Mark-recapture distance sampling (MRDS) in Distance 7.1

- Setting up Distance for MRDS
- Setting up a Distance project for MRDS
- Data requirements
- MRDS analyses

Setting up Distance

- You need a copy of R installed on your computer http://www.r-project.org/
- Currently, the required version is R 3.4.1

- Check:	Distance Preferences	\times
	General Geographic Survey Design Analysis / Simulation R Options R Options Folder containing B: C:\Program Files\R\R-3.4.1 Browse	>
	 Image properties Remove the new R objects that are created with each run Remove R objects not associated with analyses / simulations after each run (Also removes unused simulation folders) Re-install analysis / simulation engine libraries to original versions on the next run (We advise you close all other applications that may be running R before attempting to install R libraries. Note that the library installation takes a couple of minutes.) 	ŋ

• Distance automatically installs mrds R library when you run an MRDS analysis

Project setup

• Choose "Double observer" in New project Setup Wizard



Project setup

• This causes 3 extra fields to be added to the Observation layer

			\bigwedge		
		Observa	ation		
ID	Perp distance	Cluster size	object	observer	detected
ID	Decimal	Decimal	Integer	Integer	Integer
n/a	m	[None]	[None]	[None]	[None]
Int	Int	Int	Int	Int	Int

• And their roles defined in the default Survey object

📓 Project Browser	Survey Properties: [New Survey] Set: [Set 1]
Image:	Survey <u>m</u> ethods <u>D</u> ata layers <u>D</u> ata fields Field definitions These definitions specify where the numerical engines look for the data they need. Press F1 for more information.
Survey	Role Layer name Field name Area Region Area
Name: New Survey Blue =	Effort Line transect Line length
Created: 05/08/2013 22:38:57	Perp distance Observation Perp distance
Burr St.	Radial distance Observation [None]
TORP .	Angle Observation [None]
Survey Methods and Data	Cluster size Observation Cluster size
Type of survey: Line transect Properties	Object Observation object
Configuration: Double observer	Observer Observation observer
Measurements: Perpendicular distance	Detected Observation detected
Observations: Clusters of objects	
Design	
Inonel V Inonel V Details	
Comments "	
	Defents

Data requirements

- Observation data must have:
 - 2 rows per object one for Observer 1 and one for Observer 2
 - Fields for:
 - object ID
 - observer (1 or 2)
 - detected (1=yes, 0=no)
- Additional covariate data can go in fields at the appropriate level
- Example: (golf tee project)

💐 Data	🕼 Map)S		D	esigns		🙀 Surveys	1	🔤 Analj	yses	l i	Simulat	tions		
1 🔲 🔂 🕘	1	ā 1ā													
Data layers	Contents	of Observa	ation la	yer 'Obsei	rvation' and all	fields f	rom higher layers	;							
⊡ 😽 Study area	Re	gion		Line tra	insect				Observa	ation					
🗄 🎇 Region	Label	Area	ID	Label	Line length	ID	Perp distance	Cluster size	object	observer	detected	sex	exposure		
🗄 ///, Line tran	Label	Decimal	ID	Label	Decimal	ID	Decimal	Decimal	Integer	Integer	Integer	Integer	Integer		
	n/a	m2	n/a	n/a	m	n/a	m	[None]	[None]	[None]	[None]	[None]	[None]		
	Int	Int	Int	Int	Int	Int	Int	Int	Int	Int	Int	Int	Int		
						111	2.41	1	56	1	0	1	1	•	
						112	2.41	1	56	2	1	1	1		
						113	1.29	1	57	1	0	0	0		
						114	1.29	1	57	2	1	0	0		
	Default	1680	1	Default	210	115	2.95	3	58	1	0	1	0		
						116	2.95	3	58	2	1	1	0		
						117	2.19	1	59	1	1	1	1		
						_	118	2.19	1	59	2	1	1	1	
						119	1.27	3	60	1	1	1	0	-	

the 3 new required fields

observation-level covariates – fields created during data import

MRDS analyses

- Select MRDS engine in Model Definition
- Estimate tab
 - Stratification options as for CDS/MCDS engines but no post-stratification for now
 - Quantities to estimate
 - Can choose not to estimate density (saves time during model selection)
 - Can choose to estimate a detection function, or to use a fitted function from a previous analysis.
 - Useful to apply a detection function estimated with all data to a subset of the data
 - See manual for details.

Model Definition Properties: [FI - Petersen]	X
Analysis Engine: MRDS - Mark-recapture distance sampling	•
Estimate Detection function Variance Misc.	
Stratum definition	
No stratification Layer type: Field name:	
O Use layer type: Stratum	
C Post-stratify, using: Stratum 💌 Area 💌	
Sample definition (for encounter rate)	
Use layer type: Sample	
Quantities to estimate	
✓ Estimate density / abundance	
Detection function	
 Estimate detection function 	
C Use fitted detection function from previous MRDS analysis	
Defaults Name: FI - Petersen DK Ca	incel

Detection function tab

- 5 methods at present
 - ds CDS and MCDS (but no adjustment terms)
 - IO (independent observer) both point and full independence
 - Trial both point and full independence
- Choice of method determines which model you need
 - DS model = distance sampling model.
 - half-normal or hazard rate, optionally with covariates in the scale parameter
 - MR model = mark recapture model
 - GLM with logit link

Model Definition Properties: [FI - Petersen]
Analysis Engine: MRDS - Mark-recapture distance sampling
Estimate Detection function Variance Misc.
Method DS model MR model Factors Control Diagnostics Fitting method
trial.fi - trial, full independence
ds - single observer io - independent observer, point independence io.fi - independent observer, full independence trial - trial, point independence
Defaults Name: FI - Petersen <u>D</u> K <u>C</u> ancel

Model formulae

- Type in variable names joined by "+" (main effect),
 ":" (interaction), "*" (main effect + interaction)
- Note that some fields get renamed:
 - distance, size, object, observer, detected
 - fields from layers above the observation layer
- Tip look in Analysis Details log to see new names

	Analysis 3: [FI - MR dist+size+sex+exp] Set: [Set 1]		x	
	Initializing Making data files Making Data Selection Queries The following fields will be written to the data file, and can be used in model formulae. Note that you should use the new names, not the original field names in formulae, and that formulae names are case sensitive. Format: [layer name].[field name] AS new name [Observation].[Perp distance] AS distance [Observation].[Cluster size] AS size [Observation].[object] AS object [Observation].[observer] AS observer [Observation].[beserver] AS observer	* III	Inputs	
	[Observation].[detected] AS detected [Observation].[sex] AS sex		<u> </u>	1
	[Observation].[exposure] AS exposure [Line transect].[Label] AS label			
I	[Line transect] [Line length] AS line length			1

ſ	Model Definition Properties: [FI - MR dist+size+sex+exp]
	Analysis Engine: MRDS - Mark-recapture distance sampling
	Estimate Detection function Variance Misc.
	Method DS model MR model Factors Control Diagnostics
	Mark-recapture model
	This is the model for probability of detection by a single observer, p_j where j=1 or 2. Note that distance is only a covariate if it is included in the model formula.
	Class of model: 💿 Generalized linear model
	C Generalized additive model
	Link function: logit
	Model formula: (Linear/additive predictor)
	Defaults Name: FI - MR dist+size+sex+exp <u>OK</u> Cancel

Factors

- Need to specify which variables in the formulae are factors
 - Tip: type in all possible factors in the first
 Model Definition and this will be used as the basis of all subsequent definitions

Model Definition Properties: [FI - MR dist+size+sex+exp]	×
Analysis Engine: MRDS - Mark-recapture distance sampling	-
Estimate Detection function Variance Misc.	
Method DS model MR model Factors Control Diagnostics	
Here, you list variables in the DS and MD formulae that should be treated as f Separate each variable name with a comma.	actors.
Factors: observer, sex, exposure	*
	-
Defaults Name: FI - MR dist+size+sex+exp DK	Cancel

Results

- Produces
 - diagnostics (qq plots, detection function plots, goodness-of-fit tests)
 - parameter estimates, and estimated density and abundance
- Can customize plots (in Preferences)
- Plots stored as graphics files in a folder "R" within project data folder
- Results optionally stored in an .Rdata file in the "R" folder, so if you know R software you can access them (Preferences)



