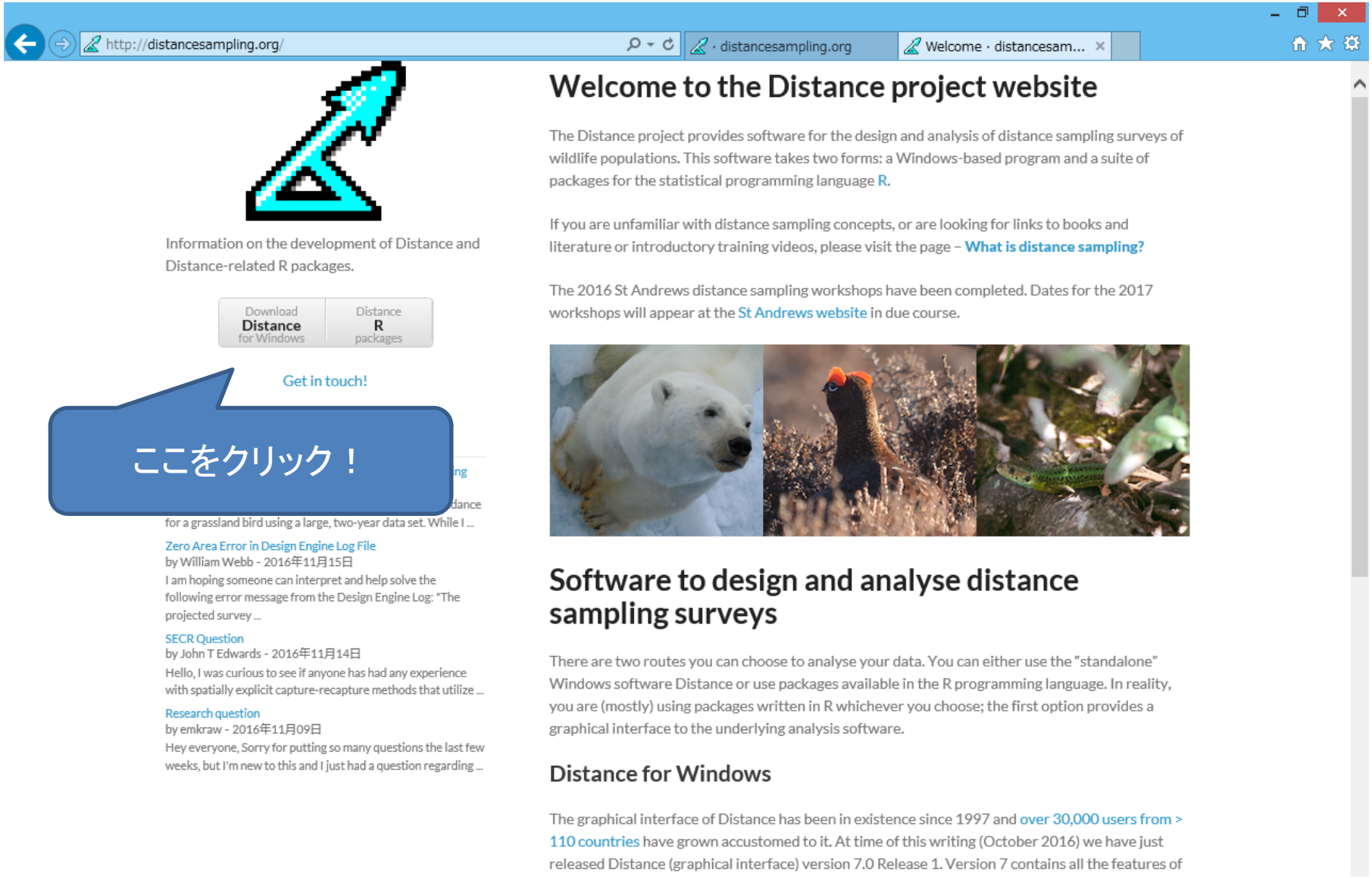
Distance7.0実施ガイド（日本語）

趣旨

- 北海道立総合研究機構による「エゾシカ調査手引き」において、ラインとランセクト法を紹介しました。ラインとランセクト法のデータ解析には「*Distance*」というソフトウェアが必要です。*Distance*はインターネット上で無料でダウンロードできますが、北米で開発されたソフトのため、使用言語は英語です。
- 調査データを用いて一連の操作ができるように、*Distance*の使用手順を日本語で簡単に説明しました。
- *Distance*が使用しているモデル構造やラインとランセクト法の原理を理解するためには、参考文献にある原著書や論文等にあたっていただくことをお勧めします。

フリーソフト*Distance*を探す

Distanceのダウンロードその１



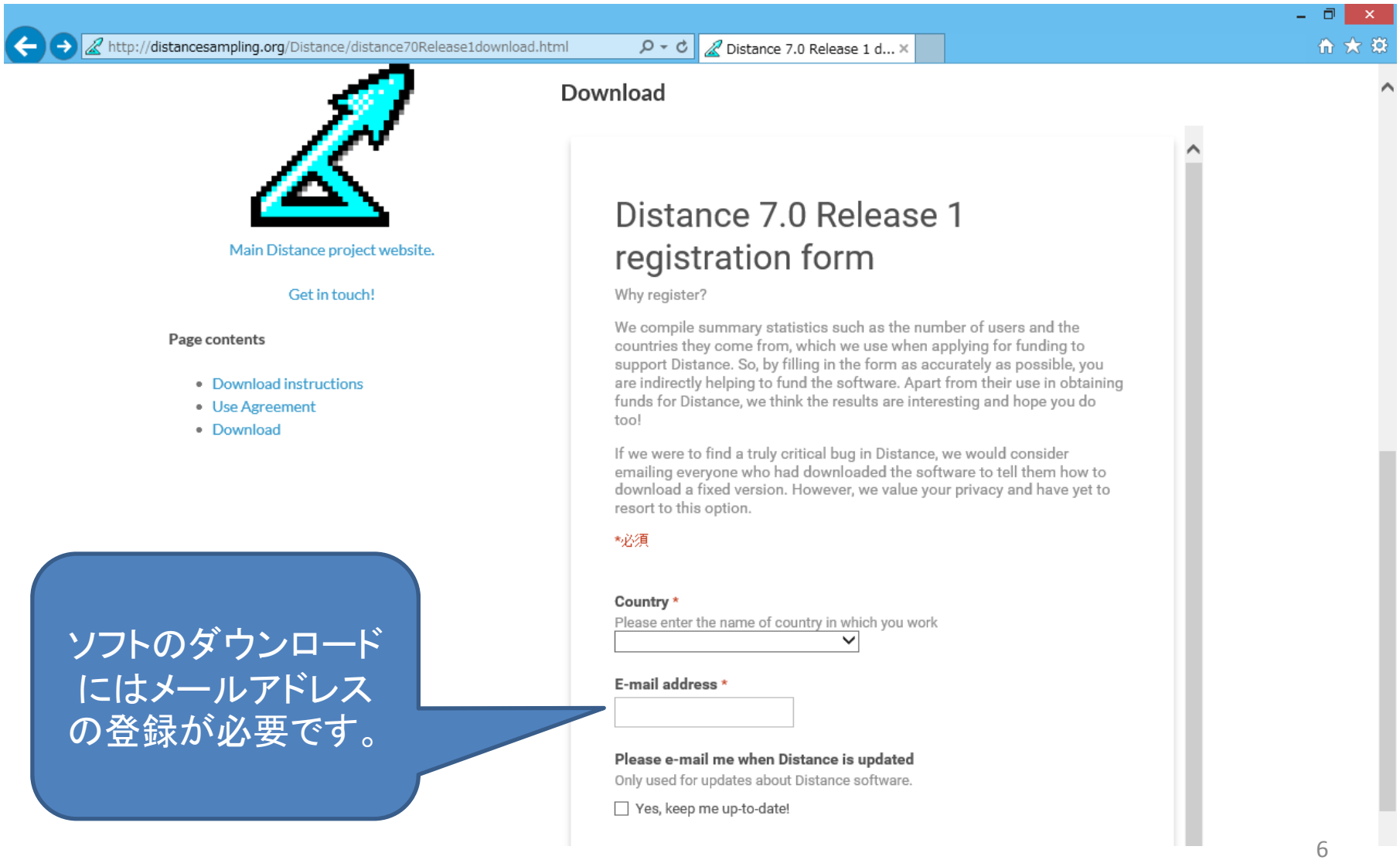
Distanceのダウンロードその2

最新版は7.0
（2016年11月16日確認）

ここで紹介する解析は、
ver6.1や6.2で行っても
変わりません。

ここをクリック！

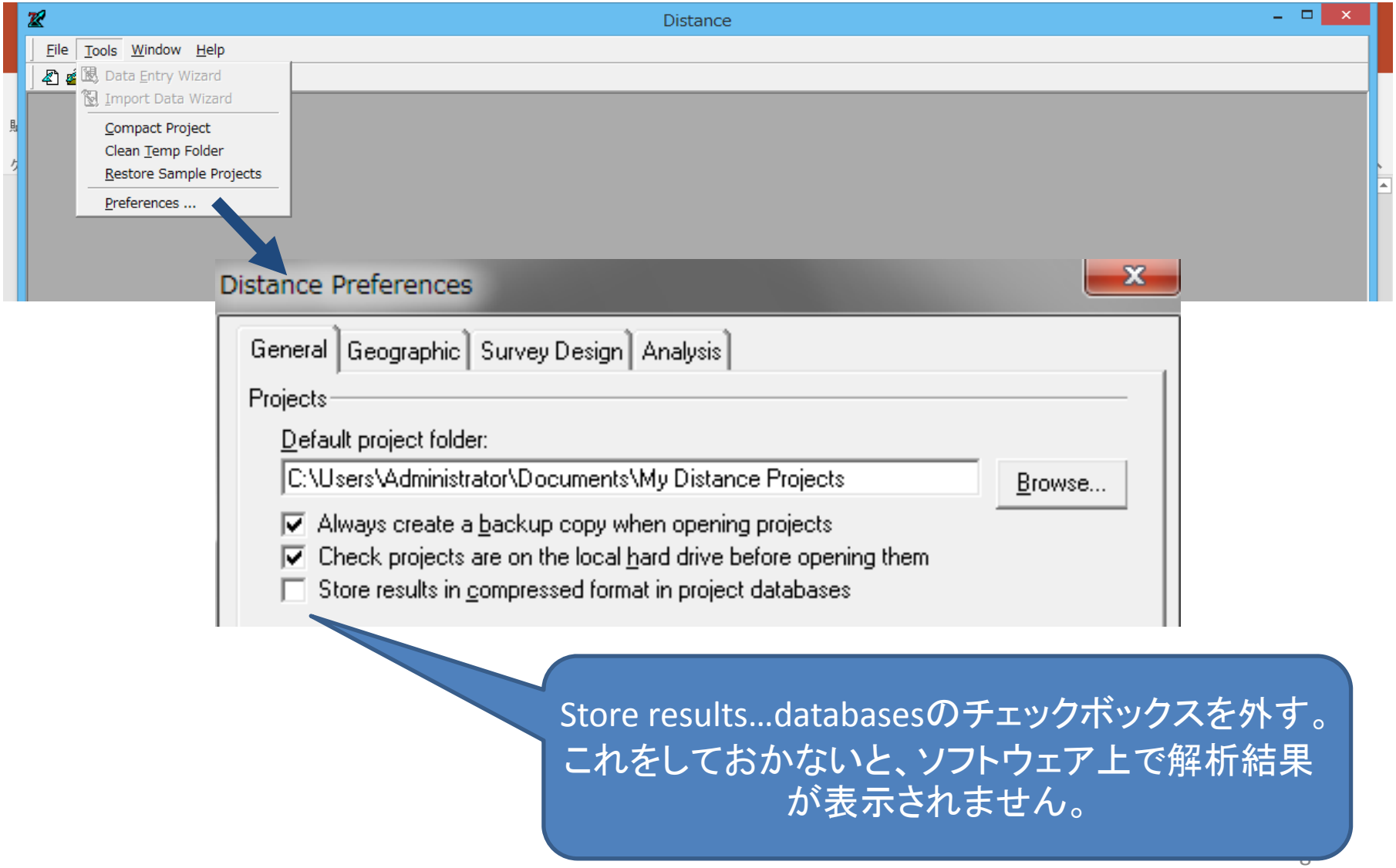
Distanceのダウンロードその3



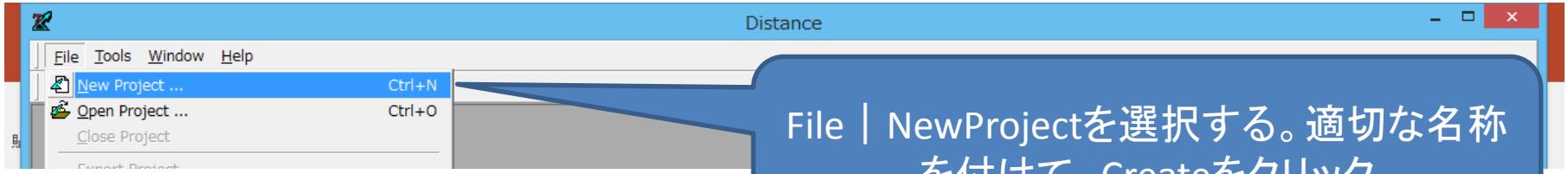
ソフトのダウンロードにはメールアドレスの登録が必要です。


インストール

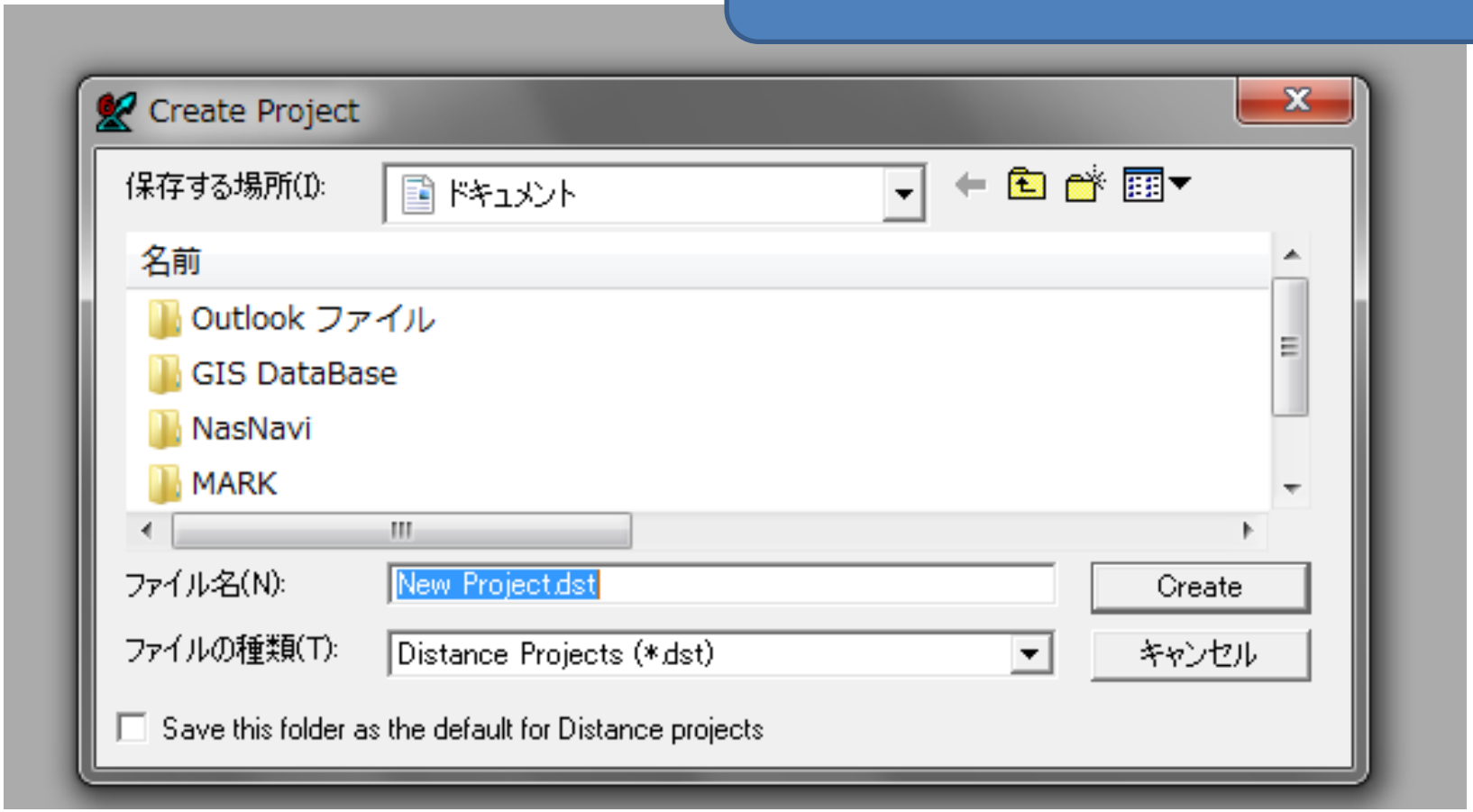
インストール後にまずやること



操作手順その１－プロジェクトの作成



File｜NewProjectを選択する。適切な名称を付けて、Createをクリック



New Project Setup Wizard - Step 1: Type of Project

Western tarsier (Tarsius bancanus) seen during a line transect survey of mammals in Sabah, Malysia Photo: Norhayati Ahmad

The new project 'lá1' has been created.

Distance can now help you to set up the project ready for use. Select from the options below, and click on the 'Next' button to step through each of the screens that follow.

If you are
'Help' bu

一番上にチェックを入れ、Nextをクリック

I want to:

- (•) Analyze a survey that has been completed
- ( ) Design a new survey
- ( ) Use an existing Distance project as a template
- ( ) Import a project or command file created in a previous version of Distance
- ( ) Exit this wizard and set up the project file manually

[ ] Project will contain geographic information

Help | Cancel | < Back | Next > | Finish

New Project Setup Wizard - Step 2: Setup for Analyzing a Survey

Distance sampling for Chameleons, Calumma oshaughnessyi
Photo: Lee Brady

You have selected to set up the project file ready to analyze a survey that has already been completed.

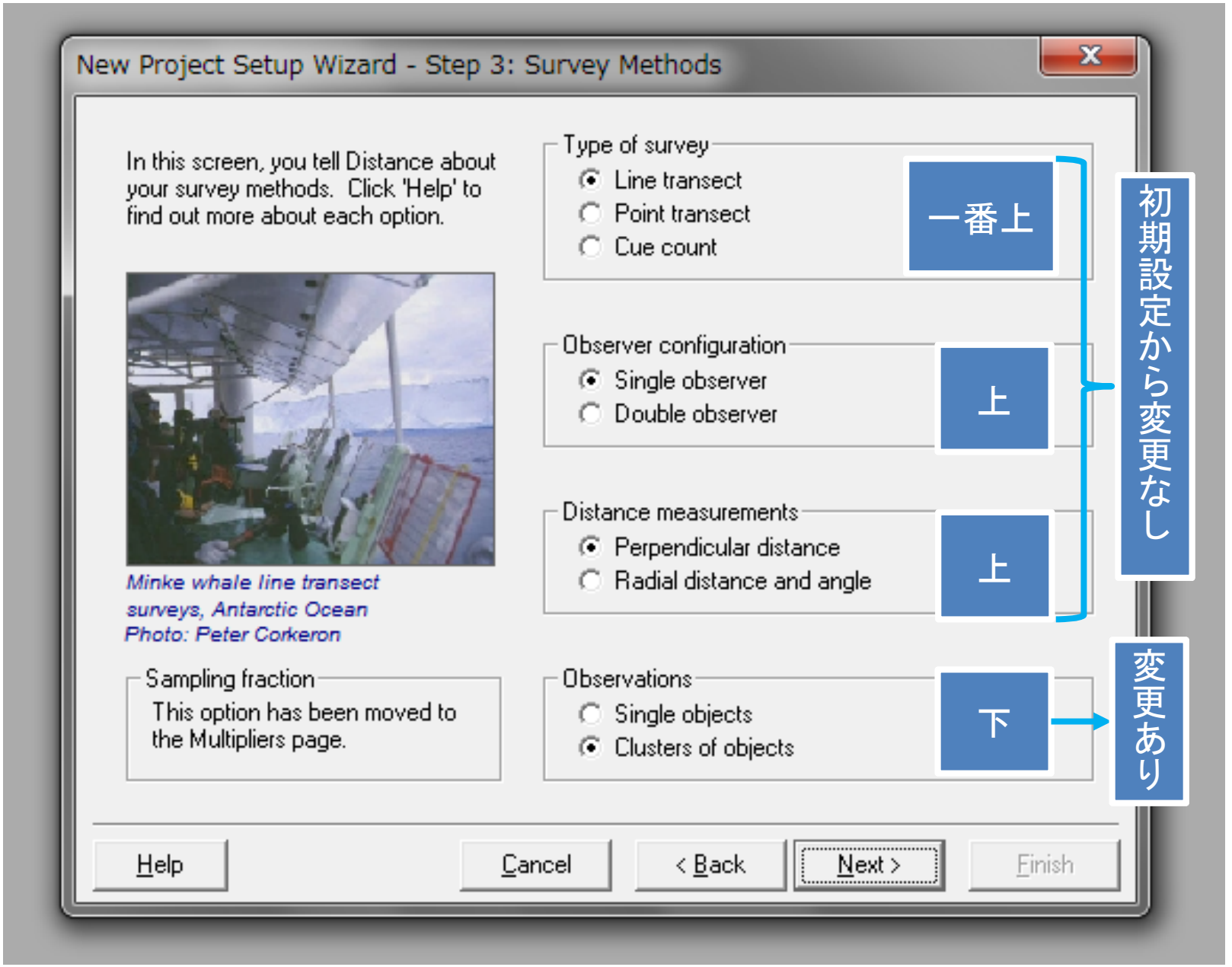
In the following screens, you will need to give Distance some information about your survey. Distance will then set up one survey object, and a simple data structure, containing a Global, Stratum, Sample and Observation data layer.

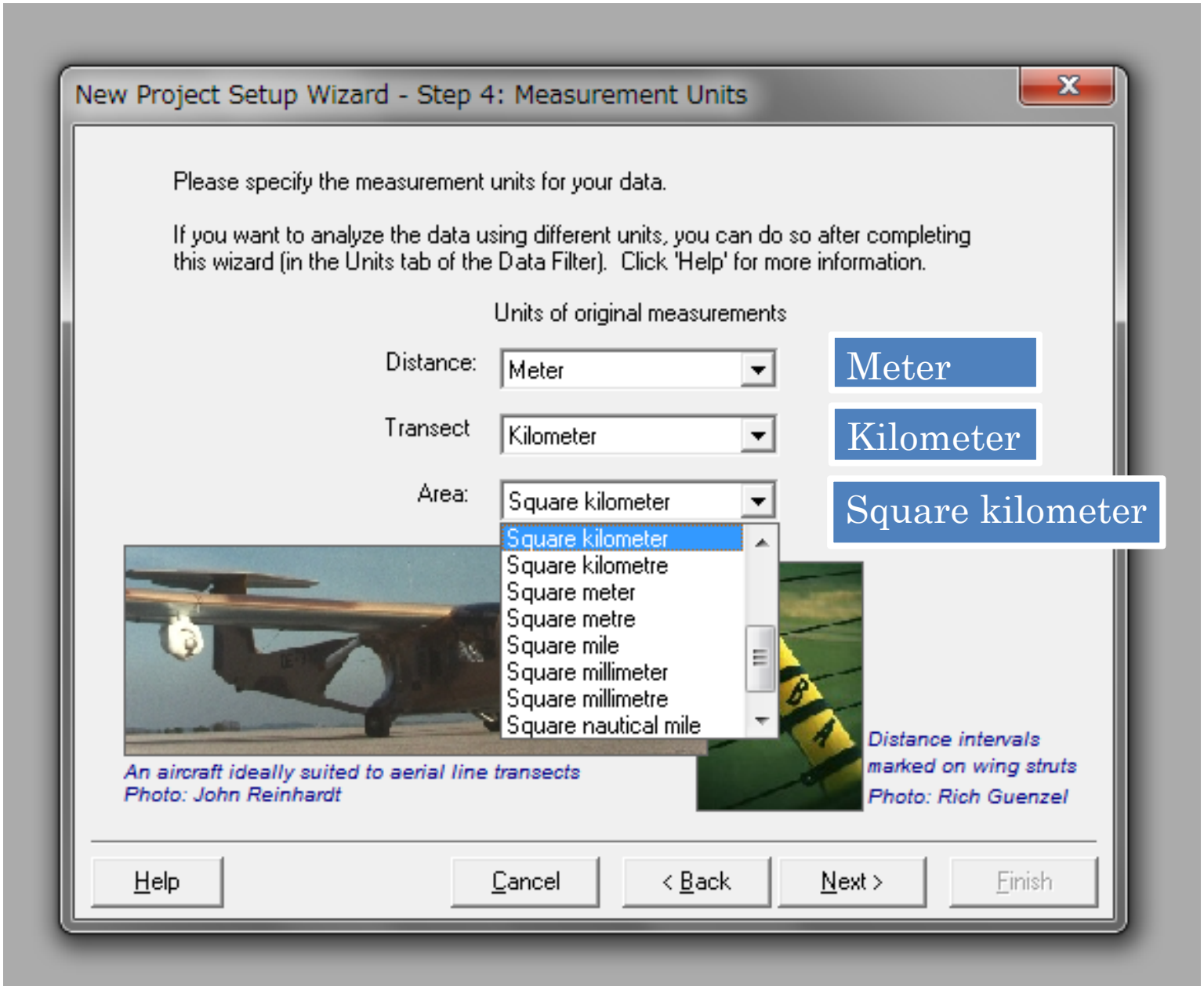
If you want to set up a more complex data structure, you will have to do this manually. In this case press the 'Back' button and select the option to set up the project file manually.

Don't show this introductory screen again.

Help | Cancel | < Back | Next > | Finish

Don’t show this introductory screen againにチェックを入れ、Nextをクリック


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
一番上
Observer configuration
Single observer
Double observer
上
Distance measurements
Perpendicular distance
Radial distance and angle
上
Sampling fraction
This option has been moved to the Multipliers page.
Observations
Single objects
Clusters of objects
下
初期設定から変更なし
変更あり
Help
Cancel
< Back
Next >
Finish


New Project Setup Wizard - Step 4: Measurement Units
Please specify the measurement units for your data.
If you want to analyze the data using different units, you can do so after completing this wizard (in the Units tab of the Data Filter). Click 'Help' for more information.
Units of original measurements
Distance:
Meter
Transect
Kilometer
Area:
Square kilometer
Square kilometer
Square kilometre
Square meter
Square metre
Square mile
Square millimeter
Square millimetre
Square nautical mile
Meter
Kilometer
Square kilometer
An aircraft ideally suited to aerial line transects
Photo: John Reinhardt
Distance intervals marked on wing struts
Photo: Rich Guenzel
Help
Cancel
< Back
Next >
Finish

New Project Setup Wizard - Step 5: Multipliers

Using a rangefinder to estimate distances
Photo: Rolf Koford

Multipliers are constants that are used to scale the final density estimate. Click 'Help' to find out more about multipliers.

Tick the boxes beside the multipliers you wish to add. Distance will then create fields in your dataset for you to enter the multiplier value and, if appropriate, its standard error (SE) and degrees of freedom (DF). You enter these values later, when you are entering the rest of your data.

Add multipliers for:	Fields added	Create fields for SE and DF?
☐ Surveys where sampling fraction is not 1	Sampling fraction	N
☐ Surveys where g(0) is less than 1	g0	Y
☐ Cue count surveys	Cue rate	Y
	Production rate	Y
☐ Indirect surveys of	Disappearance time	Y
☐ Other		

何もチェックいれず、そのままNextへ

Help | Cancel | < Back | Next > | Finish

New Project Setup Wizard - Step 6: Finished

When you press Finish, the new project database will set up as you have specified. The next task after this is to add your survey data. Please choose from one of the options in the 'Destinations' box.

The Data Entry Wizard will guide you through the process of entering your data from the keyboard. The Data Import Wizard will allow you to import the data from an external text file. If you choose to exit to Distance, you can enter data in the Data tab of the Project Browser, or start either of the Wizards from the Tools menu.

Photo: Motoi Ichihara

Destinations

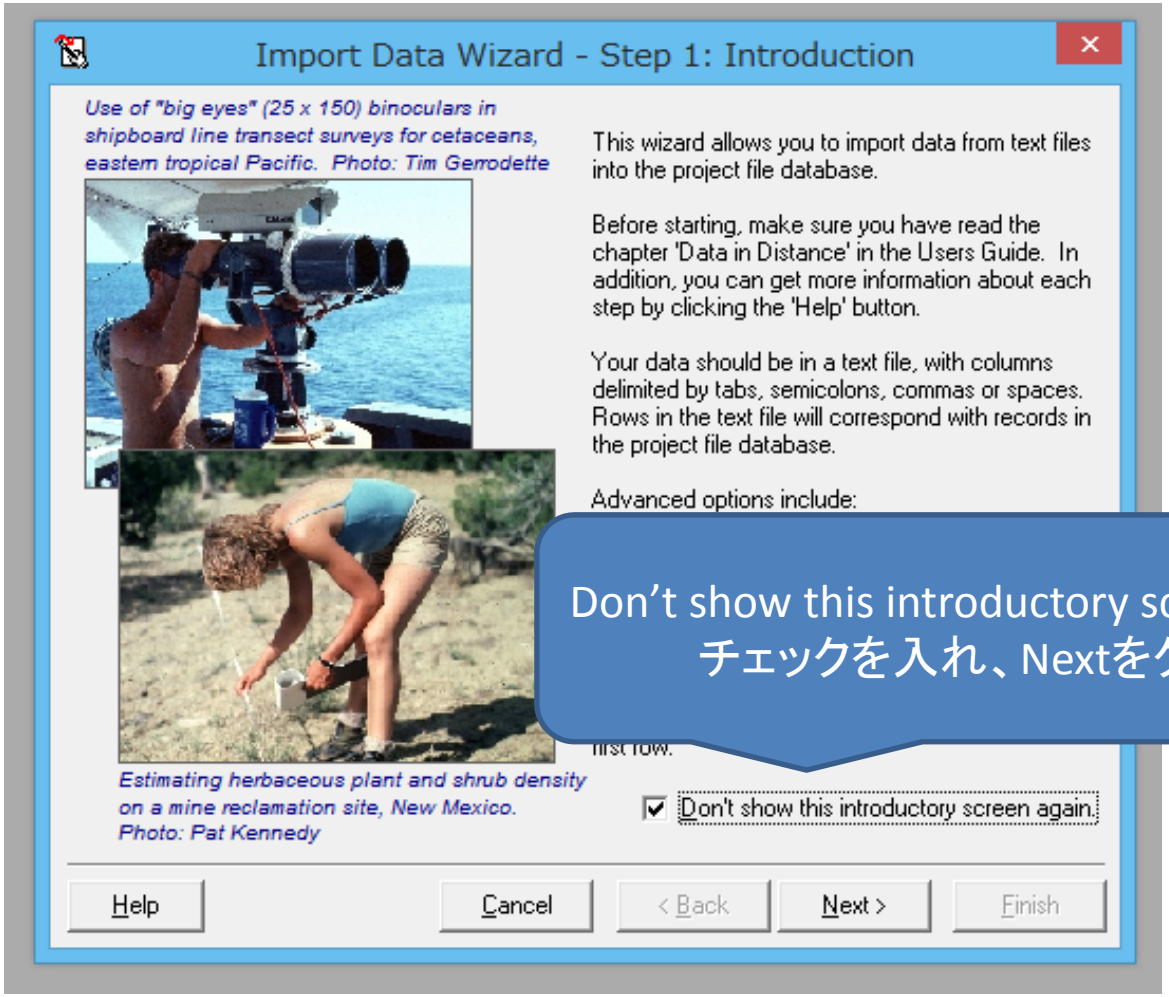
- ○ Proceed to Data Entry Wizard
- ◉ Proceed to Data Import Wizard
- ○ Exit wiza and return to Distance

真ん中をチェック

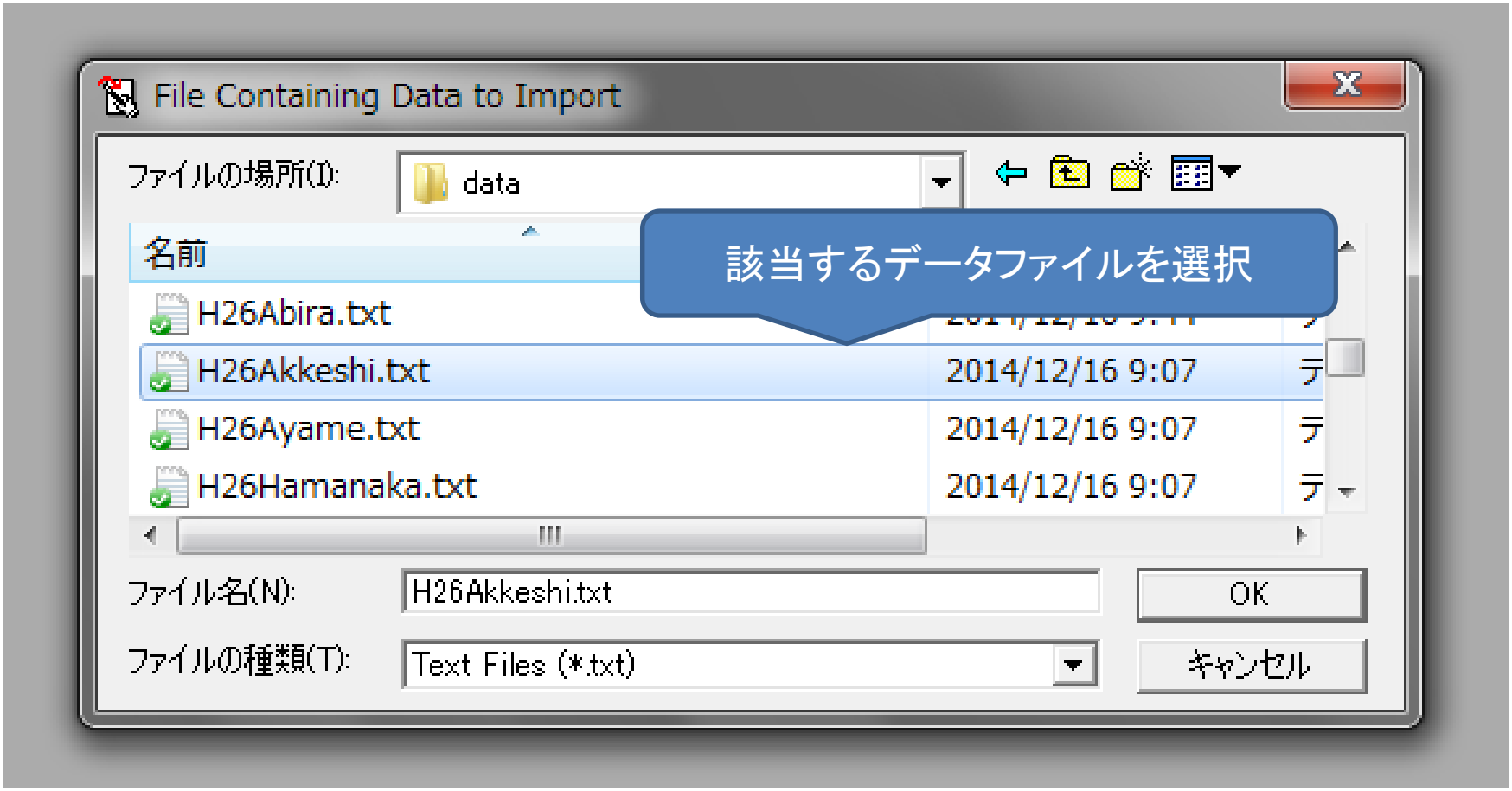
☐ Save current settings as default

Help | Cancel | < Back | Next > | Finish

操作手順その２－データのインポート



Don’t show this introductory screen againにチェックを入れ、Nextをクリック


File Containing Data to Import
ファイルの場所(I):
data
該当するデータファイルを選択
名前
H26Abira.txt
H26Akkeshi.txt
2014/12/16 9:07
H26Ayame.txt
2014/12/16 9:07
H26Hamanaka.txt
2014/12/16 9:07
ファイル名(N):
H26Akkeshi.txt
OK
ファイルの種類(T):
Text Files (*.txt)
キャンセル

Import Data Wizard - Step 3: Data Destination

Here, you tell Distance where to store the imported data.

Destination data layers

Lowest data layer: Observation

Highest data layer: Region

Parent data layer: Study area

New records will be added to these layers:

Layer name	Layer type
Region	(Stratum)
Line transect	(Sample)
Observation	(Observation)

Location of new records

- (•) Add all new records under the first record in the parent data layer
- ( ) Input file contains a column corresponding to the following field in the parent data layer:

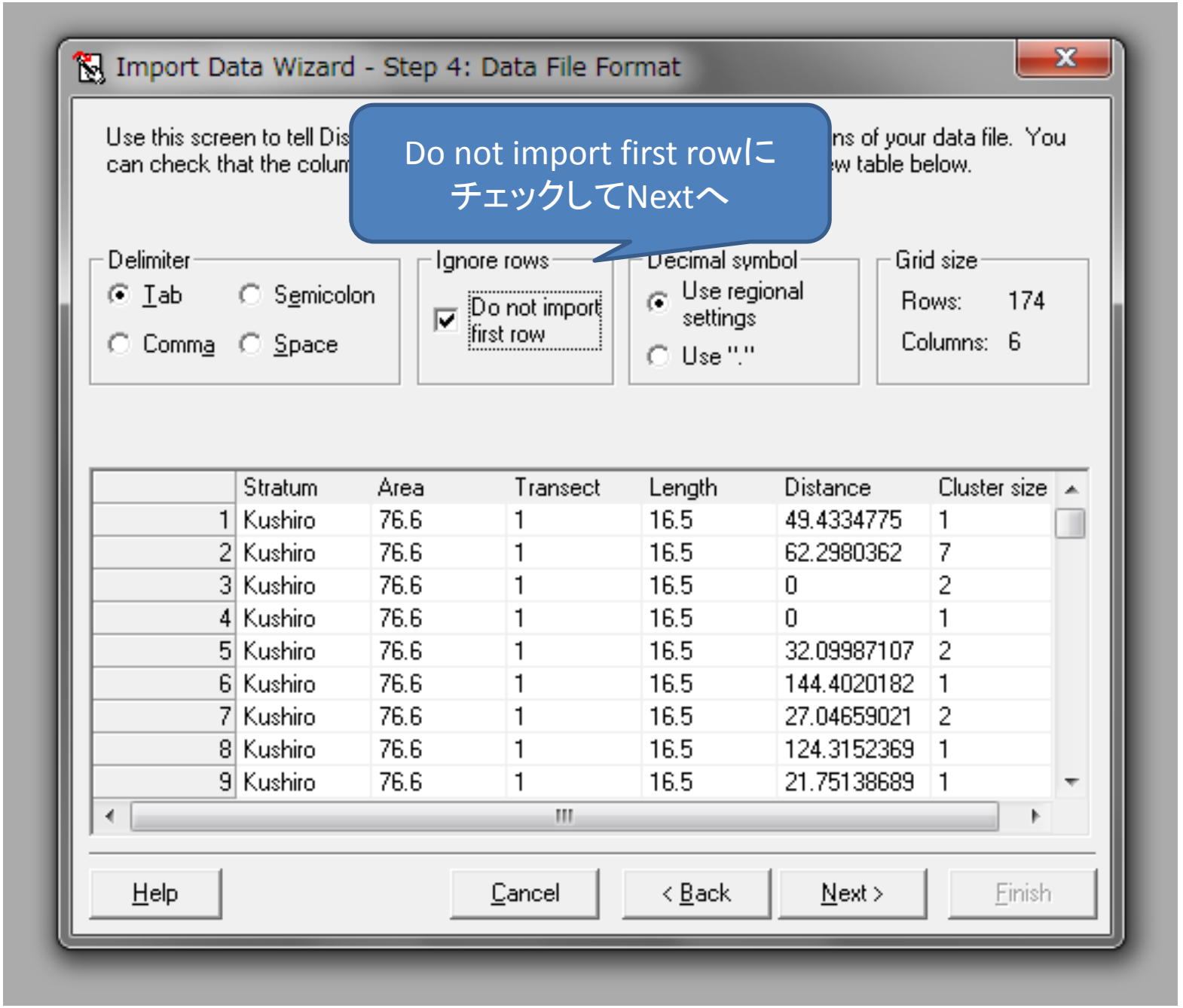
Field name: ID

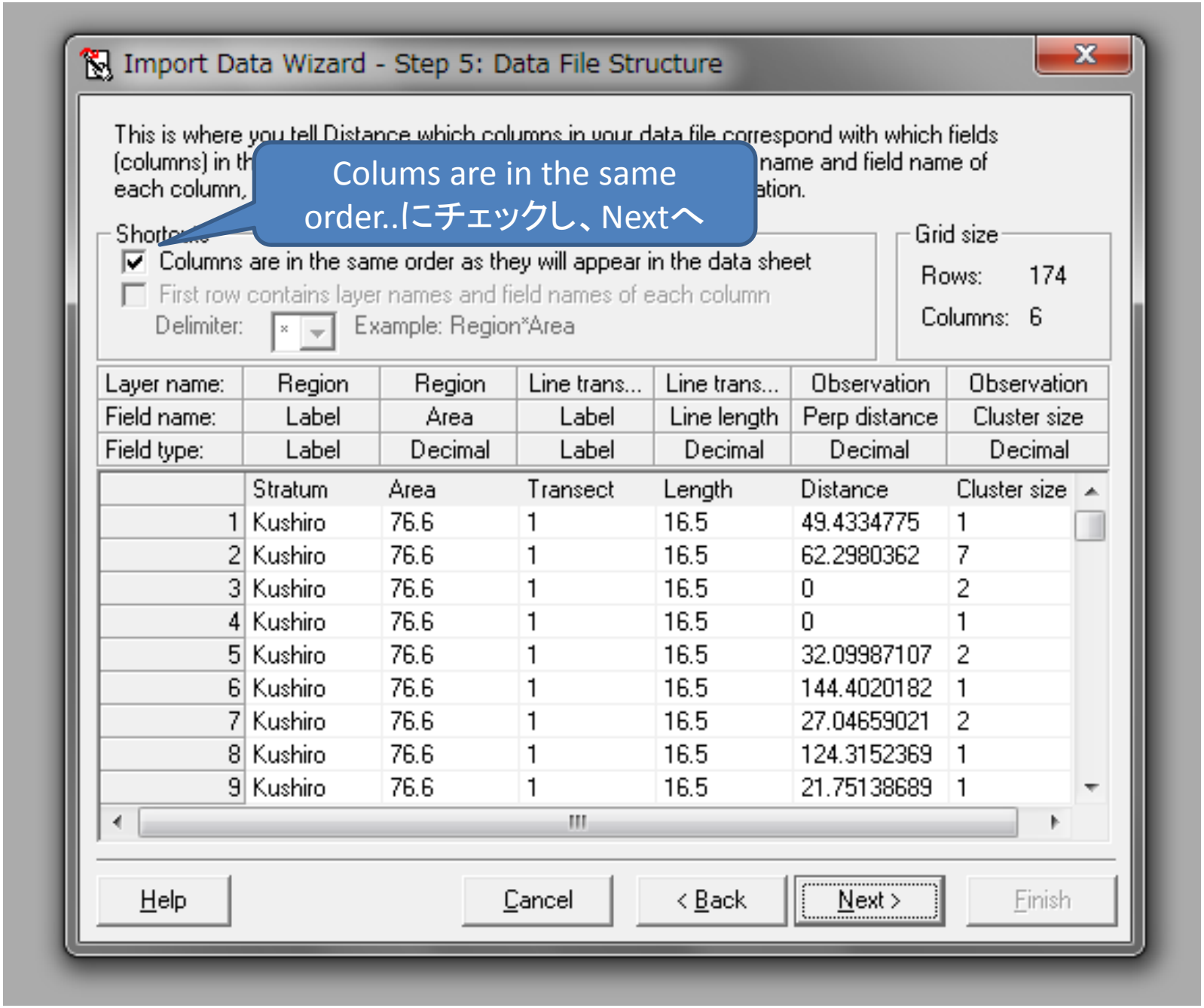
Creation of new records in lowest data layer

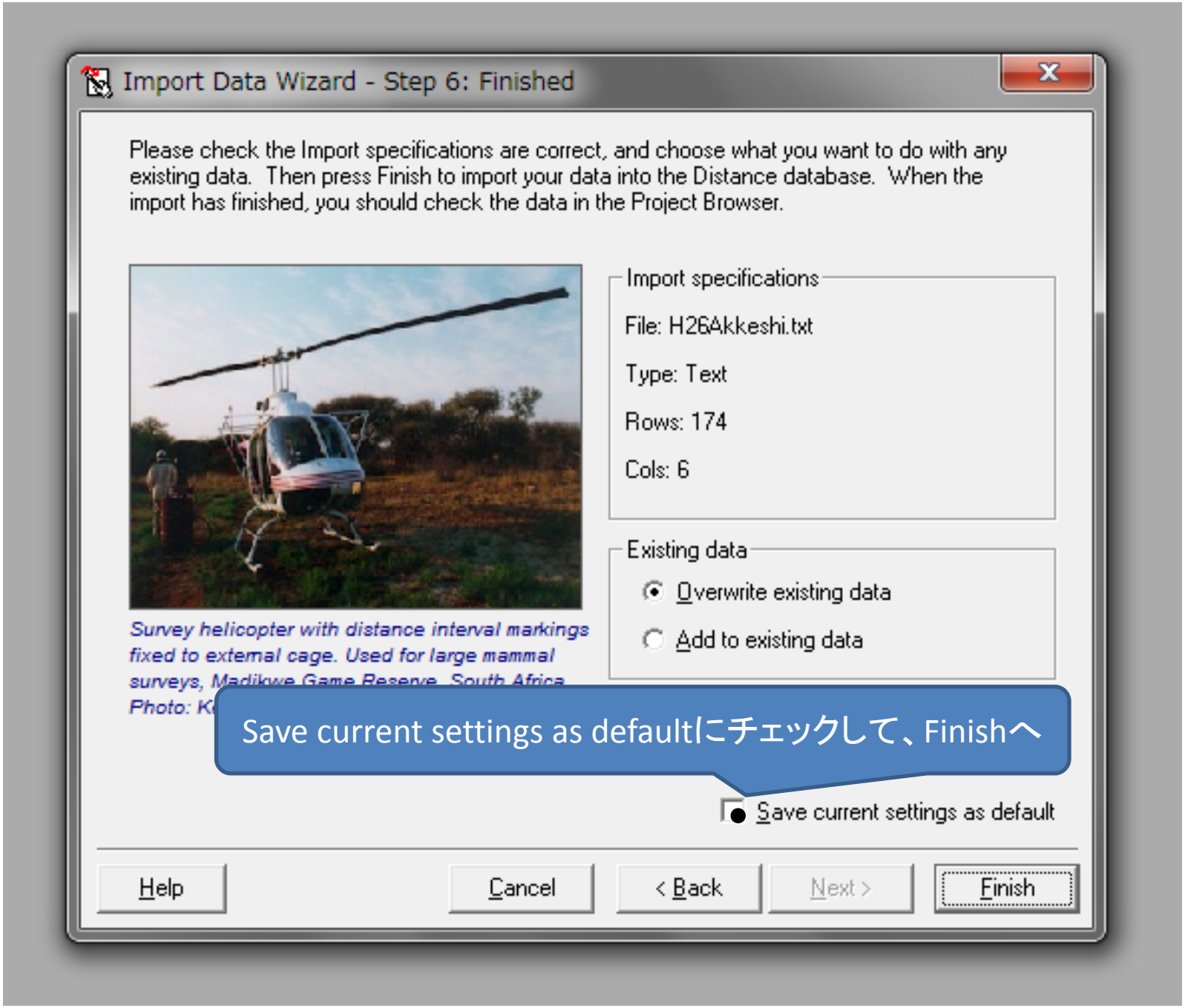
- (•) Create one new record for each line of the import file
- ( ) Create new records only when the line differs from the previous line

変更なく、Nextへ

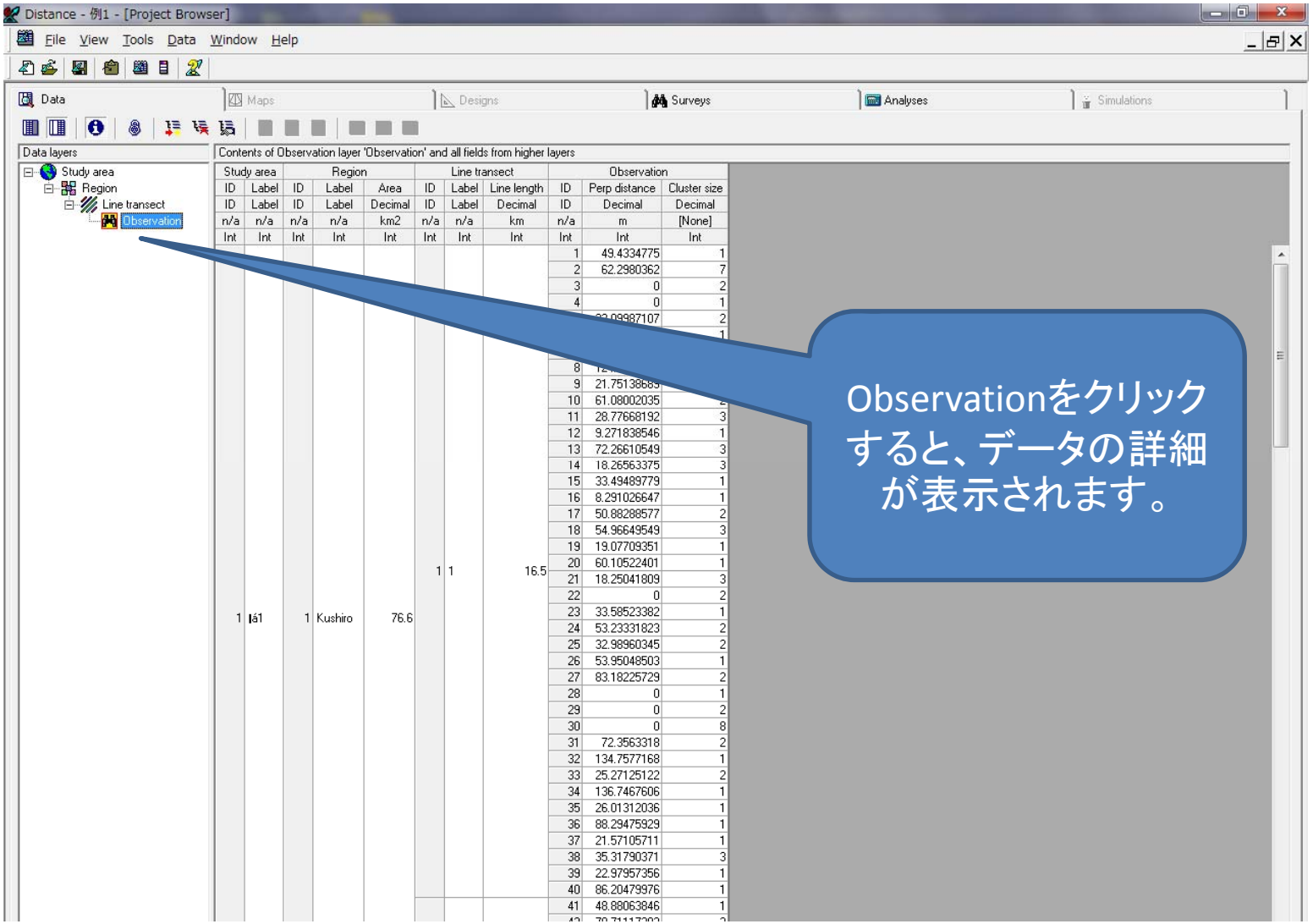
Help | Cancel | < Back | Next > | Finish


Import Data Wizard - Step 4: Data File Format
Use this screen to tell Dis
can check that the colum
ns of your data file. You
w table below.
Do not import first rowに
チェックしてNextへ
Delimiter
Tab
Semicolon
Comma
Space
Ignore rows
Do not import first row
Decimal symbol
Use regional settings
Use "."
Grid size
Rows: 174
Columns: 6
Stratum Area Transect Length Distance Cluster size
1 Kushiro 76.6 1 16.5 49.4334775 1
2 Kushiro 76.6 1 16.5 62.2980362 7
3 Kushiro 76.6 1 16.5 0 2
4 Kushiro 76.6 1 16.5 0 1
5 Kushiro 76.6 1 16.5 32.09987107 2
6 Kushiro 76.6 1 16.5 144.4020182 1
7 Kushiro 76.6 1 16.5 27.04659021 2
8 Kushiro 76.6 1 16.5 124.3152369 1
9 Kushiro 76.6 1 16.5 21.75138689 1
Help
Cancel
< Back
Next >
Finish

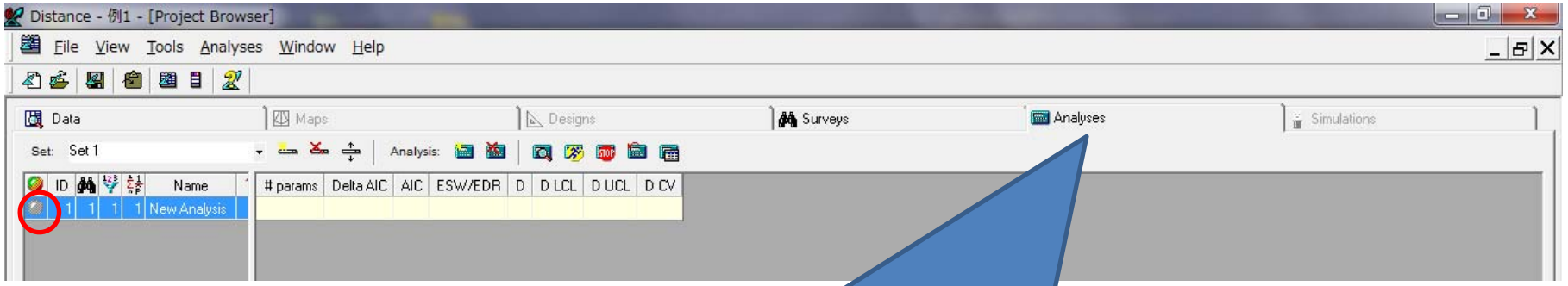

Import Data Wizard - Step 5: Data File Structure
This is where you tell Distance which columns in your data file correspond with which fields
(columns) in th
name and field name of
each column,
ation.
Colums are in the same order..にチェックし、Nextへ
Shortcuts
Columns are in the same order as they will appear in the data sheet
First row contains layer names and field names of each column
Delimiter:
Example: Region*Area
Grid size
Rows: 174
Columns: 6
Layer name: Region Region Line trans... Line trans... Observation Observation
Field name: Label Area Label Line length Perp distance Cluster size
Field type: Label Decimal Label Decimal Decimal Decimal
Stratum Area Transect Length Distance Cluster size
1 Kushiro 76.6 1 16.5 49.4334775 1
2 Kushiro 76.6 1 16.5 62.2980362 7
3 Kushiro 76.6 1 16.5 0 2
4 Kushiro 76.6 1 16.5 0 1
5 Kushiro 76.6 1 16.5 32.09987107 2
6 Kushiro 76.6 1 16.5 144.4020182 1
7 Kushiro 76.6 1 16.5 27.04659021 2
8 Kushiro 76.6 1 16.5 124.3152369 1
9 Kushiro 76.6 1 16.5 21.75138689 1
Help
Cancel
< Back
Next >
Finish


Import Data Wizard - Step 6: Finished
Please check the Import specifications are correct, and choose what you want to do with any existing data. Then press Finish to import your data into the Distance database. When the import has finished, you should check the data in the Project Browser.
Survey helicopter with distance interval markings fixed to external cage. Used for large mammal surveys, Madikwe Game Reserve, South Africa
Photo: K
Import specifications
File: H26Akkeshi.txt
Type: Text
Rows: 174
Cols: 6
Existing data
Overwrite existing data
Add to existing data
Save current settings as defaultにチェックして、Finishへ
Save current settings as default
Help
Cancel
< Back
Next >
Finish

操作手順その3－データ解析

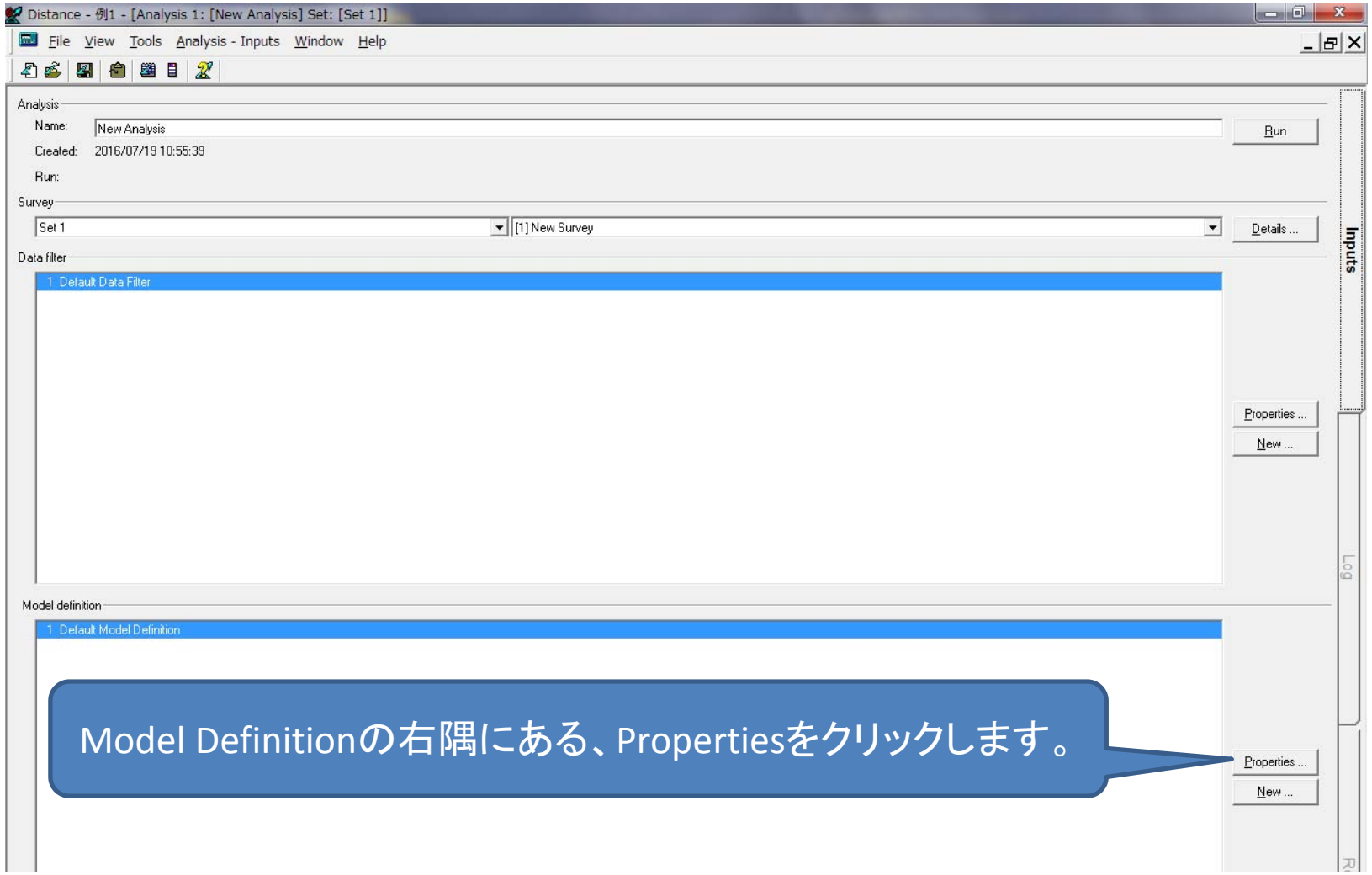


操作手順その3－データ解析つづき



Analysesをクリックし、左隅の灰色のボールをクリックします。

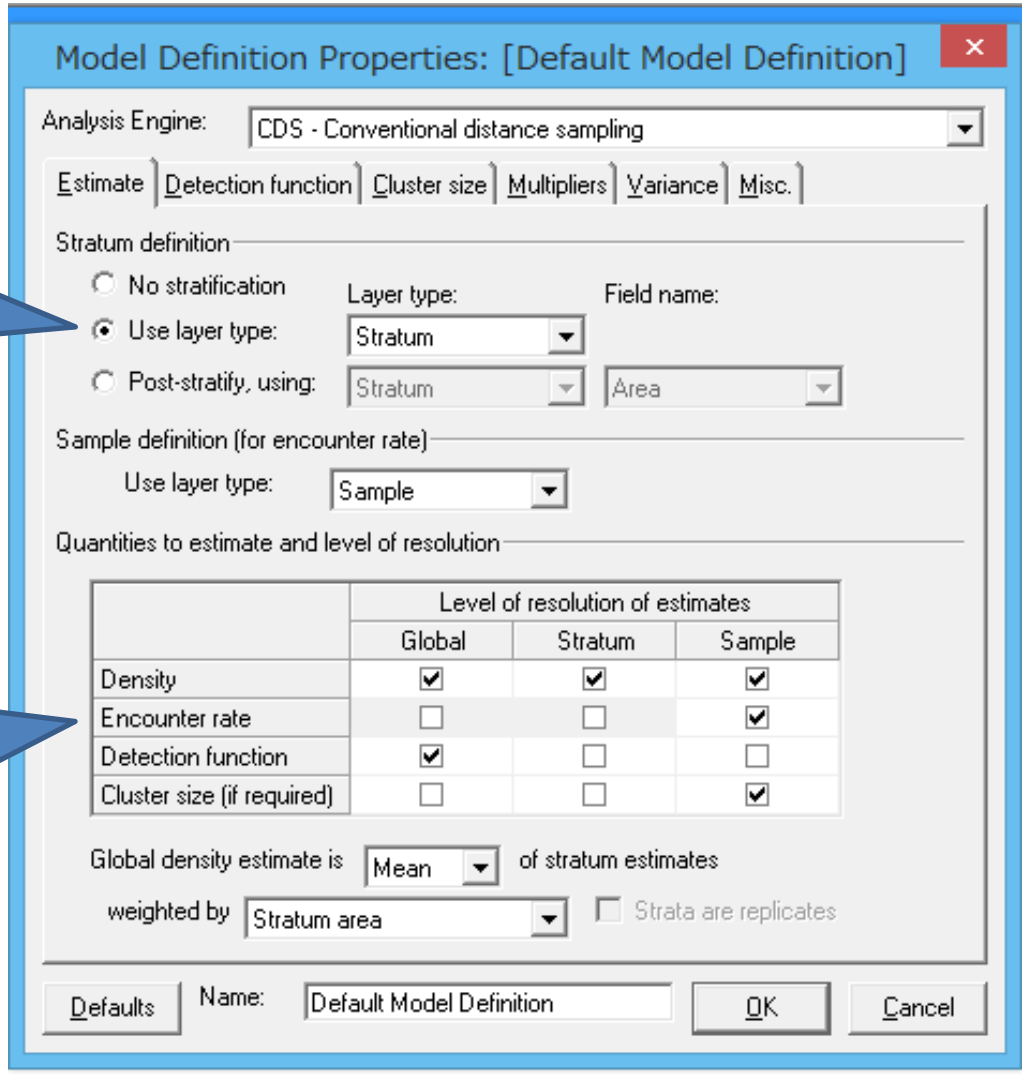
操作手順その3－データ解析つづき



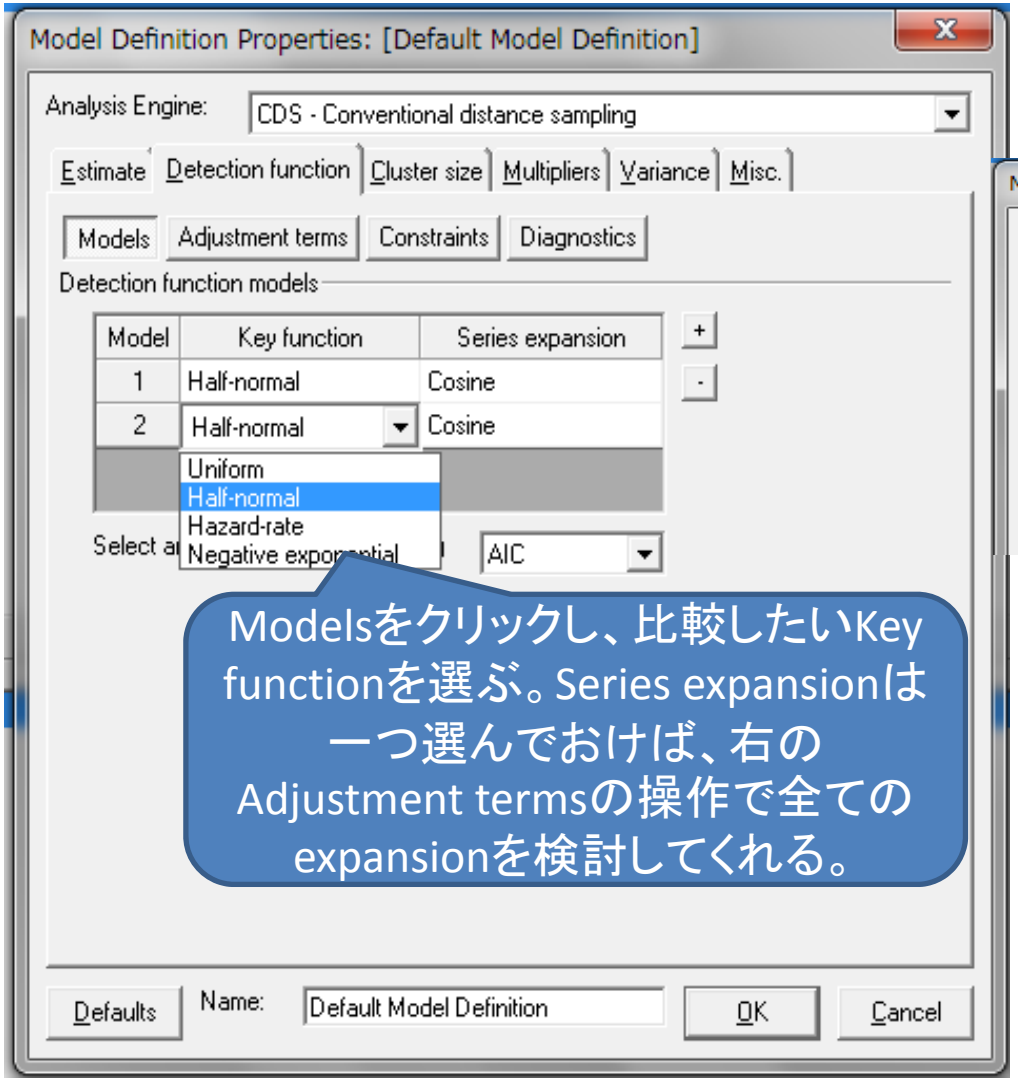
Model Definition Propertiesの Estimateについて

Use layer type をチェック

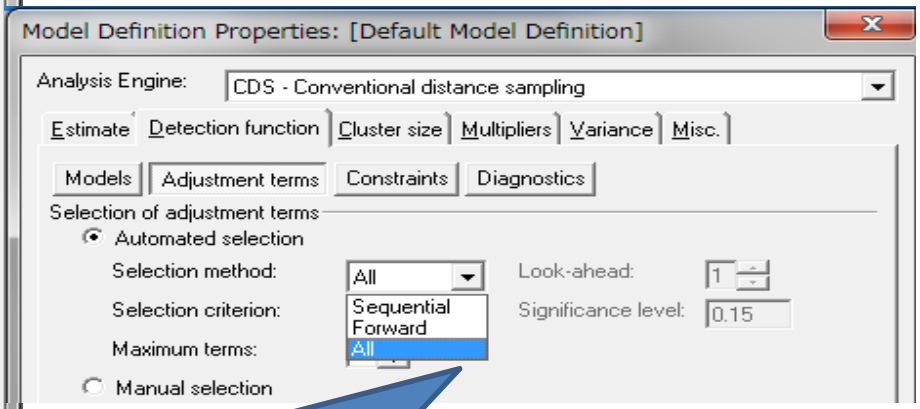
Densityは全てのスケールを選べる。
Detection functionはGlobal及びCluster sizeは適切なスケールを選択する。



Model Definition Propertiesの Detection functionについて



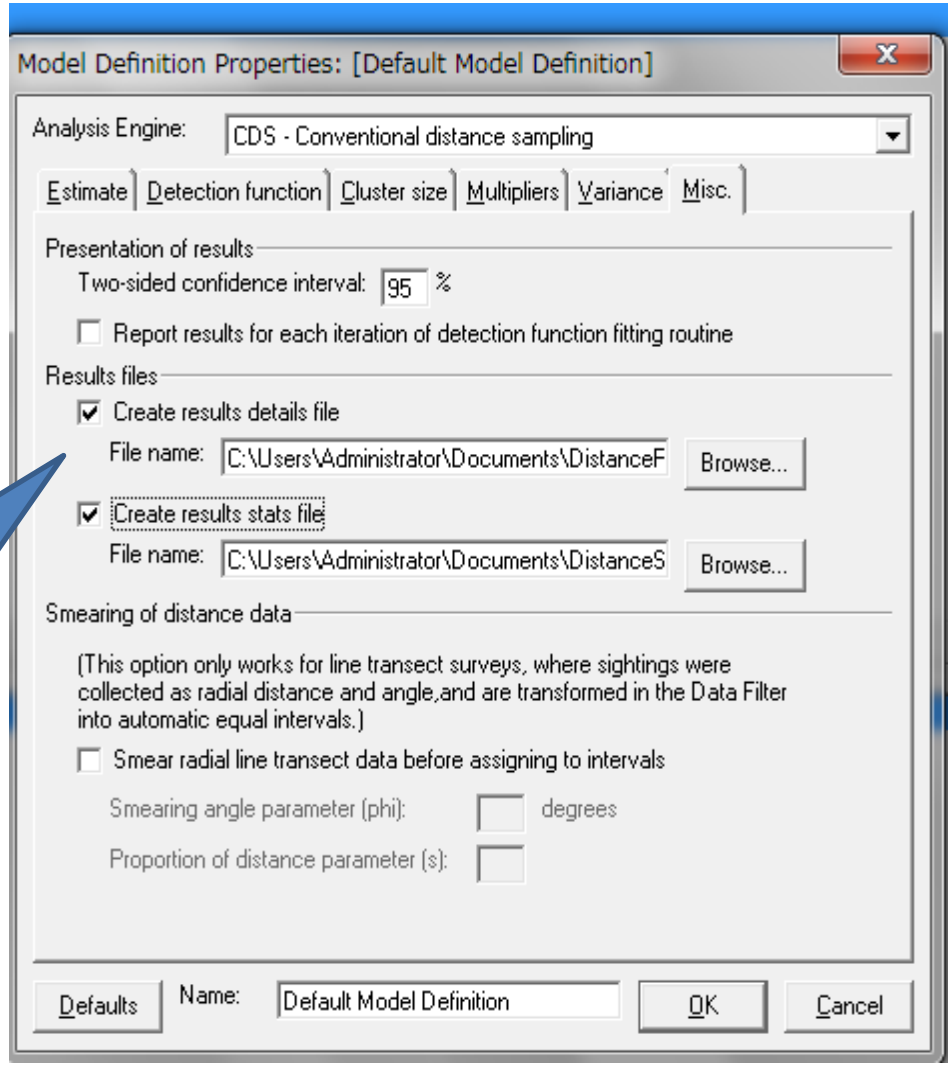
Modelsをクリックし、比較したいKey functionを選ぶ。Series expansionは一つ選んでおけば、右のAdjustment termsの操作で全てのexpansionを検討してくれる。



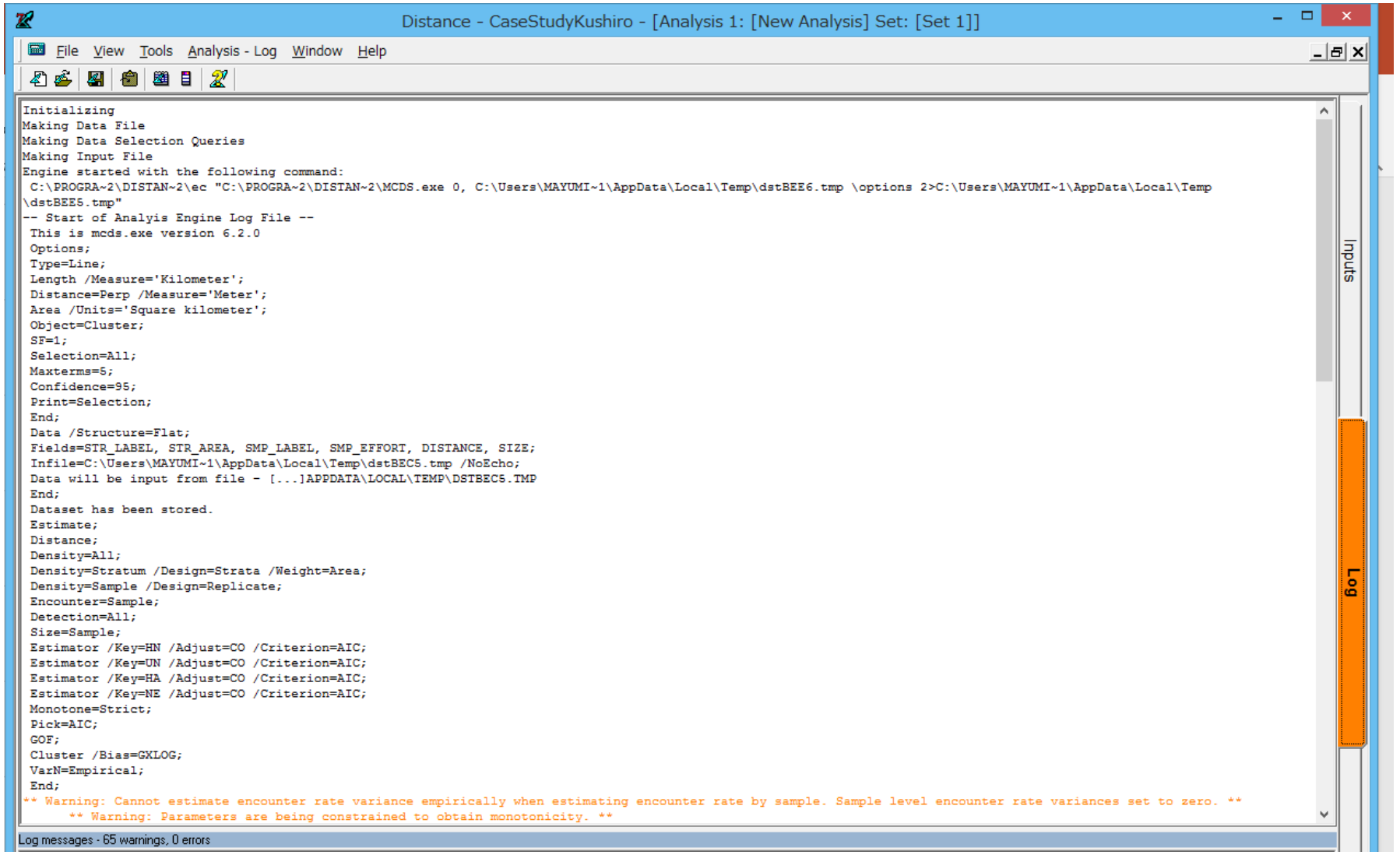
Adjustment termsをクリックし、Allを選択すれば、総当たりでモデル選択をしてくれる。

Model Definition PropertiesのMiscについて

Miscをクリックし、Results filesのCreate resultsをチェックし、該当場所を指定しておけば、解析結果がテキスト保存される。



操作手順その４－結果


Distance - CaseStudyKushiro - [Analysis 1: [New Analysis] Set: [Set 1]]
File View Tools Analysis - Log Window Help
Initializing
Making Data File
Making Data Selection Queries
Making Input File
Engine started with the following command:
C:\PROGRA~2\DISTAN~2\ec "C:\PROGRA~2\DISTAN~2\MCDS.exe 0, C:\Users\MAYUMI~1\AppData\Local\Temp\dstBEE6.tmp \options 2>C:\Users\MAYUMI~1\AppData\Local\Temp
\dstBEE5.tmp"
-- Start of Analyis Engine Log File --
This is mcds.exe version 6.2.0
Options;
Type=Line;
Length /Measure='Kilometer';
Distance=Perp /Measure='Meter';
Area /Units='Square kilometer';
Object=Cluster;
SF=1;
Selection=All;
Maxterms=5;
Confidence=95;
Print=Selection;
End;
Data /Structure=Flat;
Fields=STR_LABEL, STR_AREA, SMP_LABEL, SMP_EFFORT, DISTANCE, SIZE;
Infile=C:\Users\MAYUMI~1\AppData\Local\Temp\dstBEC5.tmp /NoEcho;
Data will be input from file - [...]APPDATA\LOCAL\TEMP\DSTBEC5.TMP
End;
Dataset has been stored.
Estimate;
Distance;
Density=All;
Density=Stratum /Design=Strata /Weight=Area;
Density=Sample /Design=Replicate;
Encounter=Sample;
Detection=All;
Size=Sample;
Estimator /Key=HN /Adjust=CO /Criterion=AIC;
Estimator /Key=UN /Adjust=CO /Criterion=AIC;
Estimator /Key=HA /Adjust=CO /Criterion=AIC;
Estimator /Key=NE /Adjust=CO /Criterion=AIC;
Monotone=Strict;
Pick=AIC;
GOF;
Cluster /Bias=GXLOG;
VarN=Empirical;
End;
** Warning: Cannot estimate encounter rate variance empirically when estimating encounter rate by sample. Sample level encounter rate variances set to zero. **
** Warning: Parameters are being constrained to obtain monotonicity. **
Log messages - 65 warnings, 0 errors
Inputs
Log

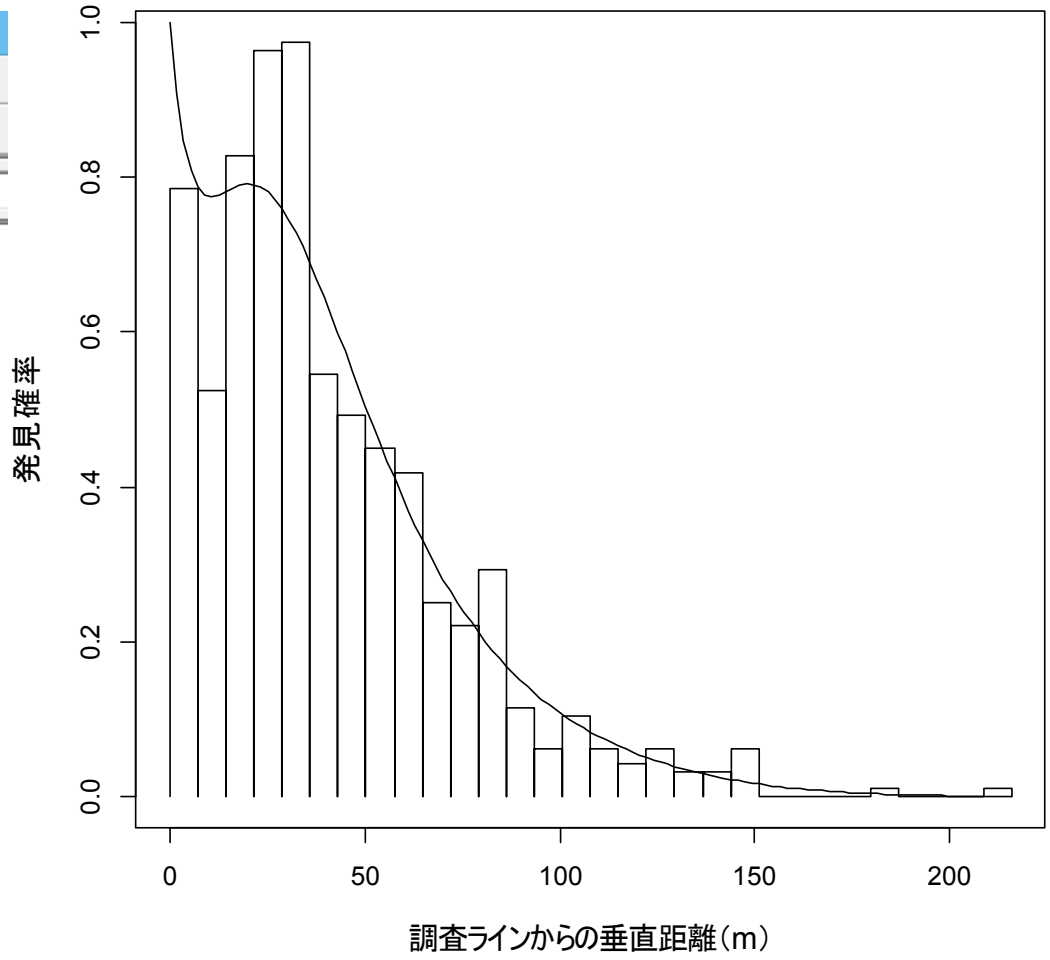
発見確率モデルの推定

File View Tools Analysis - Results Window Help

Detection Fct/Global/Model Fitting

```
Effort          :    353.1000
# samples       :    20
Width           :    215.6815
# observations:    701

Model Selection
---------------
Minimum AIC  =    6521.438
Estimator chosen based on minimum AIC :
Model
   Negative Exponential key, k(y) = Exp(-y/A(1))
   Cosine adjustments of order(s) :  1, 2, 3
```



有効観察幅（ESW）

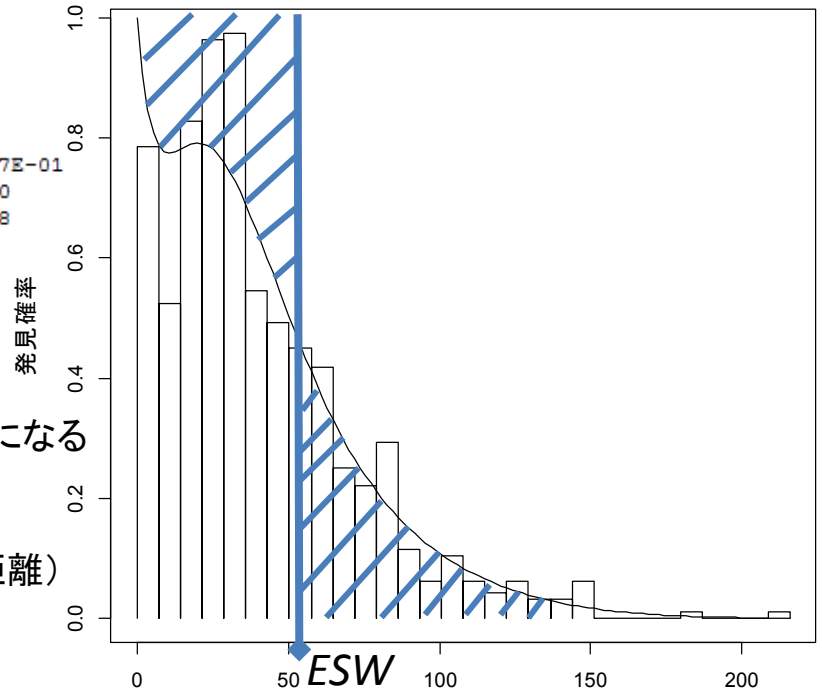
Distance - CaseStudyKushiro - [Ana

File View Tools Analysis - Results Window Help

Estimation Summary - Detection probability

Pooled Estimates:

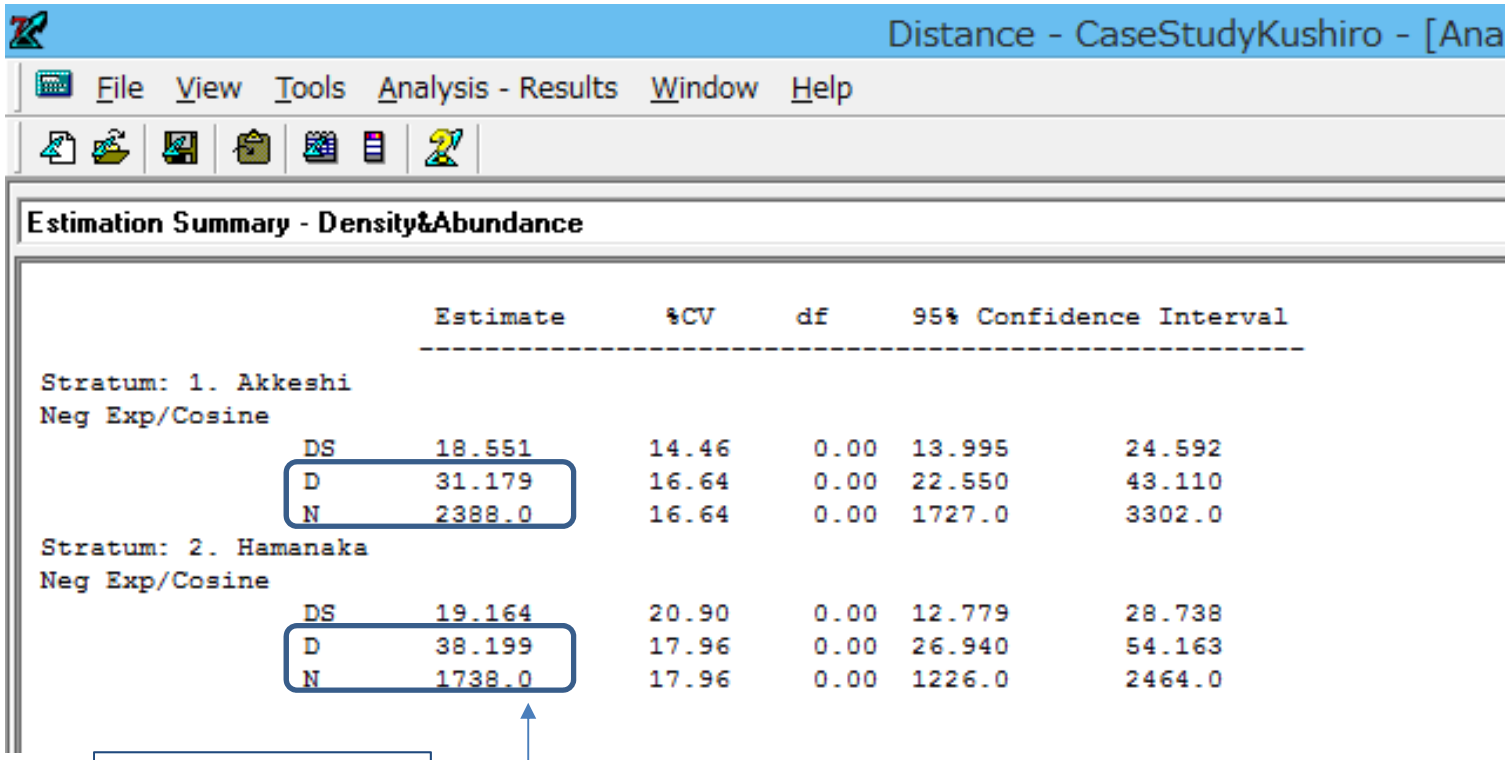
		Estimate	%CV	df	95% Confidence Interval	
Neg Exp/Cosine						
	m	4.0000				
	LnL	-3256.7				
	AIC	6521.4				
	AICc	6521.5				
	BIC	6539.6				
	Chi-p	0.40567E-03				
	f(0)	0.18937E-01	9.65	697.00	0.15675E-01	0.22877E-01
	[illegible]	[illegible]	9.65	697.00	0.20266	0.29580
	ESW	52.807	9.65	697.00	43.710	63.798



有効観察幅（Effective Strip Width；*ESW*）：
ある距離までに見落とした数とそれ以降に発見した数が同じになる調査ラインからの垂直距離

生息密度＝観察頭数の合計値／探索面積（2×*ESW*×調査距離）

推定密度と推定個体数



推定個体数＝推定密度×データファイルに入力した面積

参考文献

- User’s Guide Distance7.0 Release 1. Research Unit for Wildlife Assessment. ユーザーズガイド（ソフトウェアをインストールしたフォルダ内にある、例えば¥Program Files (x86)¥Distance 7¥Help）
- Thomas, L. Buckland, ST, Rexstad, EA, Laake, JL, Strindberg, S, Hedley, SL, Bishop, JRB, Marques, TA, Burnham, KP. 2010. Distance software: design and analysis of distance sampling surveys for estimating population size. Journal of Applied Ecology 47: 5-14.