MRDS Example: faecal pellet survey

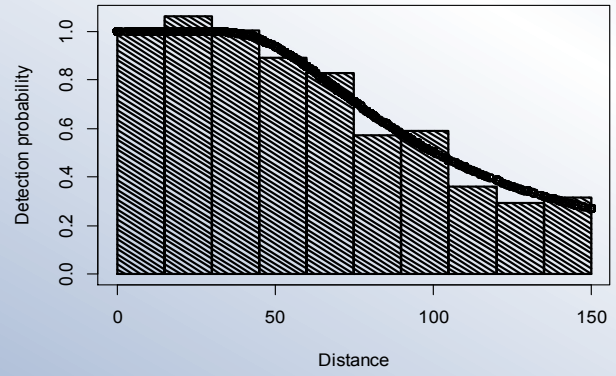
Photos from US National Park Service photo gallery

Pellet survey design

- Survey of faecal pellets of elk and deer in Olympic National Park, Washington, USA, to estimate abundance:
  - Double observer line transect survey to estimate abundance of pellets incorporating perception bias
  - Plot clearing experiment to estimate deposition/decay rates of pellets
- Stratified random sampling was used to select sampling units
  - Region (East;West); elevation (<300m;>300m); accessibility (<1km from road;<1km from hiking trail;>1km from road or trail)
- Within each sampling unit, 2 parallel transects 200m in length were selected
- Two observers worked **independently** and walked along each of the transects (**observer 1**) looking for faecal pellet groups within 2m of centre line
  - Collected information on pellets – perpendicular distance, number of pellets, dispersion, condition
  - And environmental conditions – ground cover, substrate
- Observers swapped transects (**observer 2**) and repeated survey
- Reconciled which pellet groups had been seen by observer 1 only, observer 2 only and by both observers
- References
  - Jenkins KJ and Manly BFJ (2008) A double-observer method for reducing bias in faecal pellet surveys of forest ungulates. J. App. Ecol. 45, 1339-1348
  - Burt ML, Borchers DL, Jenkins KJ and Marques TA (2014) Using mark-recapture distance sampling methods on line transect surveys. M. E. E. doi: 10.1111/2041-210X.12294 Appendix S2: Running an MRDS analysis is Distance and R: a tutorial

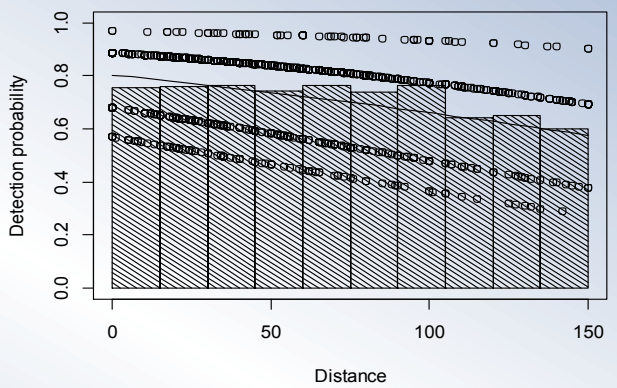
Fitted models: IO configuration

DS model: hazard rate, no covars

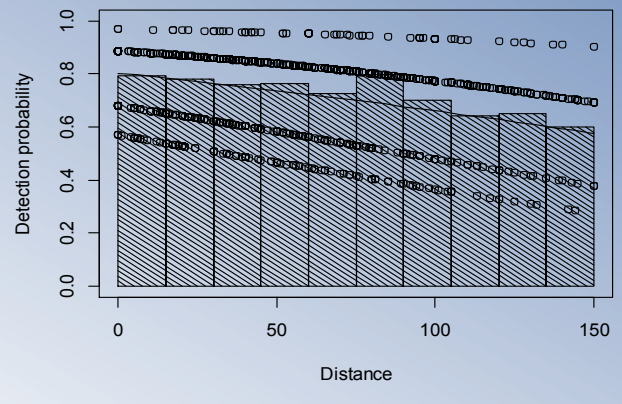


MR model: distance + sizegroup

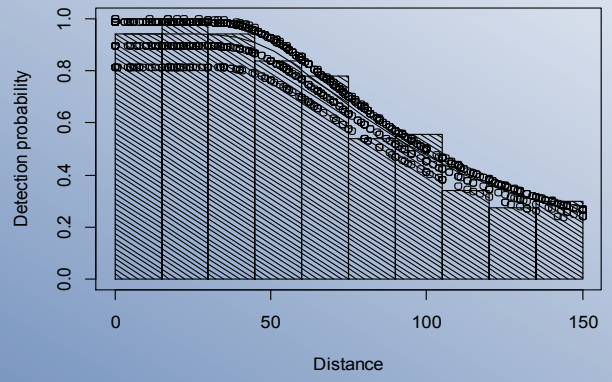
Obs 1 | Obs 2



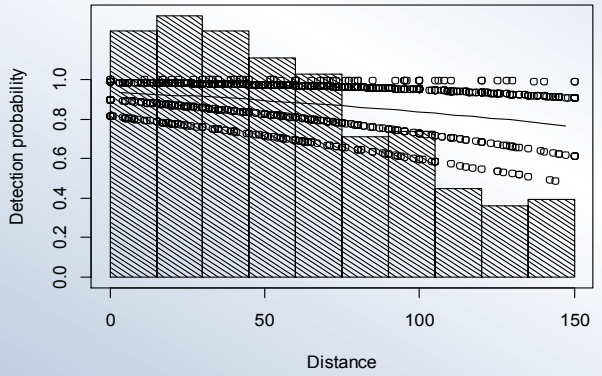
Obs 2 | Obs 1



Point independence = DS + MR



Full independence = MR



Estimates of detection probability

	Point independence		Full independence	
Estimates	**Model used**	**Estimate**	**Model used**	**Estimate**
Probability of detection assuming g(0)=1	DS	0.69 (0.03)	-	
Probability of detection on the trackline	MR	0.94 (0.01)	MR	0.94 (0.02)
Overall probability of detection	MRDS	0.65 (0.03)	MR	0.86 (0.02)
Estimated N in covered region		2116 (0.04)		1601 (0.02)

Detection function summary: IO point independence

Summary for io.fi object MR model

```
Number of observations   :  1380 Pooled
Number seen by primary   :  1094 Observer 1
Number seen by secondary :  1102 Observer 2
Number seen by both      :  816  Duplicates
AIC                      :  2457.952

Conditional detection function parameters:
               estimate          se
(Intercept)  0.28098736 0.188557908
distance    -0.00835025 0.001517454
sizegroup2   0.46927834 0.207238009
sizegroup3   1.78569572 0.193560108
sizegroup4   3.19715740 0.440773795

                          Estimate          SE         CV
Average primary p(0)     0.7952424 0.017075328 0.02147185
Average secondary p(0)   0.7952424 0.017075328 0.02147185
Average combined p(0)    0.9416874 0.009603405 0.01019808
```

Summary for ds object DS model assuming g(0)=1

```
Number of observations :  1380
Distance range         :  0  -  150
AIC                    :  13612.95

Detection function:
 Hazard-rate key function

Detection function parameters
Scale coefficient(s):
             estimate         se
(Intercept) 4.425513 0.05855335

Shape coefficient(s):
             estimate         se
(Intercept) 0.6851006 0.1247415

                 Estimate          SE         CV
Average p       0.6924608 0.02190796 0.03163784
```

On the trackline

Summary for io object MRDS model

Total AIC value : 16070.9 = 2457.952 + 13612.95

	Estimate	SE	CV
Average p	**0.6520816**	0.02167574	0.03324085
N in covered region	**2116.2996331**	78.02162494	0.03686700

$N\downarrow covered = 1380/0.652$

Overall distances

Detection function summary: IO full independence

Summary for io.fi object MR model

```
Number of observations   :  1380 Pooled
Number seen by primary   :  1094 Observer 1
Number seen by secondary :  1102 Observer 2
Number seen by both      :  816  Duplicates
AIC                      :  16217.81


Conditional detection function parameters:
               estimate          se
(Intercept)  0.28098736 0.188557908
distance    -0.00835025 0.001517454
sizegroup2   0.46927834 0.207238009
sizegroup3   1.78569572 0.193560108
sizegroup4   3.19715740 0.440773795
```

	Estimate	SE	CV
Average p	**0.8617999**	0.014769988	0.01713854
Average primary p(0)	0.7854780	0.015519397	0.01975790
Average secondary p(0)	0.7854780	0.015519397	0.01975790
Average combined p(0)	**0.9368971**	0.009788271	0.01044754
N in covered region	**1601.2998003**	32.267117776	0.02015058

Overall distances

On the trackline

$N \downarrow covered = 1380/0.862$