

# MRDS Example: faecal pellet survey



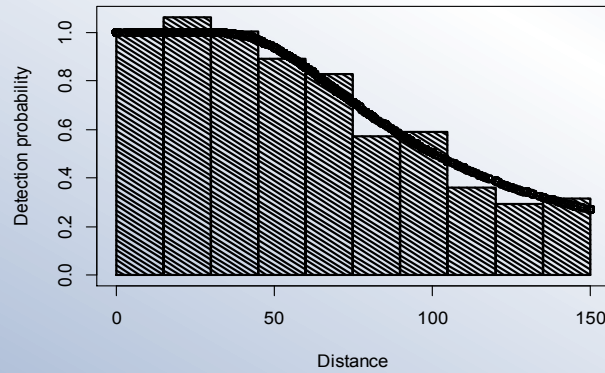
Photos from US National Park Service photo gallery

# 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 in Distance and R: a tutorial

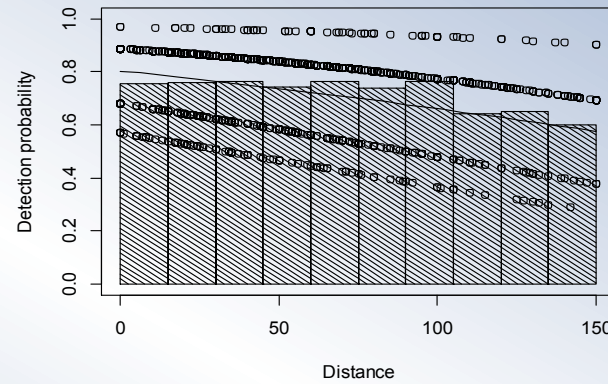
# Fitted models: IO configuration

**DS model:** hazard rate, no covars

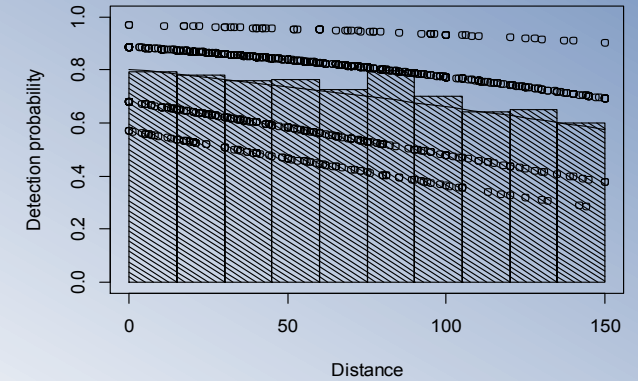


**MR model:** distance + sizegroup

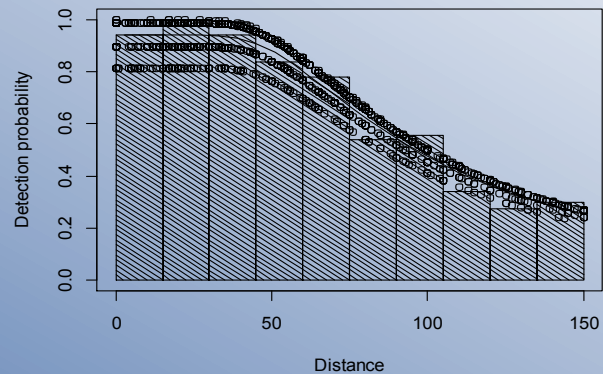
Obs 1 | Obs 2



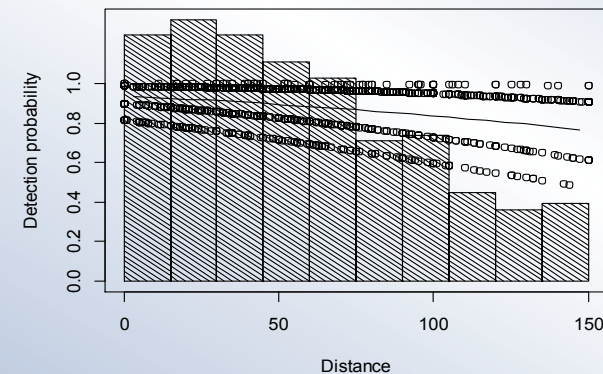
Obs 2 | Obs 1



Point independence = **DS** + **MR**



Full independence = **MR**



# Estimates of detection probability

Estimates	Point independence		Full independence	
	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
<b>Average combined p(0)</b>	<b>0.9416874</b>	0.009603405	0.01019808

## Summary for ds object DS model

Number of observations : 1380 assuming g(0)=1  
 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
<b>Average p</b>	<b>0.6924608</b>	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
<b>Average p</b>	<b>0.6520816</b>	0.02167574	0.03324085
<b>N in covered region</b>	<b>2116.2996331</b>	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
<b>Average p</b>	<b>0.8617999</b>	0.014769988	0.01713854
Average primary p(0)	0.7854780	0.015519397	0.01975790
Average secondary p(0)	0.7854780	0.015519397	0.01975790
<b>Average combined p(0)</b>	<b>0.9368971</b>	0.009788271	0.01044754
<b>N in covered region</b>	<b>1601.2998003</b>	32.267117776	0.02015058

Overall distances

On the trackline

$N_{covered} = 1380 / 0.862$