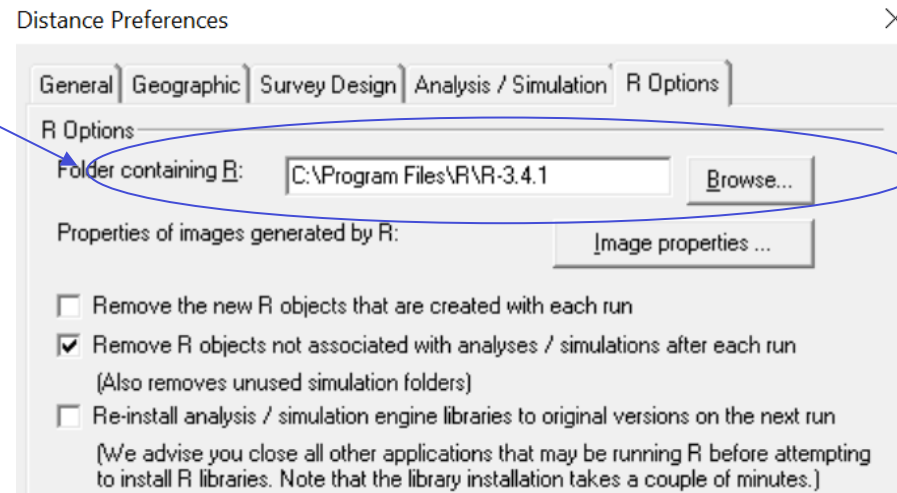


# Mark-recapture distance sampling (MRDS) in Distance 7.1

- 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:



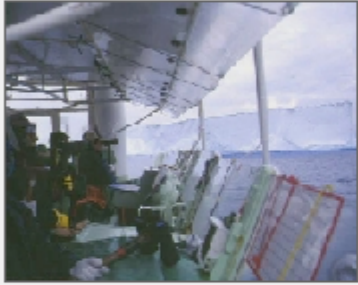
- Distance automatically installs mrds R library when you run an MRDS analysis

# Project setup

- Choose “Double observer” in New project Setup Wizard

New Project Setup Wizard - Step 3: Survey Methods

In this screen, you tell Distance about your survey methods. Click 'Help' to find out more about each option.



*Minke whale line transect surveys, Antarctic Ocean  
Photo: Peter Corkeron*

Type of survey

- ☒ Line transect
- ☐ Point transect
- ☐ Cue count

Observer configuration

- ☐ Single observer
- ☒ Double observer

Distance measurements

- ☒ Perpendicular distance
- ☐ Radial distance and angle

Sampling fraction

This option has been moved to the Multipliers page.

Observations

- ☐ Single objects
- ☒ Clusters of objects

Help Cancel < Back Next > Finish

# Project setup

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

Observation					
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

The image shows a screenshot of the 'Project Browser' window on the left and the 'Survey Properties: [New Survey] Set: [Set 1]' dialog on the right. The 'Project Browser' window has a 'Surveys' tab selected, showing a list of surveys. The 'Survey Properties' dialog has the 'Data fields' tab selected, showing a table of field definitions. Arrows point from the 'Properties...' button in the 'Survey 1' window to the 'Survey Properties' dialog, and from the 'Data fields' tab to the table of field definitions.

Survey Properties: [New Survey] Set: [Set 1]

Survey methods | Data layers | Data fields

Field definitions

These definitions specify where the numerical engines look for the data they need. Press F1 for more information.

Role	Layer name	Field name
Area	Region	Area
Effort	Line transect	Line length
Perp distance	Observation	Perp distance
Radial distance	Observation	[None]
Angle	Observation	[None]
Cluster size	Observation	Cluster size
Object	Observation	object
Observer	Observation	observer
Detected	Observation	detected

Defaults OK Cancel



# 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]

Analysis Engine: MRDS - Mark-recapture distance sampling

Estimate | Detection function | Variance | Misc.

Stratum definition

☒ No stratification    Layer type:    Field name:

☐ Use layer type: Stratum

☐ 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

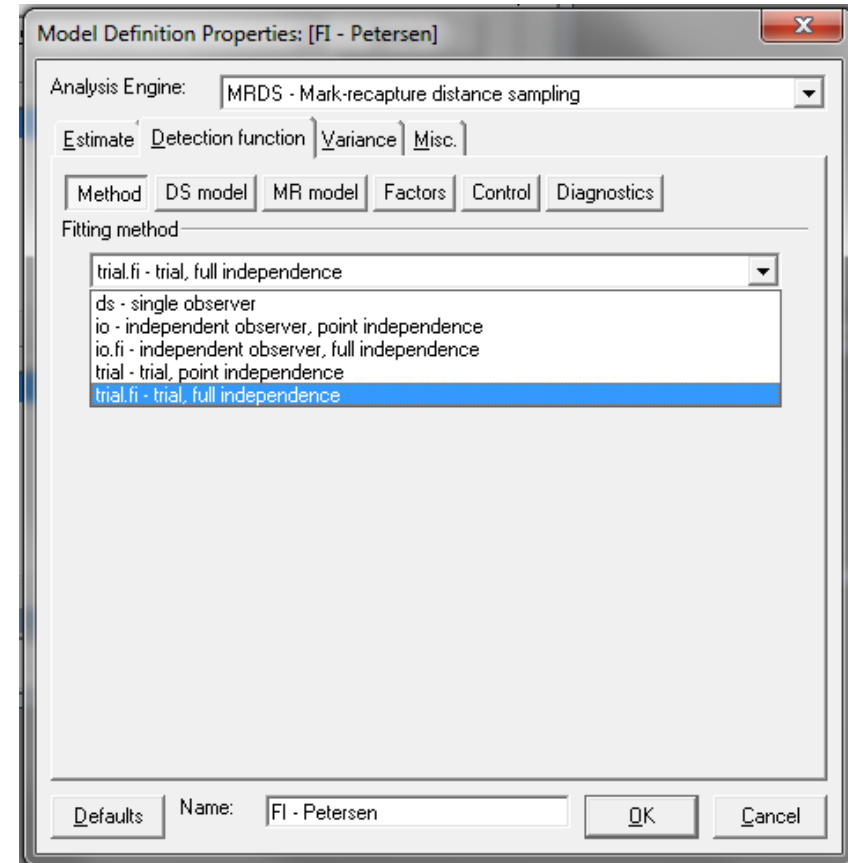
☐ Use fitted detection function from previous MRDS analysis

Analysis number: 0

Defaults    Name: FI - Petersen    OK    Cancel

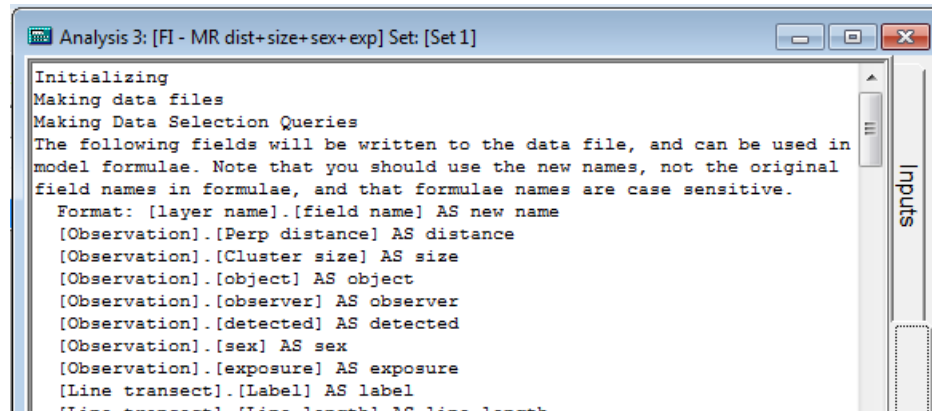
# Detection function tab

- 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



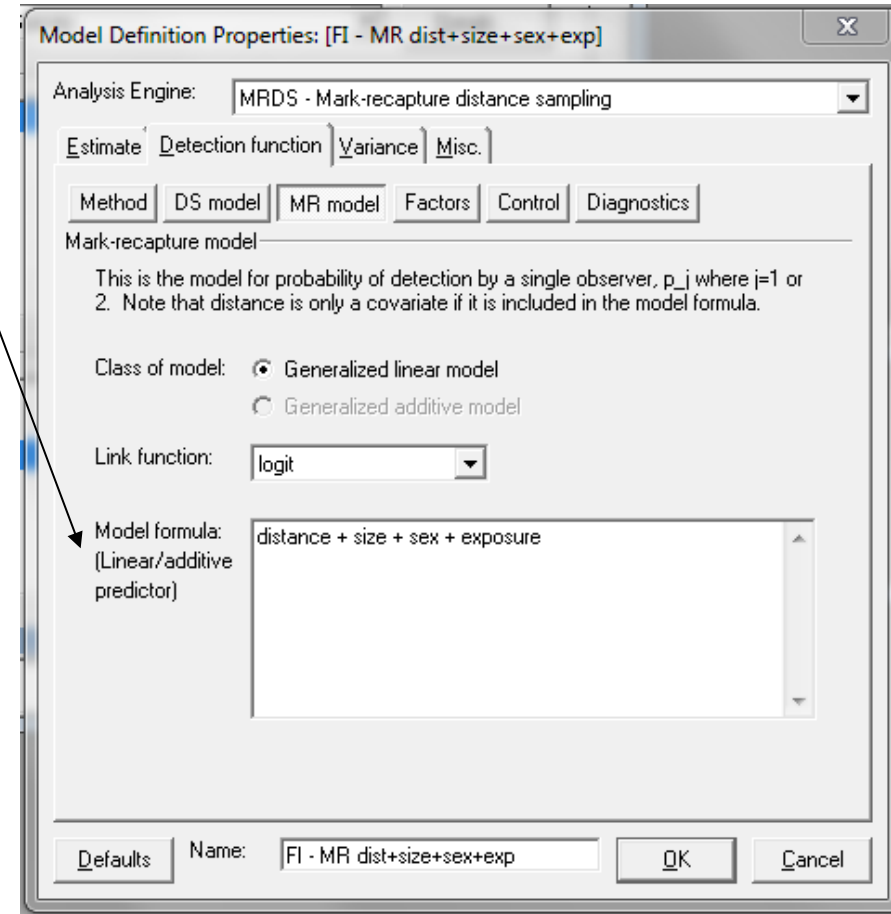
# Model formulae

- 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: [Set1]

```
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].[detected] AS detected
[Observation].[sex] AS sex
[Observation].[exposure] AS exposure
[Line transect].[Label] AS label
[Line transect].[Line length] AS line length
```



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,  $p_{ij}$  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  
☐ Generalized additive model

Link function: logit

Model formula:  
(Linear/additive predictor)

distance + size + sex + exposure

Defaults Name: FI - MR dist+size+sex+exp OK 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

Factor definition

Here, you list variables in the DS and MD formulae that should be treated as factors. Separate each variable name with a comma.

Factors: observer, sex, exposure

Defaults | Name: FI - MR dist+size+sex+exp | OK | 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)

