000
fit 1: 992/1000
          comp 1    comp 2
lambda  0.629041  0.370959
mu     76.699126 88.426578
sigma   5.364995  9.151262
loglik at estimate:  -718.0846
```



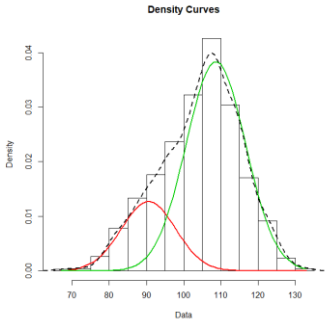
Arrival, staging males, 2013, k=2

```
one lambda <0.1: 130/1000
nested peaks: 0/1000
fit 1: 870/1000
          comp 1    comp 2
lambda  0.581933  0.418067
mu     81.545407 99.095206
sigma   8.492858  5.517646
loglik at estimate:  -582.4497
```



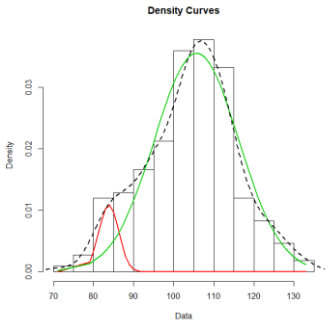
Departure, staging males, k=2

```
one lambda <0.1: 2/1000
nested peaks: 0/1000
fit 1: 998/1000
          comp 1     comp 2
lambda  0.232202   0.767798
mu     90.550621 108.636226
sigma   7.289880   7.985171
loglik at estimate:  -5388.605
```



Departure, staging males, European wintering area, k=2

```
one lambda <0.1: 581/1000
nested peaks: 419/1000
fit 1: 577/1000
          comp 1     comp 2
lambda  0.066866   0.933134
mu     83.828245 105.697330
sigma   2.463437  10.473855
loglik at estimate:  -833.6646
```

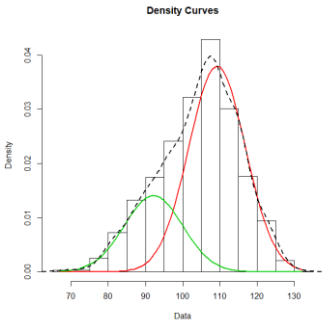


Departure, staging males, mixed wintering areas, k=2

one lambda <0.1: 18/1000
nested peaks: 0/1000
fit 1: 982/1000

	comp 1	comp 2
lambda	0.69926	0.30074
mu	109.52101	92.73575
sigma	7.42768	8.03863

loglik at estimate: -4550.484

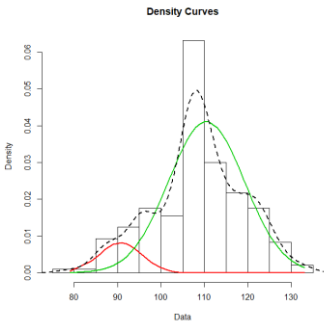


Departure, staging males, 2006, k=2

one lambda <0.1: 8/1000
nested peaks: 168/1000
fit 1: 824/1000

	comp 1	comp 2
lambda	0.101025	0.898975
mu	90.674877	110.465713
sigma	4.933147	8.728367

loglik at estimate: -721.5501

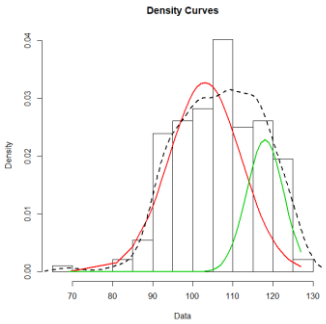


Departure, staging males, 2007, k=2

one lambda <0.1: 206/1000
nested peaks: 0/1000
fit 1: 794/1000

	comp 1	comp 2
lambda	0.736353	0.263647
mu	103.062661	118.037963
sigma	8.974660	4.603936

loglik at estimate: -687.0113

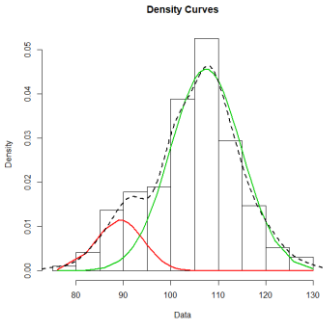


Departure, staging males, 2008, k=2

one lambda <0.1: 39/1000
nested peaks: 486/1000
fit 1: 475/1000

	comp 1	comp 2
lambda	0.142968	0.857032
mu	89.229144	107.422029
sigma	4.919424	7.488396

loglik at estimate: -694.8424

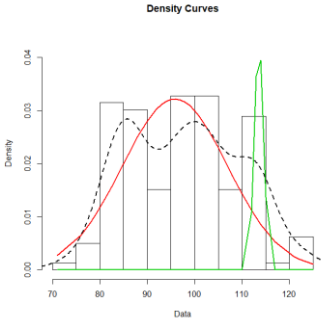


Departure, staging males, 2009, k=2

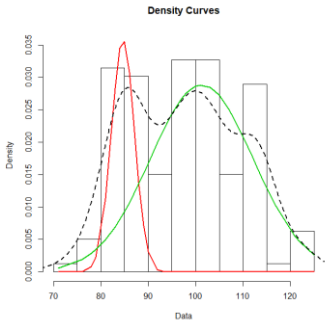
one lambda <0.1: 1/1000
nested peaks: 1/1000
fit 1: 944/1000 (selected visually)

	comp 1	comp 2
lambda	0.217127	0.782873
mu	84.665479	101.304654
sigma	2.414840	10.838905

loglik at estimate: -605.6548

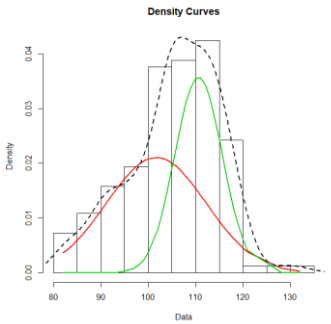


```
fit 2: 55/1000
         comp 1      comp 2
lambda  0.89698    0.103020
mu     95.86823 113.569429
sigma  11.13707    0.938776
loglik at estimate:  -607.993
```

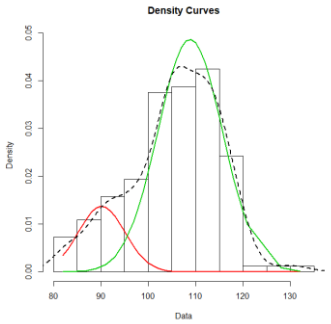


Departure, staging males, 2010, k=2

```
one lambda <0.1: 10/1000
nested peaks: 0/1000
fit 1: 625/1000
           comp 1      comp 2
lambda   0.555633    0.444367
mu     101.563639 110.563450
sigma   10.492178    5.028462
loglik at estimate:  -607.5557
```

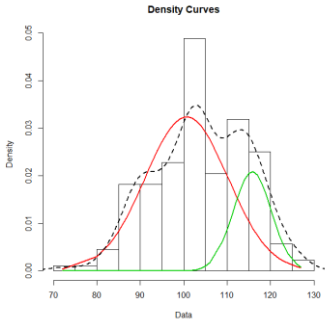



```
fit 2: 365/1000 (selected visually)
          comp 1      comp 2
lambda  0.169326    0.830674
mu     90.181457 108.845129
sigma   4.925862    6.807412
loglik at estimate:  -598.6298
```

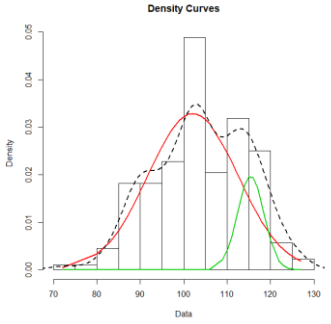


Departure, staging males, 2011, k=2

```
one lambda <0.1: 124/1000
nested peaks: 124/1000
fit 1: 768/1000 (selected visually)
           comp 1      comp 2
lambda   0.771272    0.228728
mu     100.671802 115.793972
sigma    9.502665    4.379455
loglik at estimate:  -662.3913
```




```
fit 2: 108/1000
           comp 1      comp 2
lambda   0.849811    0.150189
mu     102.137685 115.407594
sigma   10.320234    3.041345
loglik at estimate:  -662.4314
```

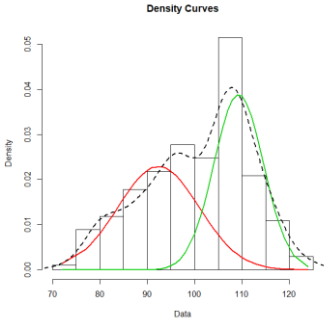


Departure, staging males, 2012, k=2

one lambda <0.1: 43/1000
nested peaks: 113/1000
fit 1: 584/1000 (selected visually)

	comp 1	comp 2
lambda	0.491699	0.508301
mu	92.394097	109.305307
sigma	8.568950	5.220720

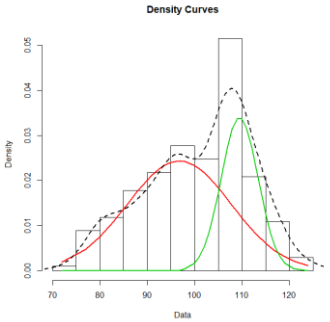
loglik at estimate: -758.4597



fit 2: 260/1000

	comp 1	comp 2
lambda	0.66896	0.33104
mu	96.77471	109.50831
sigma	10.97060	3.89277

loglik at estimate: -758.3162

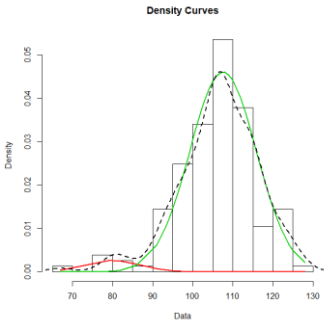


Departure, staging males, 2013, k=2

one lambda <0.1: 962/1000
nested peaks: 38/1000
fit 1: 893/1000 (selected visually)

	comp 1	comp 2
lambda	0.0442998	0.95570
mu	80.2257846	107.55719
sigma	6.7897698	8.27198

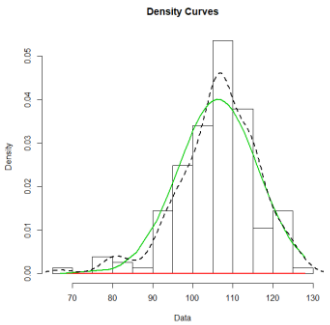
loglik at estimate: -561.8492



fit 2: 6/1000

	comp 1	comp 2
lambda	3.86599e-09	1.00000
mu	93.2188e	106.34641
sigma	1.28371e+00	9.95304

loglik at estimate: -568.6729

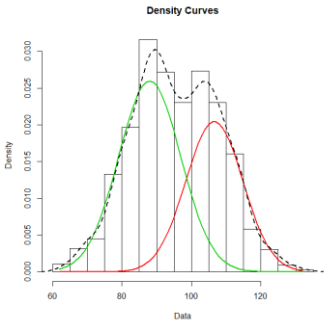


Observations of transient males, k=2

one lambda < 0.1: 3/1000
nested peaks: 0/1000
fit 1: 997/1000

	comp 1	comp 2
lambda	0.580267	0.419733
mu	87.995482	106.608971
sigma	8.912237	8.193099

loglik at estimate: -5976.606

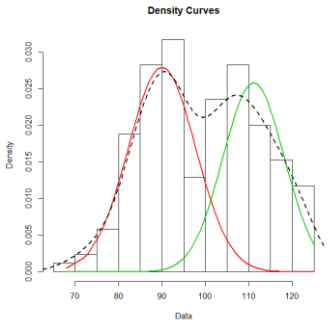


Observations of transient females, k=2

one lambda < 0.1: 11/1000
nested peaks: 209/1000
fit 1: 780/1000

	comp 1	comp 2
lambda	0.54335	0.45665
mu	89.99864	111.10150
sigma	7.76624	7.05498

loglik at estimate: -667.3678

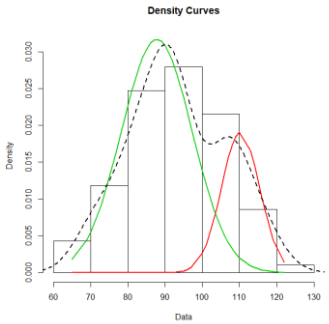


Observations of transient males, wintering in Europe, k=2

one lambda <0.1: 29/1000
nested peaks: 2/1000
fit 1: 969/1000

	comp 1	comp 2
lambda	0.754171	0.245829
mu	87.773879	110.257676
sigma	9.500814	5.150076

loglik at estimate: -366.1808

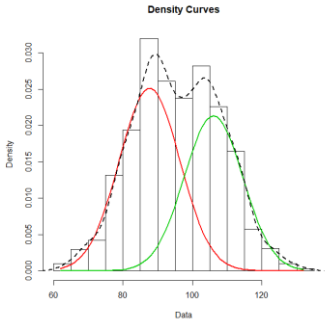


Observations of transient males, mixed wintering areas, k=2

one lambda < 0.01: 4/1000
nested peaks: 0/1000
fit 1: 996/1000

	comp 1	comp 2
lambda	0.549166	0.450834
mu	87.677842	106.075030
sigma	8.720415	8.427782

loglik at estimate: -5606.271

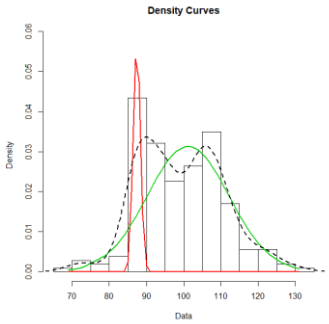


Observation of transient males, 2006, k=2

one lambda <0.1: 119/1000
nested peaks: 0/1000
fit 1: 881/1000 (rejected visually)

	comp 1	comp 2
lambda	0.138828	0.861172
mu	87.398194	101.177037
sigma	0.954584	10.972973

loglik at estimate: -796.3082

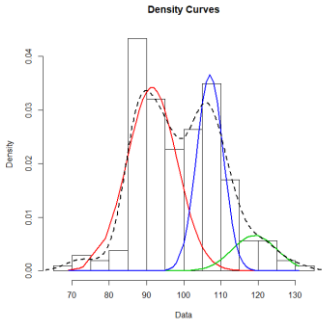


Observation of transient males, 2006, k=3

two peaks lambda < 0.1: 7/1000
two nested peaks: 819/1000
fit 1: 149/1000 (selected visually)

	comp 1	comp 2	comp 3
lambda	0.57565	0.0988508	0.325499
mu	91.48495	119.0210478	107.021781
sigma	6.70863	5.9623727	3.541900

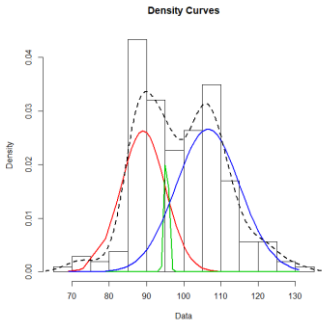
loglik at estimate: -803.5427



fit 2: 24/1000

	comp 1	comp 2	comp 3
lambda	0.267008	0.0627392	0.670253
mu	89.095275	95.4280392	106.510488
sigma	2.522127	0.6692326	11.294400

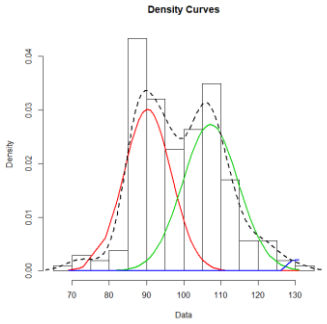
loglik at estimate: -804.9937



fit 3: 1/1000

	comp 1	comp 2	comp3
lambda	0.480616	0.511086	8.2977e-03
mu	90.300225	107.193905	1.3005e+02
sigma	6.353653	7.465394	1.0022e+00

loglik at estimate: -809.0227



Observation of transient males, 2007, k=2

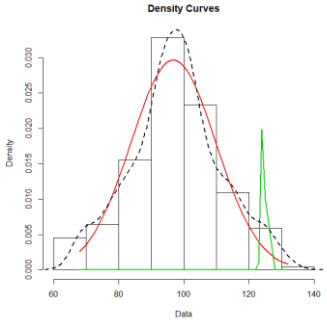
one lambda <0.1: 705/1000

nested peaks: 295/1000

fit 1: 665/1000

	comp 1	comp 2
lambda	0.968875	0.031125
mu	96.820140	124.311118
sigma	13.035823	0.525826

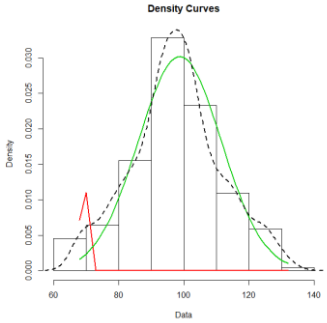
loglik at estimate: -877.3685



fit 2: 37/1000

	comp 1	comp 2
lambda	0.0375111	0.962489
mu	69.2063049	98.785339
sigma	0.9805819	12.723655

loglik at estimate: -877.03



Observation of transient males, 2008, k=2

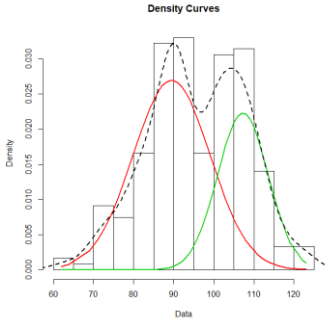
one lambda < 0.1: 32/1000

nested peaks: 289/1000

fit 1: 679/1000

	comp 1	comp 2
lambda	0.647565	0.352435
mu	89.479876	107.253295
sigma	9.588097	6.304977

loglik at estimate: -941.5154

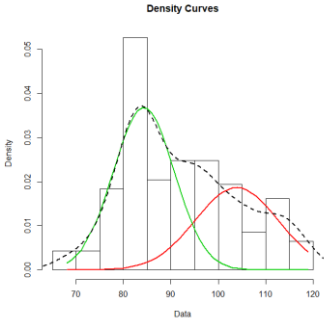


Observation of transient males, 2009, k=2

one lambda < 0.1: 0/1000
nested peaks: 413/1000
fit 1: 533/1000 (selected visually)

	comp 1	comp 2
lambda	0.406737	0.593263
mu	103.886256	84.294883
sigma	8.689759	6.438671

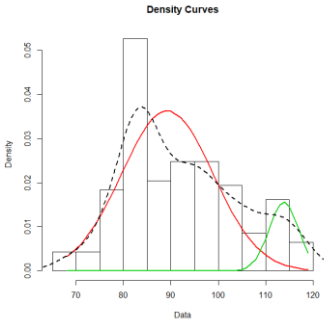
loglik at estimate: -715.8022



fit 2: 54/1000

	comp 1	comp 2
lambda	0.877712	0.122288
mu	89.254110	113.862515
sigma	9.649276	3.137965

loglik at estimate: -716.8638

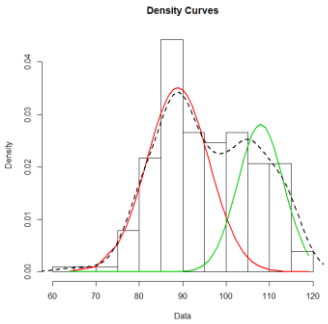


Observation of transient males, 2010 k=2

one lambda < 0.1: 7/1000
nested peaks: 43/1000
fit 1: 655/1000 (visually selected)

	comp 1	comp 2
lambda	0.627267	0.372733
mu	88.902963	107.943563
sigma	7.123294	5.287927

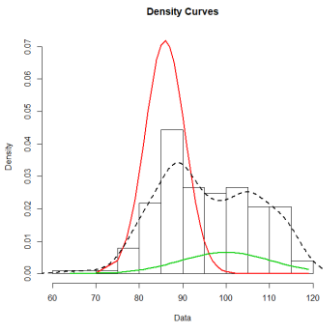
loglik at estimate: -766.5066



fit 2: 295/1000

	comp 1	comp 2
lambda	0.825066	0.174934
mu	85.929882	99.951316
sigma	4.576804	10.640975

loglik at estimate: -772.4477

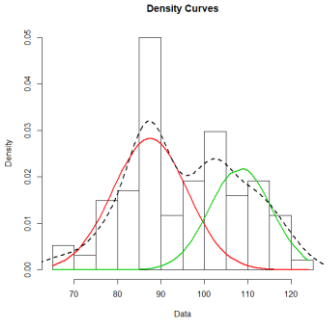


Observation of transient males, 2011, k=2

one lambda < 0.1: 32/1000
nested peaks: 279/1000
fit 1: 689/1000

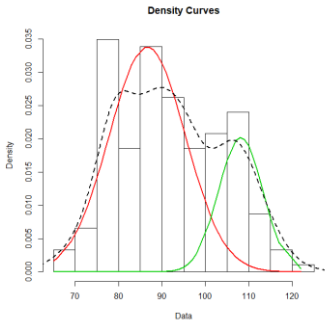
	comp 1	comp 2
lambda	0.640379	0.359621
mu	87.659086	107.989795
sigma	8.928501	6.819560

loglik at estimate: -665.2712



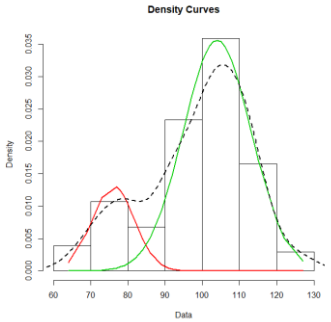
Observation of transient males, 2012, k=2

```
one lambda < 0.1: 5/1000
nested peaks: 205/1000
fit 1: 790/1000
          comp 1     comp 2
lambda  0.742721   0.257279
mu     86.598036 108.125494
sigma   8.760910   5.081523
loglik at estimate:  -709.9739
```



Observation of transient males, 2013, k=2

```
one lambda < 0.1: 22/1000
nested peaks: 0/1000
fit 1: 510/1000 (selected visually)
          comp 1     comp 2
lambda  0.185705   0.814295
mu     76.075841 103.977625
sigma   5.624744   9.125122
loglik at estimate:  -407.5396
```




```
fit 2: 468/1000
          comp 1     comp 2
lambda  0.618059   0.381941
mu     93.548469 107.288186
sigma  14.824330   5.370269
loglik at estimate:  -409.5681
```