

Hayward RPP update 7th July 2024

First Winter Survival

Hind is only marginally significant with additional Deer Year as fixed effect, and adults are now slightly more significant than hinds.

while year is not always significant:

Yellow = significant

	With birth weight		Without birth weight	
	Density	Deer Year	Density	Deer Year
Hinds	-0.325 (p=0.093)	-0.005 (p=0.72)	-0.325 (p=0.080)	-0.006 (p=0.70)
Adults	-0.372 (p=0.065)	-0.034 (p=0.027)	-0.372 (p=0.054)	-0.034 (p=0.021)
Total	-0.194 (p=0.49)	-0.024 (p=0.54)	-0.192 (p=0.23)	-0.025 (p=0.072)
LU_total	-0.280 (p=0.19)	-0.031 (p=0.052)	-0.278 (p=0.17)	-0.031 (p=0.043)

Compared to the models without additional year effect

	With birth weight Density	Without birth weight Density
Hinds	-0.36 (p=0.029)	-0.36 (p=0.023)
Adults	-0.14 (p=0.44)	-0.14 (p=0.42)
Total	-0.078 (p=0.66)	-0.075 (p=0.66)
LU_total	-0.043 (p=0.81)	-0.041 (p=0.81)

No matter with or without the additional deer year, Scaled mum age was always significant and positive in models without birth weight, and insignificant in models with birth weight.

Scaled mum age squared was always negative and significant.

Birth weight was always significant and positive

Fecundity

Overall Fecundity of females seen in rut

```
glmmTMB(Fecundity~S_Hinds+ReprodStatus+(1|DeerYear)+(1|Female),family =  
binomial(link = "logit"))
```

	Without ages and additional year	+Age +AgeSquared	+DeerYear	+Age +AgeSquared +DeerYear
Hinds	-0.183 (p=0.013)	-0.209 (p=0.016)	-0.163 (p=0.048)	-0.202 (p=0.052)
Adults	0.044 (p=0.558)	0.046 (p=0.606)	-0.037 (p=0.690)	-0.025 (p=0.835)
Total	0.091 (p=0.223)	0.097 (p=0.274)	0.048 (p=0.560)	0.061 (p=0.554)
LU_Total	0.105 (p=0.158)	0.114 (p=0.196)	0.051 (p=0.591)	0.076 (p=0.551)

Yellow = significant

All the reproductive status are always significant

With winter yield usually being less significant and closer to milk

Age and age squared are both always significant when included

Positive for Age and negative for age squared

The additional year is always insignificant when included

Hind density is the only density measure that is significant for overall fecundity

Fecundity by female status

Without additional year, age and age squared

Results for Scaled Density

	Milk	Summer yeld	Winter yeld	True yeld	Naive
Hinds	-0.305 (p=0.017)	-0.257 (p=0.131)	0.072 (p=0.633)	-0.087 (p=0.511)	-0.083 (p=0.245)
Adults	0.029 (p=0.833)	-0.194 (p=0.2)	0.274 (p=0.039)	0.339 (p=0.002)	0.003 (p=0.970)
Total	0.120 (p=0.374)	-0.212 (p=0.161)	0.371 (p=0.004)	0.429 (p=0.00004)	0.021 (p=0.753)
LU_Total	0.135 (p=0.318)	-0.181 (p=0.232)	0.324 (p=0.012)	0.421 (p=0.00009)	0.025 (p=0.703)

With additional year Without age and age squared

Adults for winter yield and true yield are now insignificant

Without additional year is removed, adults for winter yield ($p=0.0387$) and true yield ($p=0.0024$) would be significant as well.

Results for Scaled Density

	Milk	Summer yield	Winter yield	True yield	Naive
Hinds	-0.325 ($p=0.033$)	-0.334 ($p=0.071$)	0.183 ($p=0.261$)	0.081 ($p=0.547$)	-0.091 ($p=0.250$)
Adults	-0.054 ($p=0.736$)	-0.262 ($p=0.162$)	0.300 ($p=0.080$)	0.164 ($p=0.250$)	-0.016 ($p=0.851$)
Total	0.088 ($p=0.547$)	-0.246 ($p=0.149$)	0.409 ($p=0.007$)	0.328 ($p=0.007$)	0.015 ($p=0.849$)
LU_Total	0.105 ($p=0.525$)	-0.257 ($p=0.184$)	0.416 ($p=0.016$)	0.311 ($p=0.029$)	0.022 ($p=0.808$)

Results for Year as linear

	Milk (Year)	Summer yield (Year)	Winter yield (Year)	True yield (Year)	Naive (Year)
Hinds	0.00311 ($p=0.775$)	0.01339 ($p=0.309$)	-0.01569 ($p=0.136$)	-0.02970 ($p=0.0007$)	0.00134 ($p=0.806$)
Adults	-0.01034 ($p=0.364$)	-0.00909 ($p=0.535$)	0.00279 ($p=0.815$)	-0.01998 ($p=0.059$)	-0.00220 ($p=0.725$)
Total	-0.00539 ($p=0.606$)	-0.00591 ($p=0.659$)	0.00492 ($p=0.638$)	-0.01481 ($p=0.094$)	-0.00096 ($p=0.865$)
LU_Total	-0.00345 ($p=0.772$)	-0.00961 ($p=0.526$)	0.00962 ($p=0.430$)	-0.01219 ($p=0.242$)	-0.00043 ($p=0.947$)

With Age and Age squared

	Milk	Summer yeld	Winter yeld	True yeld	Naive
Hinds	-0.382 (p=0.020)	-0.299 (p=0.0584) Failed to converge	0.218 (p=0.207)	0.112 (p=0.419)	-0.074 (p=0.842)
Adults	-0.075 (p=0.673)	-0.229 (p=0.214)	0.366 (p=0.044)	0.283 (p=0.053)	-0.00007 (p=1) Failed to converge
Total	0.079 (p=0.626)	-0.225 (p=0.181)	0.476 (p=0.003)	0.410 (p=0.0008)	0.012 (p=0.974)
LU_Total	0.100 (p=0.589)	-0.229 (p=0.231)	0.493 (p=0.008)	0.430 (p=0.028)	0.024 (p=0.953)

Age and Age squared are significant in all the models except the summer yeld models
Positive for Age and negative for age squared

The additional year hinds true yeld is again the only time that is significant.

Hinds summer yeld and Adults naive both produced NaN for Deer Year and failed to converge

Spikes with birth weight

Birth weight was always significant and positive,
~0.2 (p~0.03) for 1973-1996 and ~0.19 (p~0.019) for 1973-2021

Deer Year was always significant and positive, but significance can vary between densities, being least significant in hinds models and most significant in adults models.

	1973-1996 Density	1973-2021 Density	1973-1996 Deer year	1973-2021 Deer year
Hinds	0.0025 (p=0.679)	0.0047 (p=0.337)	0.050 (p=0.024)	0.030 (p=0.001)
Adults	0.0031 (p=0.417)	0.0054 (p=0.139)	0.055 (p=0.0006)	0.041 (p=2.41e-6)
Total	0.0018 (p=0.621)	0.0035 (p=0.245)	0.053 (p=0.003)	0.038 (p=2.59e-6)
LU_Total	0.0076 (p=0.504)	0.0130 (p=0.178)	0.055 (p=0.002)	0.041 (p=4.94e-6)

635 sample with birth weight
812 samples when birth weight was excluded

Spike without birth weight 1973-1996

Results for Densities

	Observed year With Deer Year	Observed year w/o Deer Year	Birth Year With Deer Year	Birth Year w/o Deer Year
Hinds	0.0023 (p=0.700)	0.0109 (p=0.029)	0.0053 (p=0.317)	0.0133 (p=0.0053)
Adults	0.0037 (p=0.365)	0.0058 (p=0.232)	0.0055 (p=0.123)	0.0068 (p=0.144)
Total	0.0019 (p=0.598)	0.0055 (p=0.168)	0.0050 (p=0.119)	0.0080 (p=0.0377)
LU_Total	0.0085 (p=0.450)	0.0141 (p=0.296)	0.0163 (p=0.099)	0.0195 (p=0.134)

Deer year was significant and positive ~0.05 with varying significance in observed year models

~0.06 in birth year models and more significant than in observed year models

Results for Deer Year

	Observed Year Deer Year	Birth Year Deer Year
Hinds	0.054 (p=0.0232)	0.052 (p=0.0175)
Adults	0.058 (p=0.00143)	0.065 (p=0.00011)
Total	0.057 (p=0.00297)	0.059 (p=0.0006)
LU_Total	0.058 (p=0.00135)	0.065 (p=0.00009)

Spike without birth weight 1973-2021

Results for Densities

	Observed year With Deer Year	Observed year w/o Deer Year	Birth Year With Deer Year	Birth Year w/o Deer Year
Hinds	0.0053 (p=0.260)	0.0147 (p=0.0006)	0.0007 (p=0.158)	0.0152 (p=0.0003)
Adults	0.0065 (p=0.070)	-0.0021 (p=0.593)	0.0060 (p=0.083)	-0.0024 (p=0.537)
Total	0.0046 (p=0.119)	0.0005 (p=0.884)	0.0055 (p=0.055)	0.0012 (p=0.735)
LU_Total	0.0017 (p=0.08)	-0.0084 (p=0.398)	0.0174 (p=0.059)	-0.0079 (p=0.428)

Results for Deer Year

	Observed Year Deer Year	Birth Year Deer Year
Hinds	0.031 (p=0.000839)	0.029 (p=0.00216)
Adults	0.044 (p=0.000000133)	0.044 (p=0.000000205)
Total	0.040 (p=0.000000164)	0.041 (p=0.000000103)
LU_Total	0.045 (p=0.000000235)	0.046 (p=0.000000172)

When including an additional deer year as fixed effect, Adults, Total and LU_Total became more significant than without, but were still insignificant.

Spike with mother status next year

Out of the 812 observations, 803 of the mother's status were milk the next year, 4 were winter yeld and 5 summer yeld.

Mother status the next year was insignificant in all models.

Birth Weight

```
glmmTMB(BirthWt~Hinds
        +Sex
        +DaysFrom1May
        +DeerYear
        +(1|DeerYear)
        +(1|MumCode),
        family = gaussian(),data=birthwt)
```

Results for Density

		+MumAge +MumAgeSquared	+MumStatus	+MumAge +MumAgeSquared +MumStatus
Hinds	-0.0004 (p=0.836)	-0.0015 (p=0.476)	-0.0008 (p=0.702)	-0.0017 (p=0.418)
Adults	-0.0007 (p=0.656)	-0.0011 (p=0.468)	-0.0007 (p=0.643)	-0.0007 (p=0.659)
Total	-0.0002 (p=0.870)	-0.0006 (p=0.617)	-0.0003 (p=0.831)	-0.0003 (p=0.806)
LU_Total	-0.0013 (p=0.762)	-0.0024 (p=0.568)	-0.0013 (p=0.756)	-0.0010 (p=0.813)

Mum Age and Mum Age squared were always very significant when included
Positive for Mum Age and negative for Mum Age Squared

Additional Deer Year as linear was never significant

Days from 1st of May was always positive

It was not significant for models without mum age and status. (p~0.125)

It was significant when mum age was included. (p~0.002)

More significant when mum status was included. (p~2e-5)

Most significant when mum age and status were both included. (p~2e-13)

Summer yield and True yield were always positive and more significant than winter yield which was negative.

Naive was the most significant reproductive status when age wasn't included

Naive was insignificant when age was included

Results for the other variables are similar for all densities, so I've only included the summary of Hinds models.

```
> summary(Hinds_bw)
Family: gaussian ( identity )
Formula:
BirthWt ~ Hinds + Sex + DaysFrom1May + DeerYear + (1 | DeerYear) +
(1 | MumCode)
Data: birthwt
```

AIC	BIC	logLik	deviance	df.resid
9433.2	9481.5	-4708.6	9417.2	3077

Random effects:

Conditional model:

Groups	Name	Variance	Std.Dev.
DeerYear	(Intercept)	0.07323	0.2706
MumCode	(Intercept)	0.58302	0.7636
Residual		0.90073	0.9491

Number of obs: 3085, groups: DeerYear, 50; MumCode, 796

Dispersion estimate for gaussian family (sigma^2): 0.901

Conditional model:

	Estimate	Std. Error	z value	Pr(> z)
(Intercept)	3.2641036	7.8749817	0.414	0.679
Hinds	-0.0004485	0.0021694	-0.207	0.836
Sex	0.3803936	0.0376855	10.094	<2e-16 ***
DaysFrom1May	0.0022992	0.0014968	1.536	0.125
DeerYear	0.0013052	0.0040159	0.325	0.745

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1


```

> summary(Age_Hinds_bw)
Family: gaussian ( identity )
Formula:
BirthWt ~ Hinds + Sex + DaysFrom1May + DeerYear + MumAge + MumAgeSquared +
(1 | DeerYear) + (1 | MumCode)
Data: birthwt

      AIC      BIC   logLik deviance df.resid
  9115.2   9175.5  -4547.6   9095.2     3072

Random effects:

Conditional model:
Groups   Name      Variance Std.Dev.
DeerYear (Intercept) 0.07312  0.2704
MumCode  (Intercept) 0.62324  0.7895
Residual                    0.78486  0.8859
Number of obs: 3082, groups: DeerYear, 50; MumCode, 793

Dispersion estimate for gaussian family (sigma^2): 0.785

Conditional model:
              Estimate Std. Error z value Pr(>|z|)
(Intercept)   0.723857   7.938244   0.091  0.92734
Hinds         -0.001526   0.002143  -0.712  0.47639
Sex            0.372272   0.035425  10.509 < 2e-16 ***
DaysFrom1May   0.004405   0.001424   3.094  0.00198 **
DeerYear       0.001710   0.004046   0.423  0.67247
MumAge         0.464703   0.025416  18.284 < 2e-16 ***
MumAgeSquared -0.024289   0.001385 -17.537 < 2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

```

> summary(Status_Hinds_bw)
Family: gaussian ( identity )
Formula:
BirthWt ~ Hinds + Sex + DaysFrom1May + DeerYear + MotherStatus +
(1 | DeerYear) + (1 | MumCode)
Data: birthwt

      AIC      BIC   logLik deviance df.resid
1115.4    9187.8  -4545.7   9091.4     3073

Random effects:

Conditional model:
Groups   Name              Variance Std.Dev.
DeerYear (Intercept) 0.06844   0.2616
MumCode  (Intercept) 0.60933   0.7806
Residual                    0.78530   0.8862
Number of obs: 3085, groups:  DeerYear, 50; MumCode, 796

Dispersion estimate for gaussian family (sigma^2): 0.785

Conditional model:
              Estimate Std. Error z value Pr(>|z|)
(Intercept)    9.3948187   7.6679093    1.225 0.220495
Hinds          -0.0008014   0.0020912   -0.383 0.701566
Sex             0.3559537   0.0354356   10.045 < 2e-16 ***
DaysFrom1May    0.0069202   0.0014642    4.726 2.29e-06 ***
DeerYear       -0.0018096   0.0039084   -0.463 0.643368
MotherStatusSummer yeld  0.4115076   0.0634416    6.486 8.79e-11 ***
MotherStatusTrue yeld   0.3958162   0.0506506    7.815 5.51e-15 ***
MotherStatusWinter yeld -0.2437961   0.0696560   -3.500 0.000465 ***
MotherStatusNa\xefve    -0.4740244   0.0539755   -8.782 < 2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

```
> summary(Mum_Hinds_bw)
Family: gaussian ( identity )
Formula:
BirthWt ~ Hinds + Sex + DaysFrom1May + DeerYear + MumAge + MumAgeSquared +
MotherStatus + (1 | DeerYear) + (1 | MumCode)
Data: birthwt
```

AIC	BIC	logLik	deviance	df.resid
8909.2	8993.7	-4440.6	8881.2	3068

Random effects:

Conditional model:

Groups	Name	Variance	Std.Dev.
DeerYear	(Intercept)	0.07601	0.2757
MumCode	(Intercept)	0.65480	0.8092
Residual		0.71206	0.8438

Number of obs: 3082, groups: DeerYear, 50; MumCode, 793

Dispersion estimate for gaussian family (sigma^2): 0.712

Conditional model:

	Estimate	Std. Error	z value	Pr(> z)
(Intercept)	-2.260408	8.032985	-0.281	0.77841
Hinds	-0.001749	0.002158	-0.811	0.41763
Sex	0.358359	0.033945	10.557	< 2e-16 ***
DaysFrom1May	0.010510	0.001434	7.329	2.32e-13 ***
DeerYear	0.003123	0.004093	0.763	0.44555
MumAge	0.428100	0.034459	12.424	< 2e-16 ***
MumAgeSquared	-0.023635	0.001731	-13.655	< 2e-16 ***
MotherStatusSummer yeld	0.605512	0.062385	9.706	< 2e-16 ***
MotherStatusTrue yeld	0.513821	0.049466	10.387	< 2e-16 ***
MotherStatusWinter yeld	-0.207767	0.066801	-3.110	0.00187 **
MotherStatusNa\xefve	0.023343	0.074483	0.313	0.75397

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1