

# Comparative study<sup>a</sup>

1. Point transect, 5-minute counts (9.8 hrs)
2. Point transect, snapshot method (8.4 hrs)
3. Cue counting, 5 mins per point (10.0 hrs)
4. Line transect sampling (7.9 hrs)
5. Territory mapping

<sup>a</sup>Buckland, S.T. 2006. Point-transect surveys for songbirds: robust methodologies. *The Auk* 123:345-357.

# Focal species in Montrave study

Chaffinch  
*Fringilla coelebs*



Great tit  
*Parus major*



Robin  
*Erythacus rubecula*



Wren  
*Troglodytes troglodytes*



# Study area, Montrave Estate

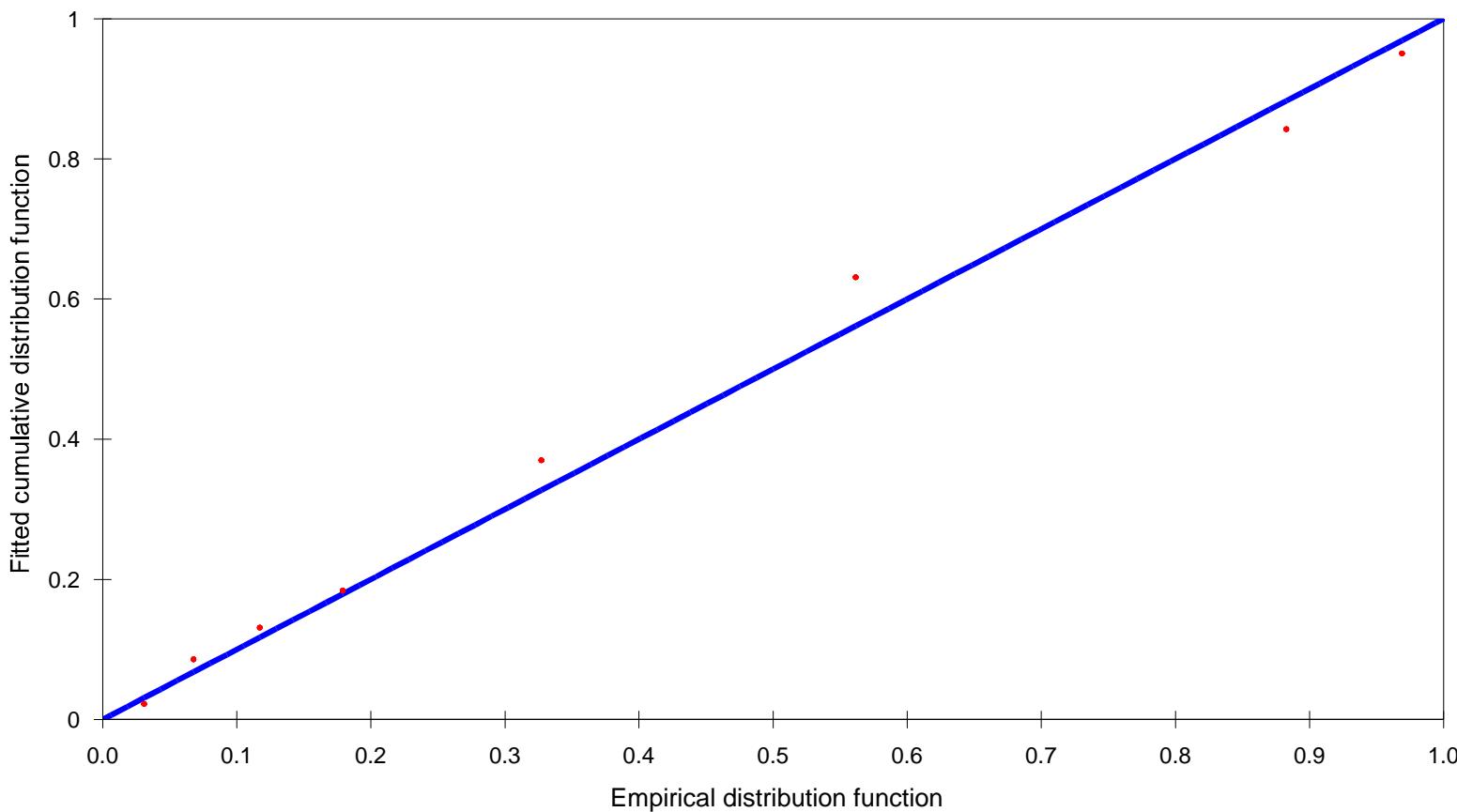


Parkland and  
mixed woodland  
33.2 ha  
 $k = 32$  points

# The data

	Chaffinch	Great tit	Robin	Wren
M1 ( $w=110m$ ) $n$ :	74	44	57	132
M2 ( $w=110m$ ) $n$ :	63	18	50	117
M3 ( $w=92.5m$ ) $n$ :	627	177	785	765
Cue rate:				
Sample size	33	12	26	43
Mean	7.9	8.2	17.9	7.3
M4 ( $w=95m$ ) $n$ :	73	32	80	155
M5 territories:	25	7	28	43

# Example analyses: chaffinch



# K-S and C-von M tests

Kolmogorov-Smirnov test

D\_n = 0.0978

p = 0.4205

Cramer-von Mises family tests

W-sq (uniform weighting) = 0.1194

0.400 < p <= 0.500

Relevant critical values:

W-sq crit(alpha=0.500) = 0.1188

W-sq crit(alpha=0.400) = 0.1464

C-sq (cosine weighting) = 0.0705

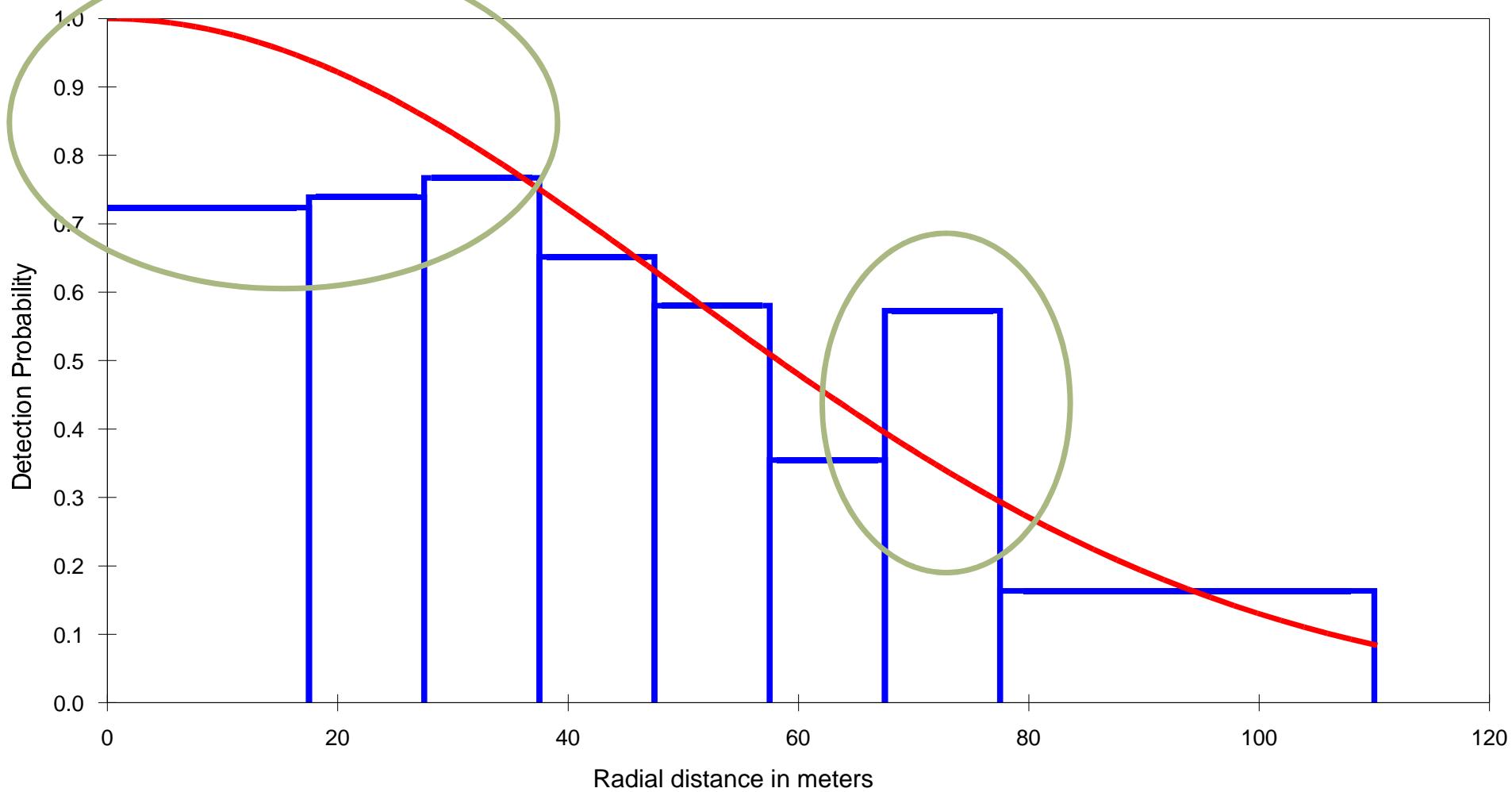
0.500 < p <= 0.600

Relevant critical values:

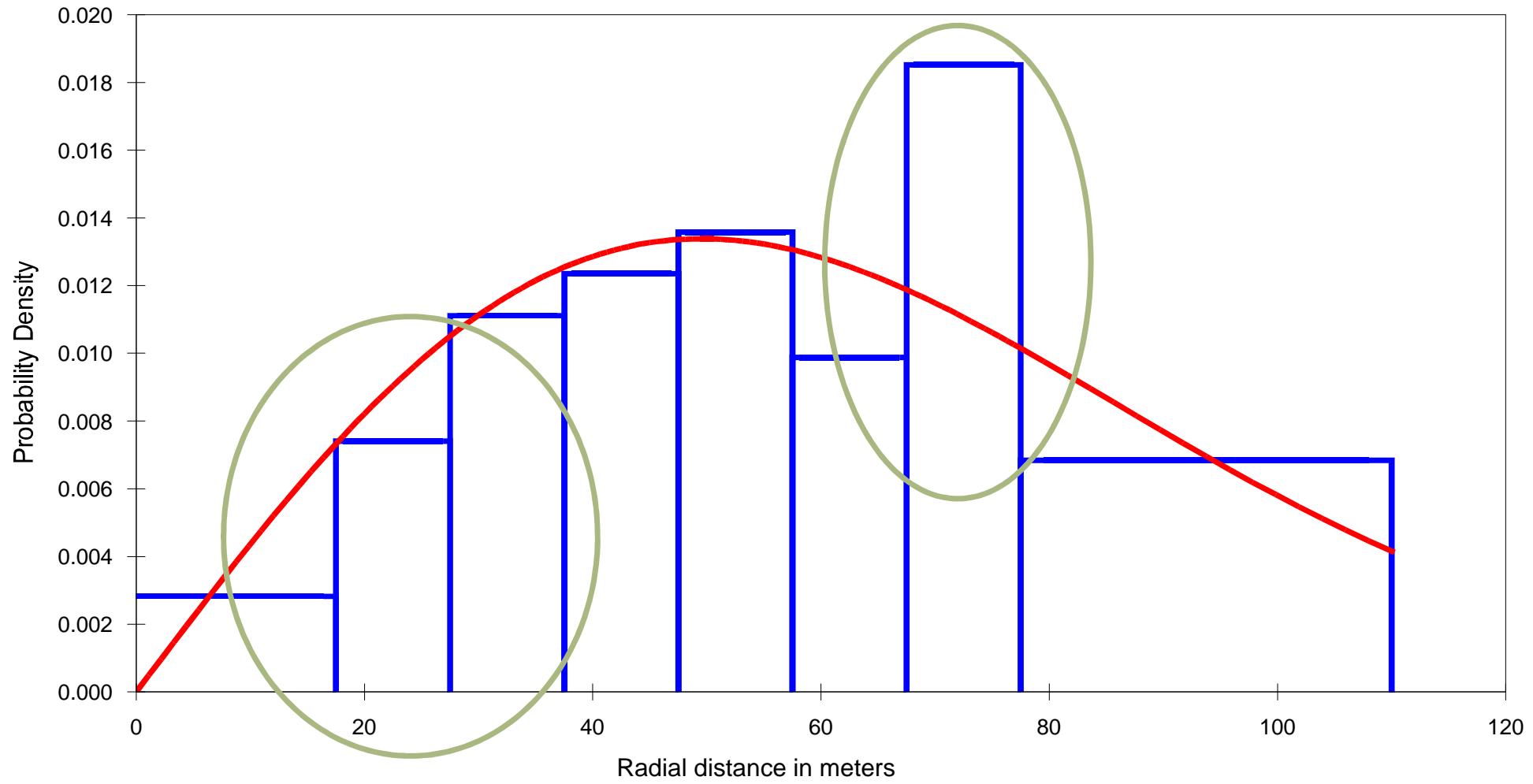
C-sq crit(alpha=0.600) = 0.0623

C-sq crit(alpha=0.500) = 0.0770

# Detection function



# Probability density function



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# Chi-square gof test

Cell i	Cut Points	Observed Values	Expected Values	Chi-square Values
1	0.000	17.5	4	5.36
2	17.5	27.5	6	7.29
3	27.5	37.5	9	9.42
4	37.5	47.5	10	10.57
5	47.5	57.5	11	10.77
6	57.5	67.5	8	10.15
7	67.5	77.5	15	8.95
8	77.5	110.	18	18.50

Total Chi-square value = 5.1918 Degrees of Freedom = 6.00

Probability of a greater chi-square value, P = 0.51946

The program has limited capability for pooling. The user should judge the necessity for pooling and if necessary, do pooling by hand.



# Estimation summary

Effort : 64.00000  
# samples : 32  
Width : 110.0000  
# observations: 81

Model 1

Half-normal key,  $k(y) = \text{Exp}(-y^{*2}/(2*A(1)^{*2}))$

Parameter	Point Estimate	Standard Error	Percent Coef. of Variation	95% Percent Confidence Interval
h(0)	0.44566E-03	0.69514E-04	15.60	0.32734E-03 0.60674E-03
p	0.37089	0.57851E-01	15.60	0.27242 0.50494
EDR	66.991	5.2246	7.80	57.373 78.220
n/K	1.2656	0.12697	10.03	1.0320 1.5522
D	0.89769	0.16648	18.55	0.62355 1.2924
N	30.000	5.5637	18.55	21.000 43.000

# Estimation summary (cont.)

## Measurement Units

Density: Numbers/hectares

EDR: meters

## Component Percentages of Var(D)

Detection probability : 70.7

Encounter rate : 29.3



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# Estimated densities

Method	Chaffinch		Great Tit		European Robin		Winter Wren	
	$\hat{D}$	95% CL	$\hat{D}$	95% CL	$\hat{D}$	95% CL	$\hat{D}$	95% CL
Conventional point sampling	1.03	0.74-1.43	0.58	0.36-0.94	0.52	0.26-1.06	1.29	0.80-2.11
Snapshot	0.90	0.62-1.29	0.22	0.13-0.39	0.60	0.38-0.94	1.02	0.80-1.32
Cue-count	0.71	0.45-1.23	0.26	0.09-0.76	0.82	0.52-1.31	1.21	0.82-1.79
Line transect	0.64	0.46-0.90	0.26	0.16-0.42	0.69	0.47-1.00	1.07	0.87-1.31
Territory mapping	0.75		0.21		0.84		1.30	

## Estimated effective detection radii (meters)

Method	Chaffinch		Great Tit		European Robin		Winter Wren	
	$\hat{\rho}$	95% CL	$\hat{\rho}$	95% CL	$\hat{\rho}$	95% CL	$\hat{\rho}$	95% CL
Conventional point sampling	67	58-78	62	51-74	74	52-104	71	57-90
Snapshot	67	57-78	64	54-75	65	54-77	75	69-83
Cue-count	74	70-79	65	58-71	51	47-57	66	63-69
Line transect <sup>†</sup>	59	48-72	63	47-84	60	44-83	75	65-86

<sup>†</sup>effective strip half-width shown for line transect method

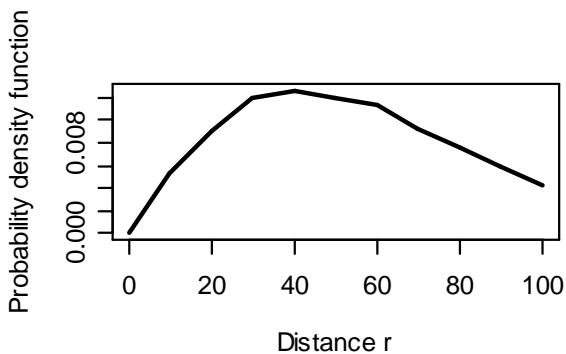
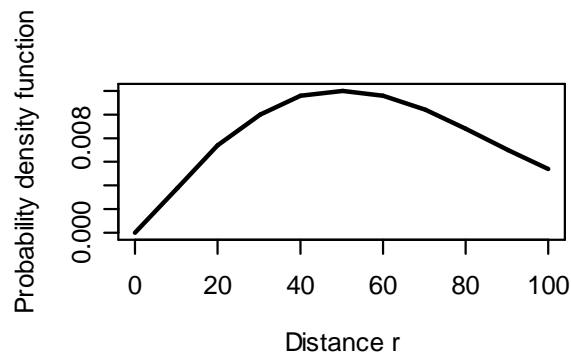
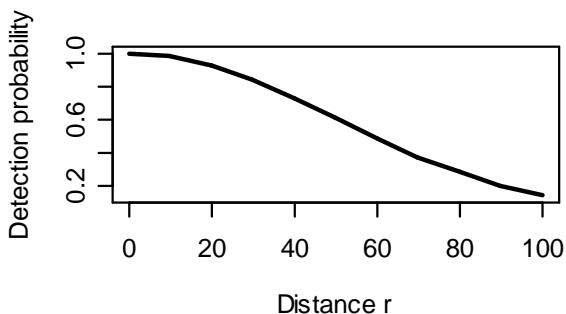
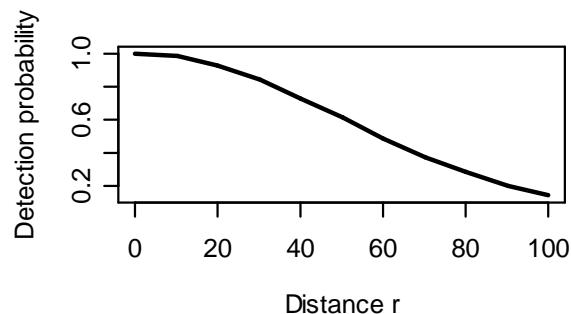
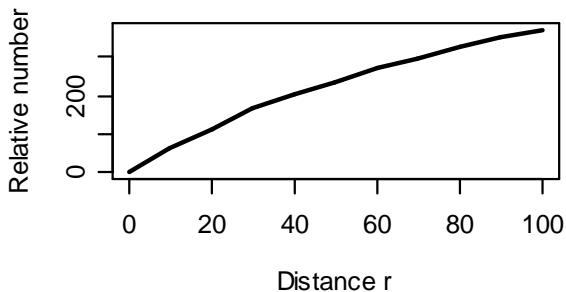
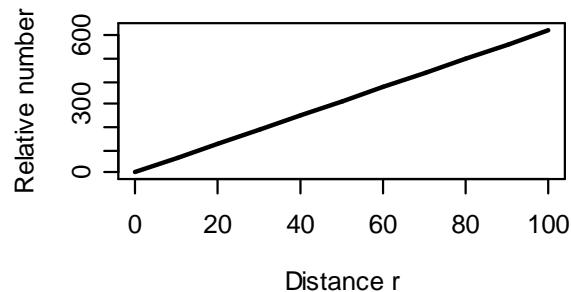
## Estimated hours of fieldwork to obtain a 10% CV for estimated density

Method	Common chaffinch	Great tit	European robin	Winter wren
Conventional point sampling	28	60	131	61
Snapshot	29	70	44	14
Cue-count	56	352	57	40
Line transect	22	49	29	11

# Simulation study, three investigations

1. All assumptions satisfied:  
half-normal model, 1000 replicates
2. Overlapping points:  
Point separation 100m, effective detection radius 106m
3. Edge effect (similar to Montrave study area),  
no sampling in buffer zone, birds detected outside study area  
boundary not recorded

# Edge effect simulation



## Simulation results – true density = 1

	Popn 1	Popn 2	Popn 3	Popn 3, w=80m
$\bar{n}$	353	354	41	32
mean	1.0029	1.0056	0.9509	0.9961
sd	0.0706	0.0815	0.1924	0.3160
se(mean)	0.0022	0.0026	0.0061	0.0100
mean(se)	0.0754	0.0750	0.2099	0.3557

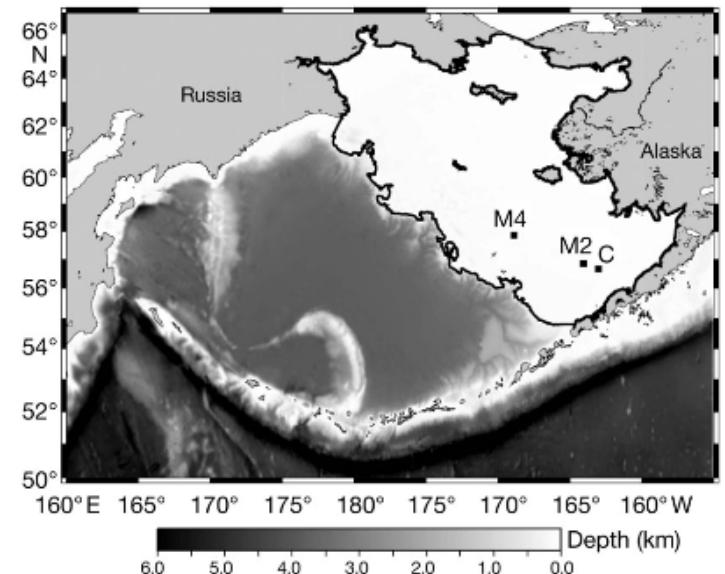
Popn 1: all assumptions hold

Popn 2: overlapping plots

Popn 3: edge effect

# Point transects with marine mammals

- Seafloor mounted acoustic recording packages deployed and listening for right whale “up-calls”
- Constitutes an example of cue counting
- Analysis incorporated
  - false-positive proportion in call classification,
  - ambient noise as covariate,
  - left truncation because of inexact distance estimation at small distances



Not a recommended allocation of survey effort; proof of concept

# Right whale abundance estimates

- Detection probability of 0.29 (CV=2%) from fitted model
- Density estimate of 0.26 whales per 10000km<sup>2</sup> (CV=29%)
- Abundance in shelf region of Bering Sea: 25 (CI: 13-47)

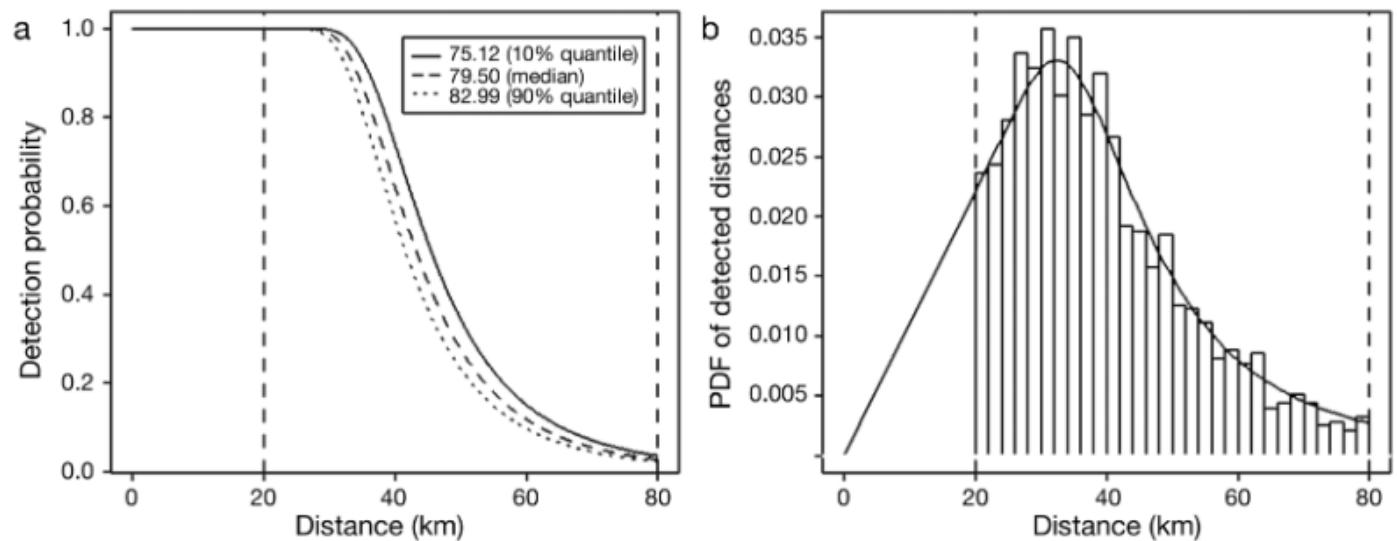


Fig. 2. Distances to detected right whale calls and fitted model: (a) shows the detection function (as a function of distance, for 3 values of the noise covariate, namely the 10, 50, and 90% quantile of the observed distribution) and (b) corresponds to the probability density function (PDF) of detection distances, and goodness-of-fit could be judged based on this plot. Vertical dashed lines represent the left and right truncation distances

See Marques, Munger, Thomas, Wiggins and Hildebrand (2011) Estimating North Pacific right whale density using passive acoustic cue counting. Endangered Species Research 13:163-172.