

# 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、ライトランセクト法を紹介しました。ライト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ト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

The screenshot shows a Google search for "distance sampling". The search bar contains "distance sampling" and the search button is highlighted. Below the search bar, there are navigation tabs: "すべて", "画像", "動画", "ニュース", "地図", "もっと見る", and "ツール". The search results show approximately 844,000 items in 0.42 seconds. A hint indicates that only Japanese search results are shown. The first result is "Distance Sampling" from "distancesampling.org", which is highlighted with a yellow box. A blue callout bubble points to this result, containing the text: "インターネットで「Distance Sampling」と検索すればトップに出てきます。". Below this, there are two more results: "What is distance sampling? · distancesampling.org" and "Distance sampling - Wikipedia".

Google distance sampling

すべて 画像 動画 ニュース 地図 もっと見る ツール

約 844,000 件 (0.42 秒)

ヒント: 日本語の検索結果のみ表示します。検索言語は [表示設定] で指定できます。

**Distance Sampling**  
[distancesampling.org/](https://distancesampling.org/) ▾ このページを訳す  
The Distance project provides software for the design and analysis of distance sampling surveys of wildlife populations. This software takes two forms: a Windows-based program and a suite of packages for the statistical programming ...  
[Download Distance for Windows](#) · [Distance R packages](#) · [History](#) · [Extras](#)

**What is distance sampling? · distancesampling.org**  
[distancesampling.org/whatisds.html](https://distancesampling.org/whatisds.html) ▾ このページを訳す  
Distance sampling is a widely used methodology for estimating animal density or abundance. Its name derives from the fact that the information used for inference are the recorded distances to objects of interest (usually animals) obtained by ...

**Distance sampling - Wikipedia**  
[https://en.wikipedia.org/wiki/Distance\\_sampling](https://en.wikipedia.org/wiki/Distance_sampling) ▾ このページを訳す  
Distance sampling is a widely used group of closely related methods for estimating the density and/or abundance of populations. The main methods are based on line transects or point transects. In this method of sampling, the data collected ...

インターネットで「Distance Sampling」と検索すればトップに出てきます。

# Distanceのダウンロードその1

Information on the development of Distance and Distance-related R packages.

Download Distance for Windows | Distance R packages

Get in touch!

ここをクリック!

## Welcome to the Distance project website

The Distance project provides software for the design and analysis of distance sampling surveys of wildlife populations. This software takes two forms: a Windows-based program and a suite of packages for the statistical programming language R.

If you are unfamiliar with distance sampling concepts, or are looking for links to books and literature or introductory training videos, please visit the page – [What is distance sampling?](#)

The 2016 St Andrews distance sampling workshops have been completed. Dates for the 2017 workshops will appear at the [St Andrews website](#) in due course.

## Software to design and analyse distance sampling surveys

There are two routes you can choose to analyse your data. You can either use the “standalone” Windows software Distance or use packages available in the R programming language. In reality, you are (mostly) using packages written in R whichever you choose; the first option provides a graphical interface to the underlying analysis software.

## Distance for Windows

The graphical interface of Distance has been in existence since 1997 and [over 30,000 users from > 110 countries](#) have grown accustomed to it. At time of this writing (October 2016) we have just released Distance (graphical interface) version 7.0 Release 1. Version 7 contains all the features of

# Distanceのダウンロードその2



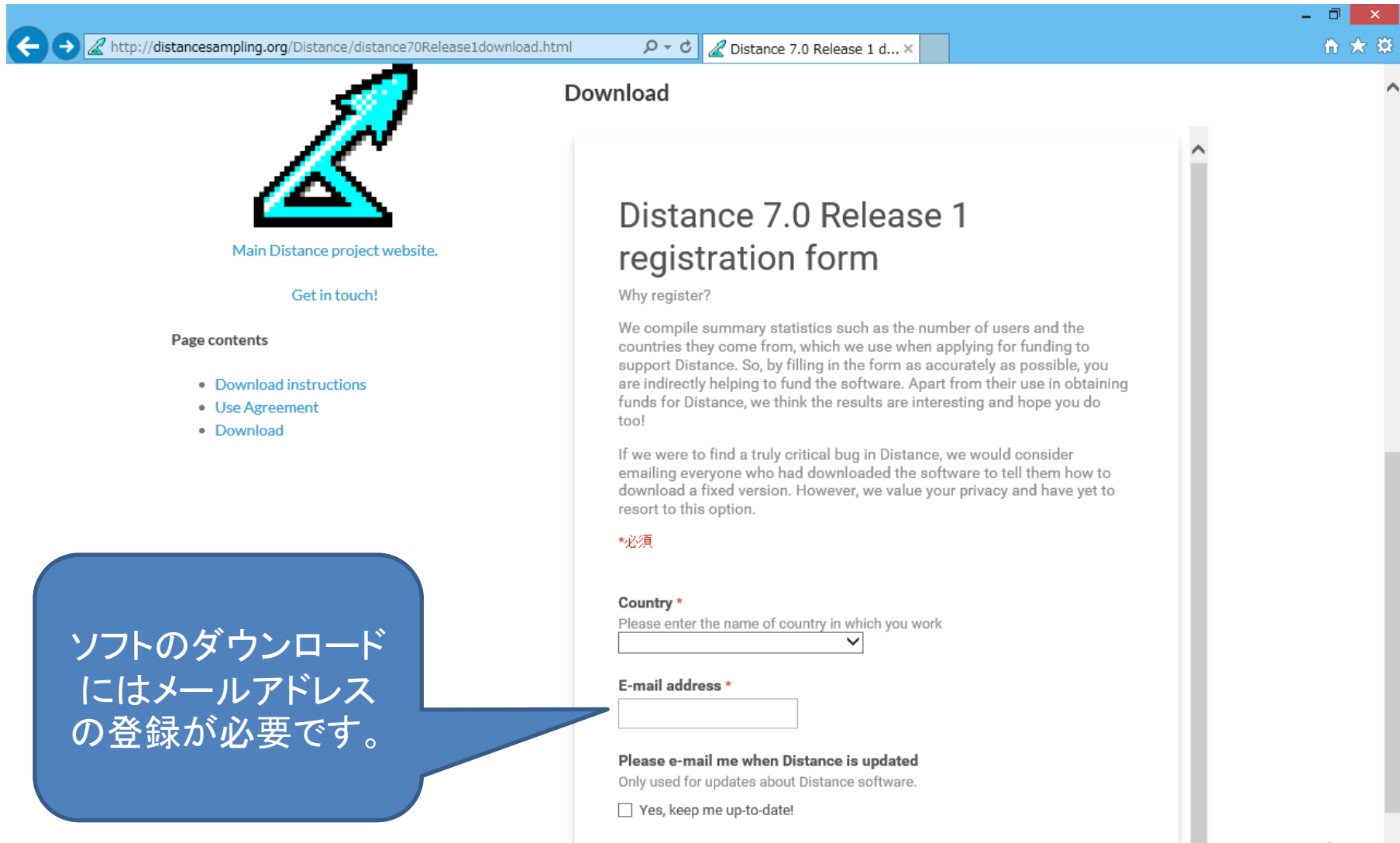
The screenshot shows a web browser window with the URL <http://distancesampling.org/Distance/>. The page title is "Distance for Windows". The main content includes a large cyan arrow icon pointing to the right, with the text "Main Distance project website." and "Get in touch!". Below this is a "Page contents" section with a list of links: "Download latest version", "Download previous versions", and "Other useful pages". The main text describes the latest version of Distance (7.0) and provides a link to "Download latest version". A blue callout box points to this link with the text "ここをクリック!". Below the "Download latest version" section is the "Download previous versions" section, which includes a link to "Go to download page for Distance 7.0 Release 1." and a blue callout box with the text "ここをクリック!". The page also features a photograph of a deer in a forest.

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



← → http://distancesampling.org/Distance/distance70Release1download.html Distance 7.0 Release 1 d... ×

## Download



Main Distance project website.

Get in touch!

Page contents

- [Download instructions](#)
- [Use Agreement](#)
- [Download](#)

### Distance 7.0 Release 1 registration form

Why register?

We compile summary statistics such as the number of users and the countries they come from, which we use when applying for funding to support Distance. So, by filling in the form as accurately as possible, you are indirectly helping to fund the software. Apart from their use in obtaining funds for Distance, we think the results are interesting and hope you do too!

If we were to find a truly critical bug in Distance, we would consider emailing everyone who had downloaded the software to tell them how to download a fixed version. However, we value your privacy and have yet to resort to this option.


\*必須

**Country \***  
Please enter the name of country in which you work

**E-mail address \***

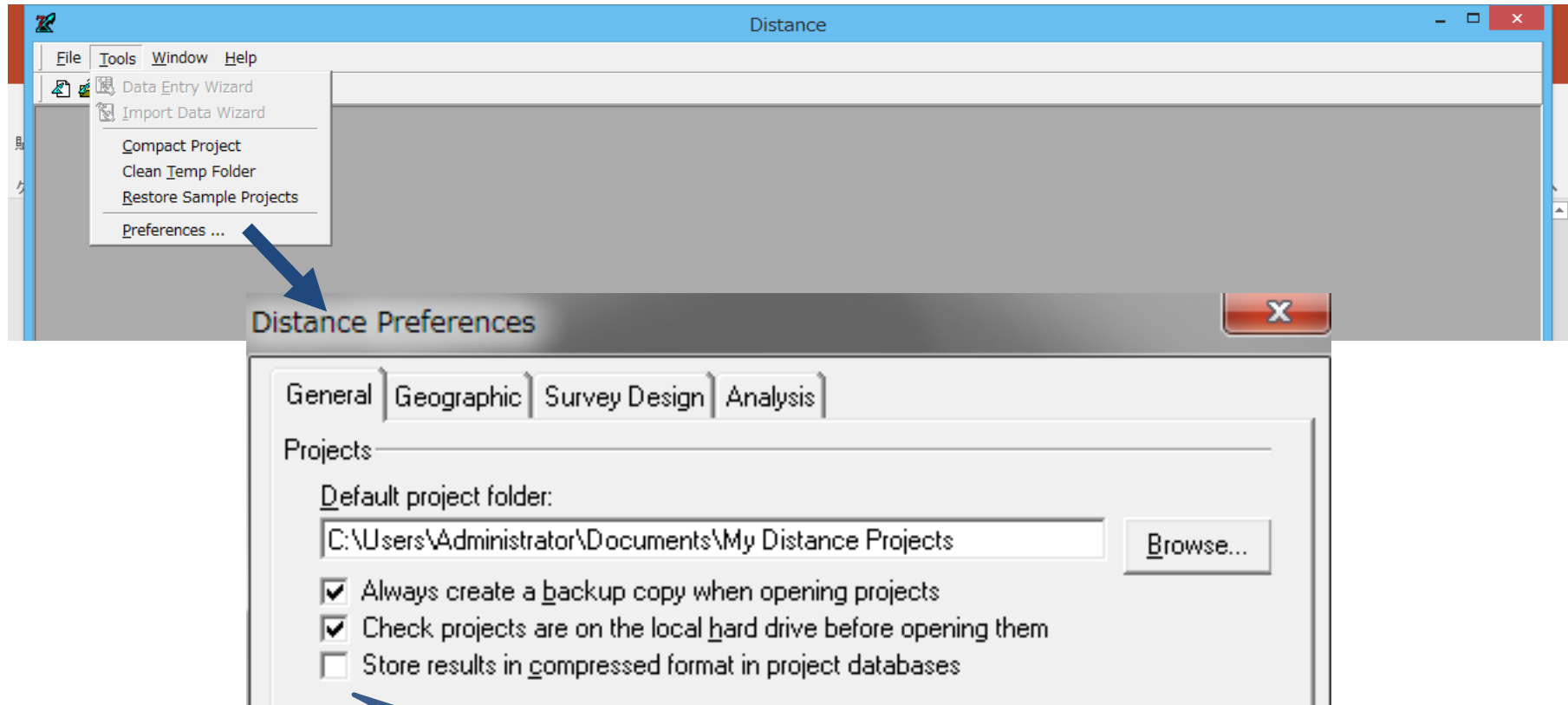
**Please e-mail me when Distance is updated**  
Only used for updates about Distance software.  
 Yes, keep me up-to-date!

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。

A photograph of a person in a forest holding a large deer head with prominent antlers. The scene is dimly lit, with a bright light source in the upper center creating a lens flare effect. The text 'インストール' is overlaid in the center of the image.

# インストール

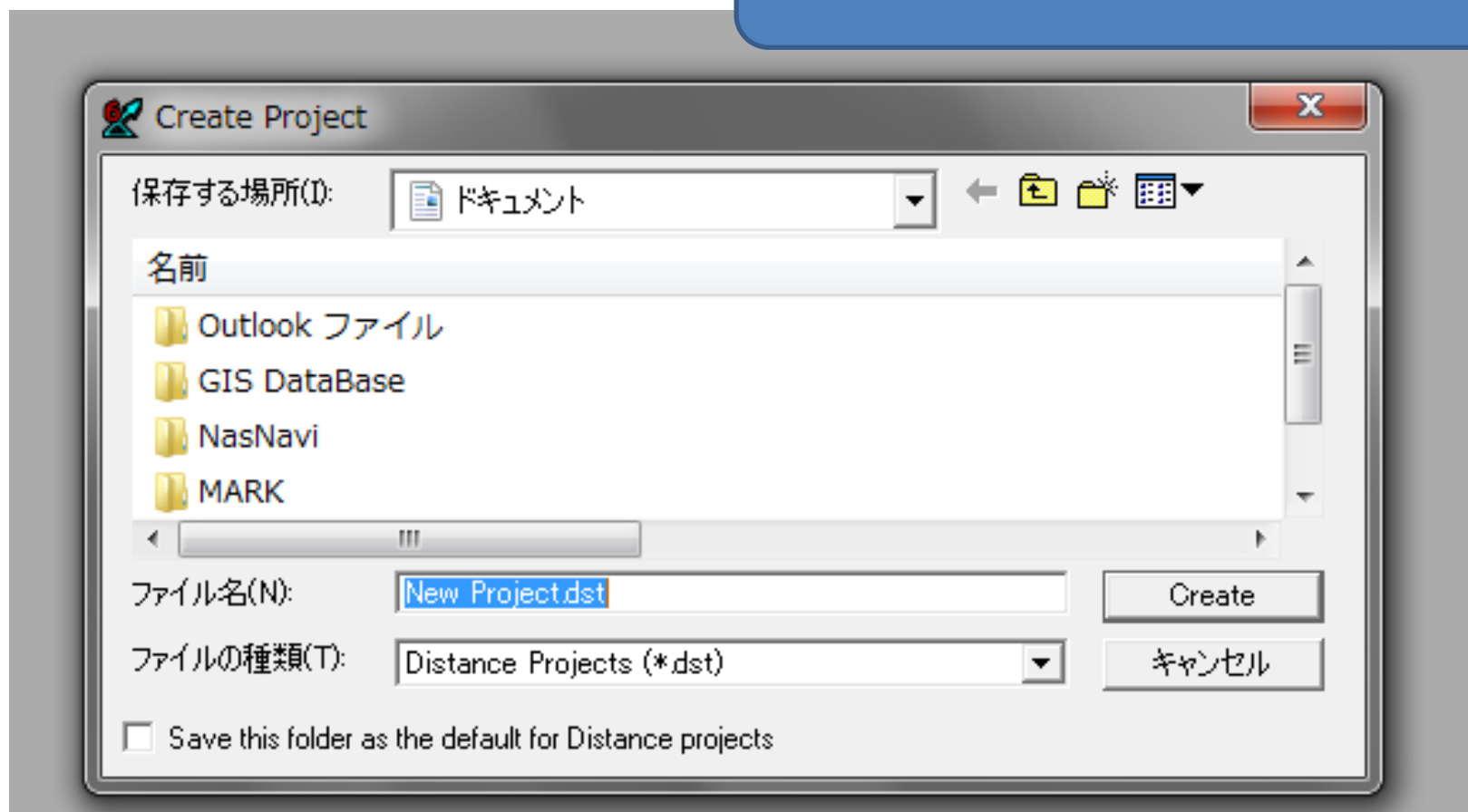
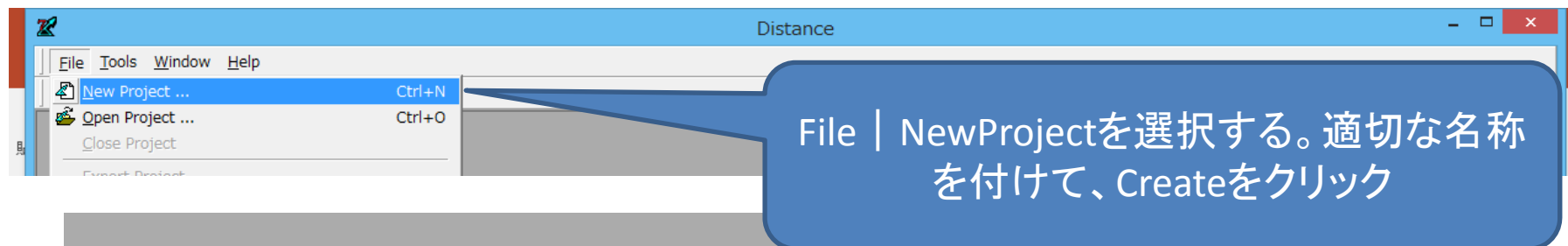
# インストール後にまずやること



Store results...databasesのチェックボックスを外す。  
これをしておかないと、ソフトウェア上で解析結果  
が表示されません。



# 操作手順その1ープロジェクトの作成



New Project Setup Wizard - Step 1: Type of Project



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

The new project '1á1' 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に  
チェックを入れ、Nextをクリック

Don't show this introductory screen again.

Help

Cancel

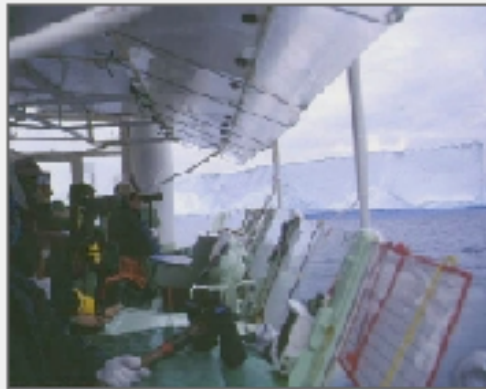
< Back

Next >

Finish

### 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*

#### Sampling fraction

This option has been moved to the Multipliers page.

#### 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

#### 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:

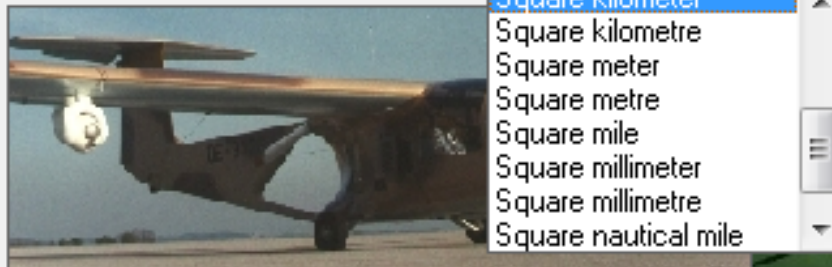
Meter

Transect:

Kilometer

Area:

Square kilometer



*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



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



Using a rangefinder  
to estimate distances  
Photo: Rolf Koford

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?
<input type="checkbox"/> Surveys where sampling fraction is not 1	Sampling fraction	N
<input type="checkbox"/> Surveys where $g(0)$ is less than 1	$g(0)$	Y
<input type="checkbox"/> Cue count surveys	Cue rate	Y
<input type="checkbox"/> Indirect surveys of <input type="text"/>	Production rate	Y
	Disappearance time	Y
<input type="checkbox"/> 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 wizard and return to Distance

真ん中をチェック

Save current settings as default

Help

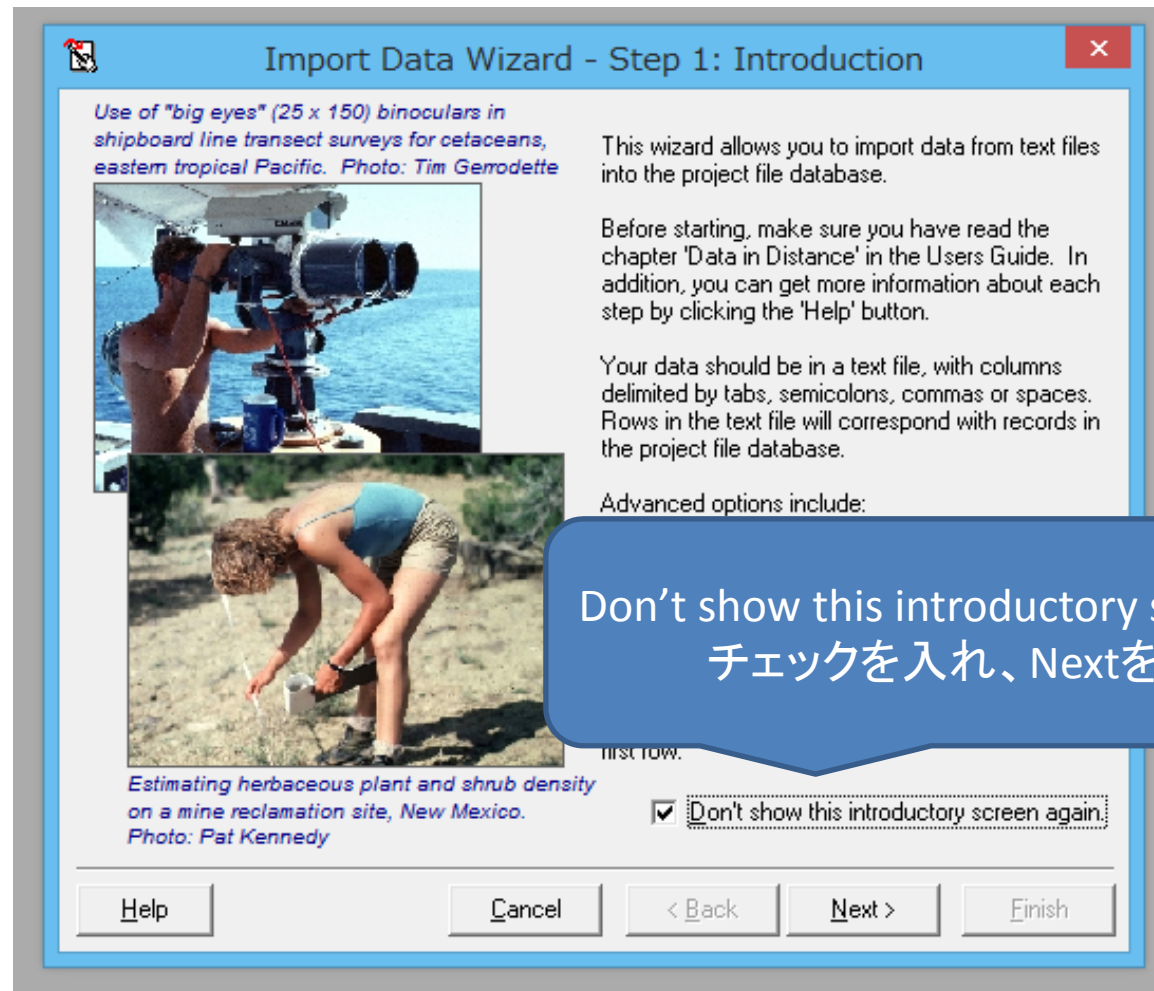
Cancel

< Back

Next >

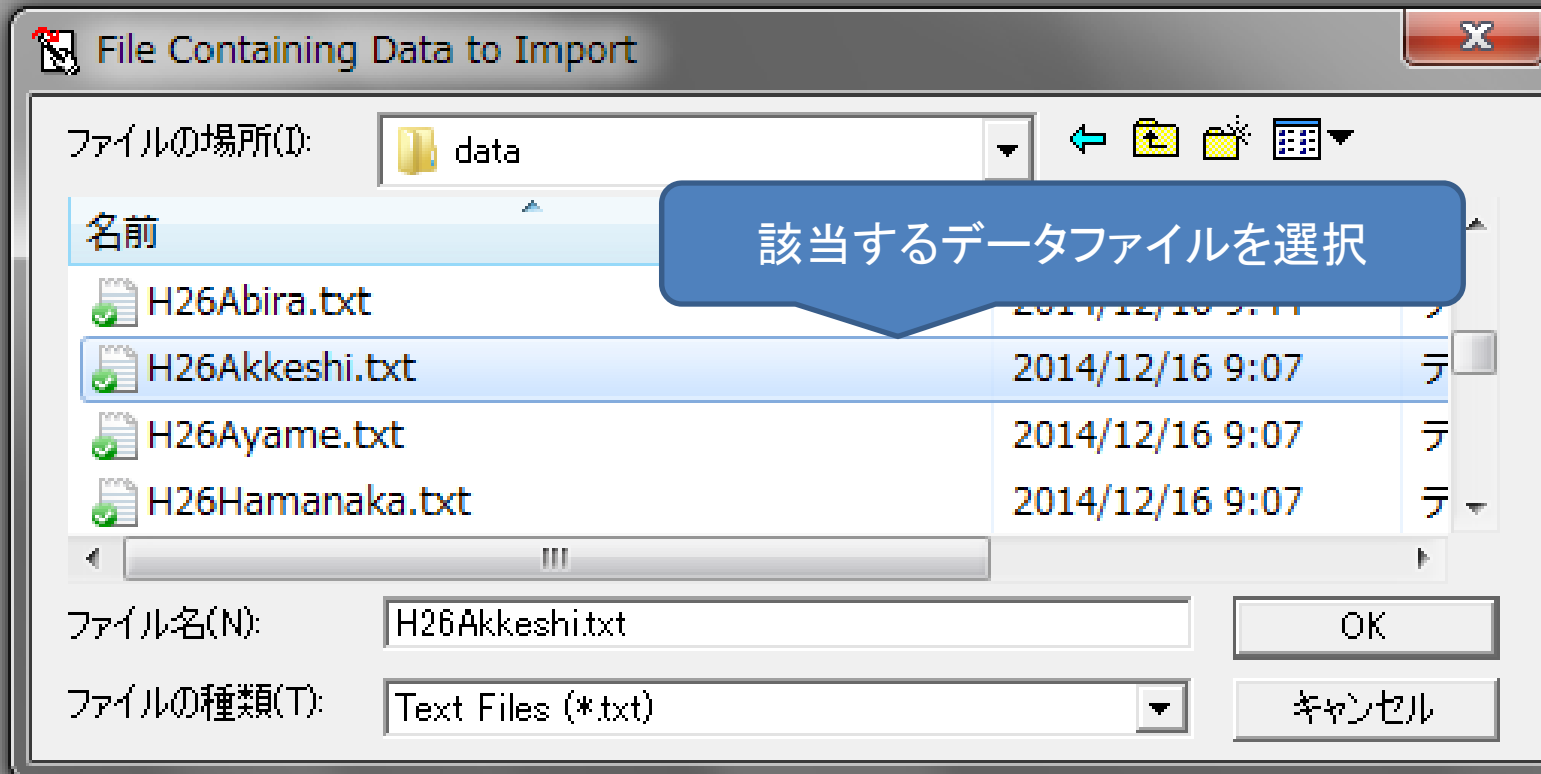
Finish

# 操作手順その2ー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





### Import Data Wizard - Step 3: Data Destination

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

#### Destination data layers

Lowest data layer:

Highest data layer:

Parent data layer:

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:



#### 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 Disk Utility how to import the data from the first rows of your data file. You can check that the column names are correct in the preview 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 the application. Enter the column name and field name of each column.

**Columns 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

Buttons: 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ーデータ解析

The screenshot shows a software window titled "Distance - 例1 - [Project Browser]". The interface includes a menu bar (File, View, Tools, Data, Window, Help) and a toolbar. Below the toolbar are tabs for "Data", "Maps", "Designs", "Surveys", "Analyses", and "Simulations".

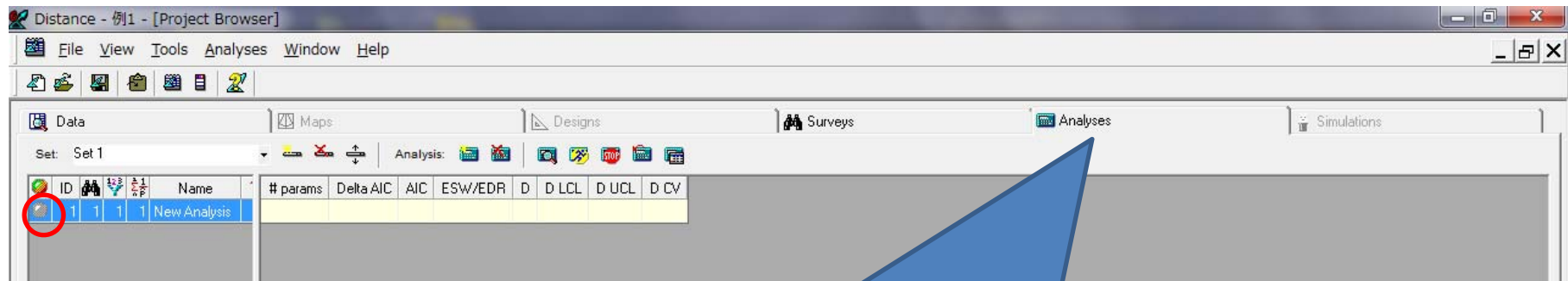
The "Data layers" panel on the left shows a tree view with "Study area", "Region", "Line transect", and "Observation". The "Observation" layer is selected and highlighted in blue. A blue callout box with a pointer indicates that clicking on "Observation" displays the data details.

The main window displays the "Contents of Observation layer 'Observation' and all fields from higher layers". The data is organized into columns for "Study area", "Region", "Line transect", and "Observation".

Study area			Region			Line transect			Observation		
ID	Label	Area	ID	Label	Decimal	ID	Label	Decimal	ID	Perp distance	Cluster size
ID	Label	Decimal	ID	Label	Decimal	ID	Label	Decimal	ID	Decimal	Decimal
n/a	n/a	n/a	n/a	n/a	km2	n/a	n/a	km	n/a	m	[None]
Int	Int	Int	Int	Int	Int	Int	Int	Int	Int	Int	Int
									1	49.4334775	1
									2	62.2980362	7
									3	0	2
									4	0	1
									5	83.09987107	2
									6	0	1
									7	0	1
									8	0	1
									9	21.75138685	2
									10	61.08002035	2
									11	28.77668192	3
									12	9.271838546	1
									13	72.26610549	3
									14	18.26563375	3
									15	33.49489779	1
									16	8.291026647	1
									17	50.88288577	2
									18	54.96649549	3
									19	19.07709351	1
									20	60.10522401	1
						1 1		16.5	21	18.25041809	3
									22	0	2
									23	33.58523382	1
									24	53.23331823	2
									25	32.98960345	2
									26	53.95048503	1
									27	83.18225729	2
									28	0	1
									29	0	2
									30	0	8
									31	72.3563318	2
									32	134.7577168	1
									33	25.27125122	2
									34	136.7467606	1
									35	26.01312036	1
									36	88.29475929	1
									37	21.57105711	1
									38	35.31790371	3
									39	22.97957356	1
									40	86.20479976	1
									41	48.88063846	1
									42	70.7117300	2

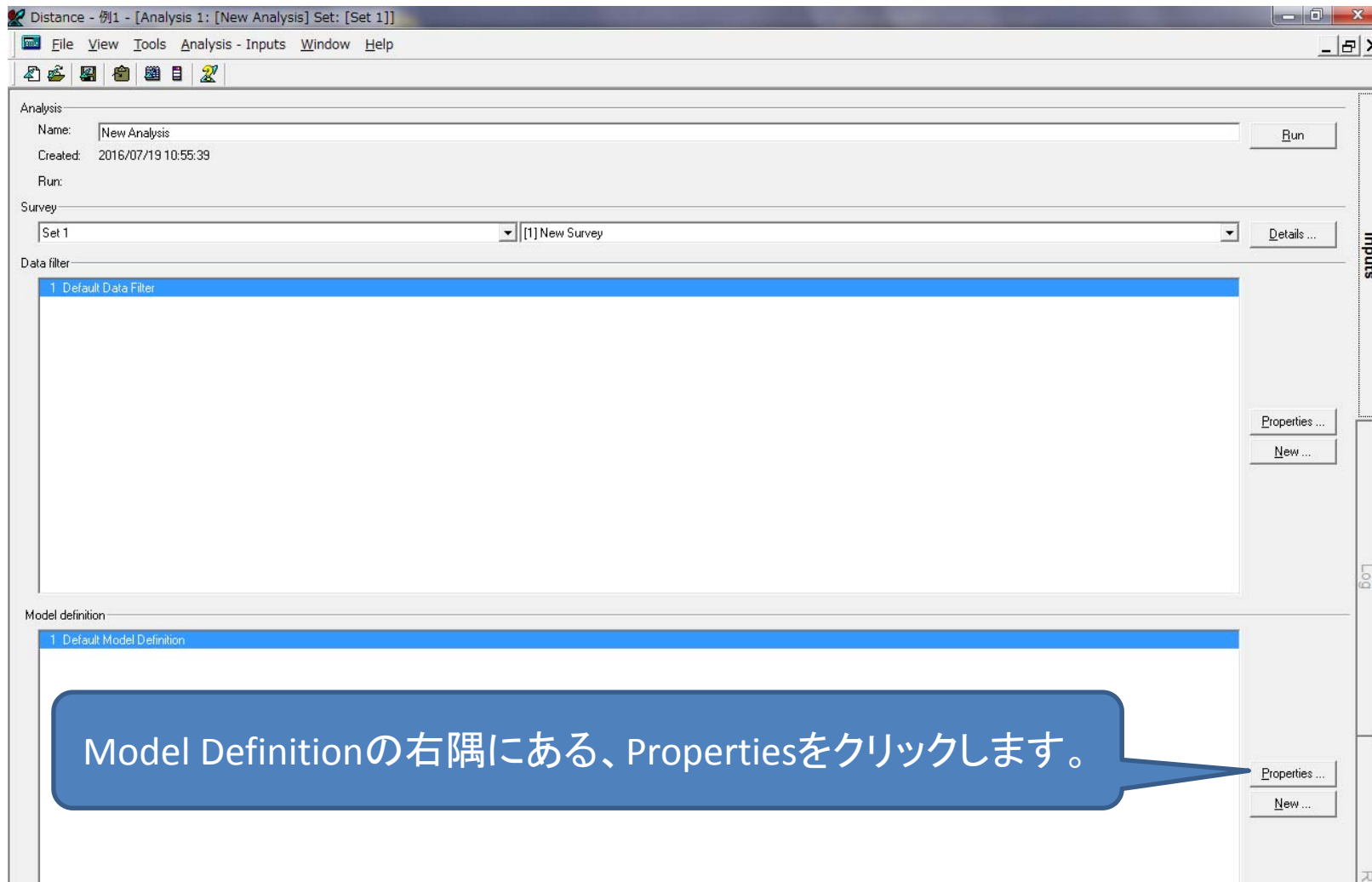
Observationをクリックすると、データの詳細が表示されます。

# 操作手順その3ーデータ解析つづき



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ーデータ解析つづき





# 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: [Default Model Definition]

Analysis Engine: CDS - Conventional distance sampling

Estimate | Detection function | Cluster size | Multipliers | Variance | Misc.

Stratum definition

No stratification    Layer type:    Field name:

Use layer type: Stratum    Stratum    Area

Post-stratify, using: Stratum    Area

Sample definition (for encounter rate)

Use layer type: Sample

Quantities to estimate and level of resolution

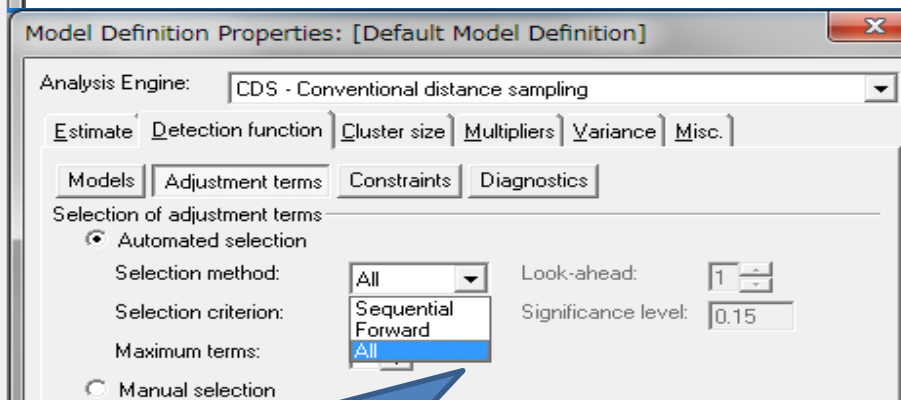
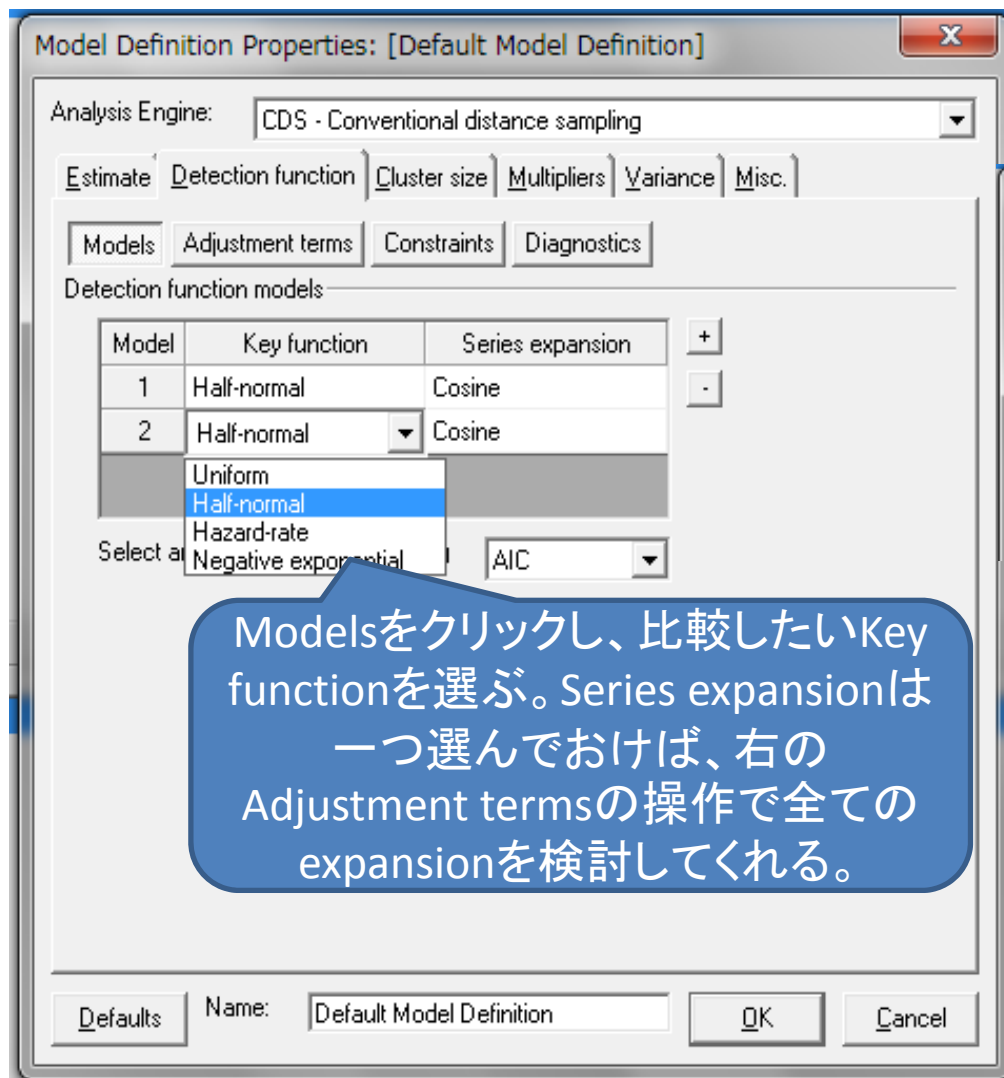
	Level of resolution of estimates		
	Global	Stratum	Sample
Density	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Encounter rate	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Detection function	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cluster size (if required)	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Global density estimate is Mean of stratum estimates

weighted by Stratum area     Strata are replicates

Defaults    Name: Default Model Definition    OK    Cancel

# Model Definition Propertiesの Detection functionについて

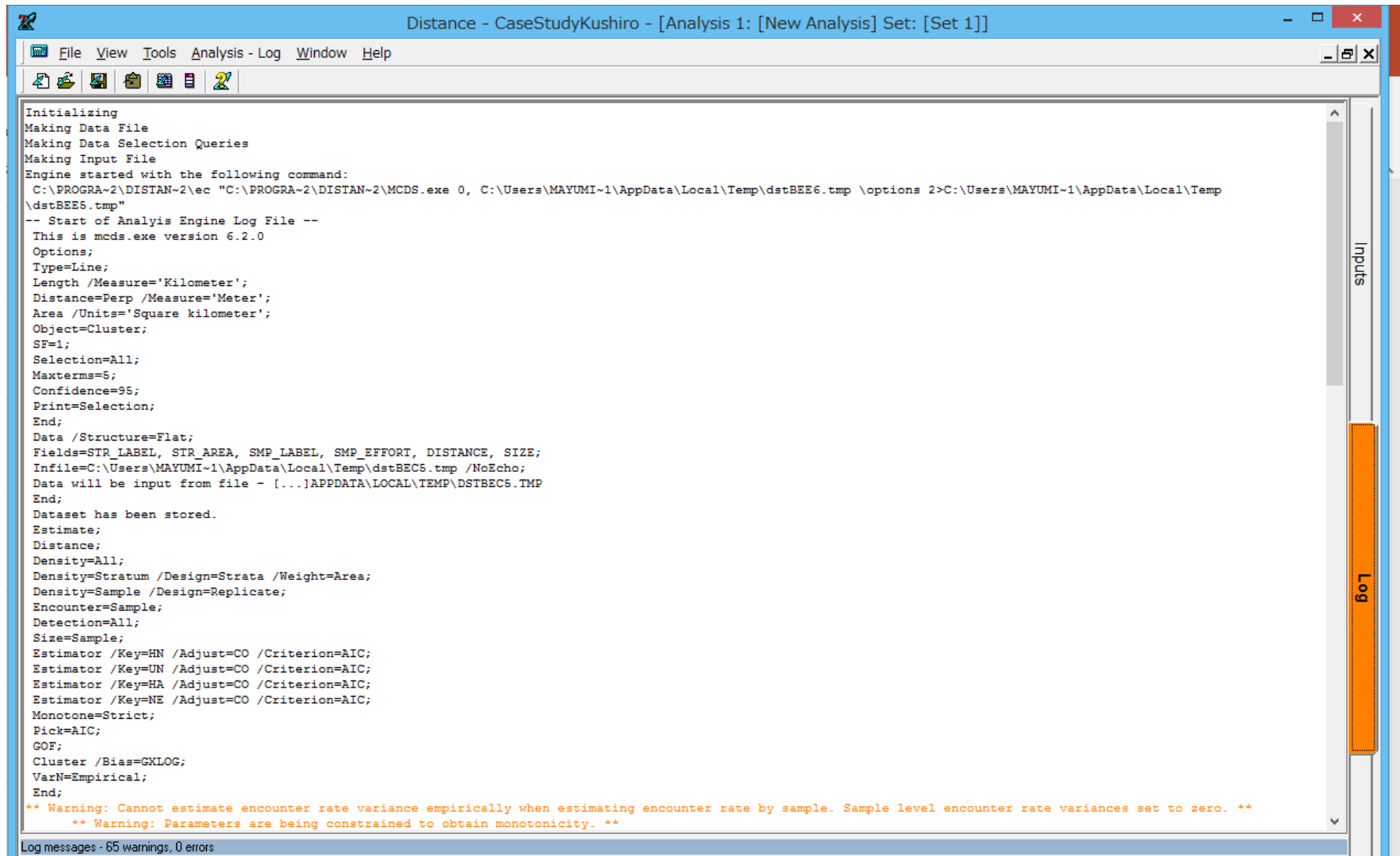


# Model Definition Propertiesの Miscについて

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。

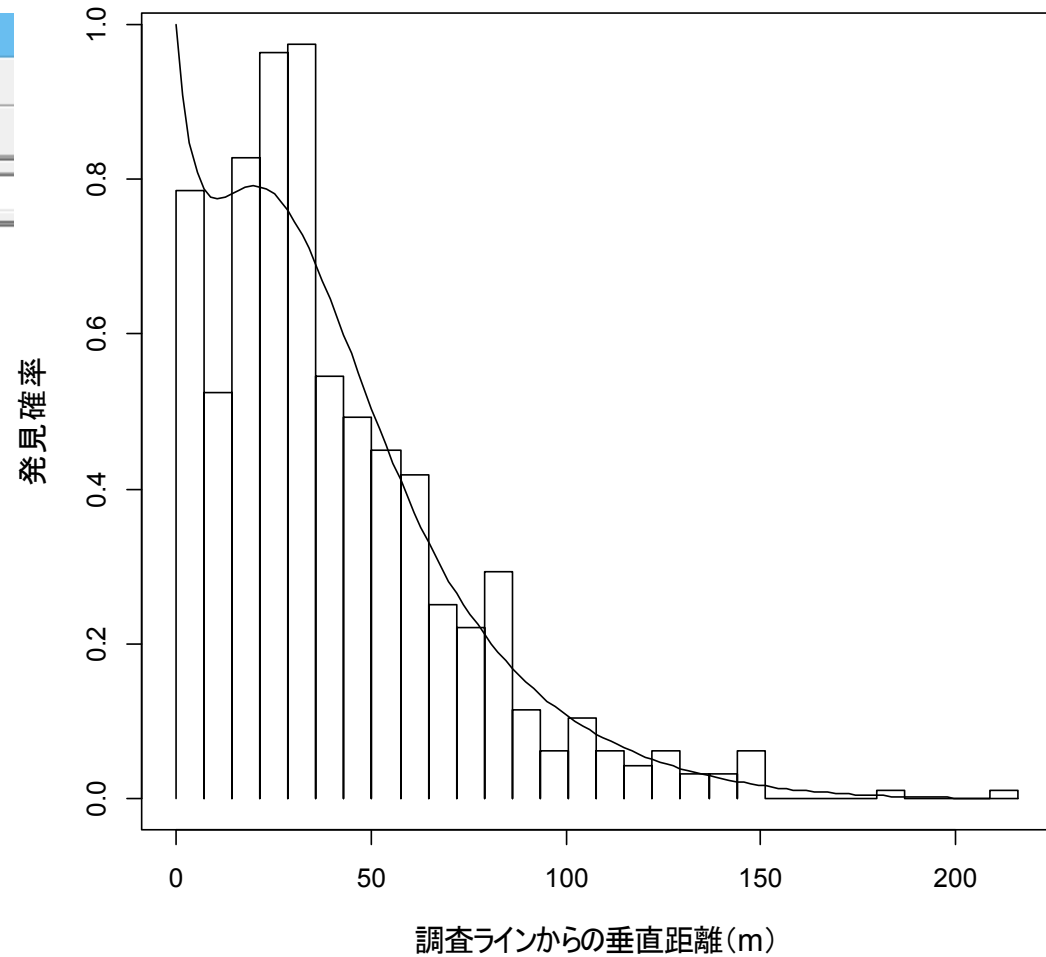
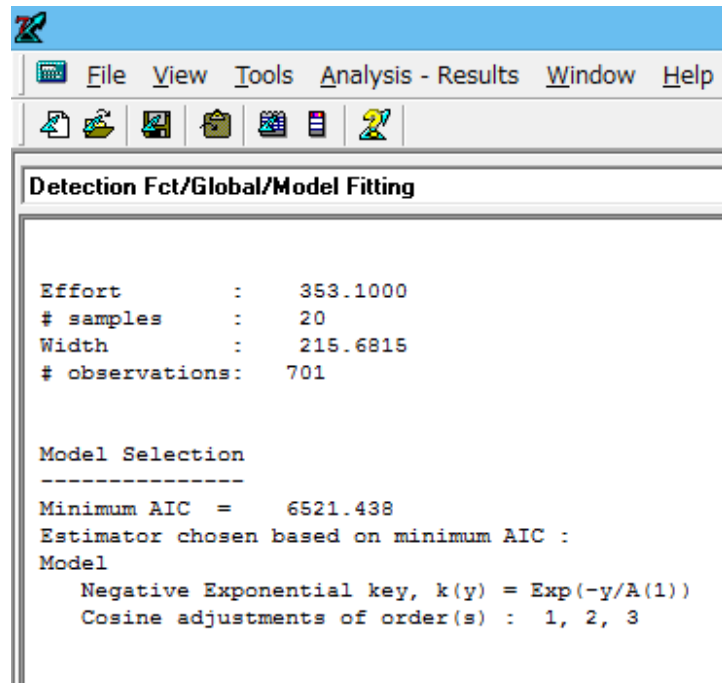
The screenshot shows the 'Model Definition Properties: [Default Model Definition]' dialog box. The 'Analysis Engine' is set to 'CDS - Conventional distance sampling'. The 'Misc' tab is selected, showing options for 'Presentation of results' (Two-sided confidence interval: 95%, Report results for each iteration of detection function fitting routine: unchecked) and 'Results files' (Create results details file: checked, File name: C:\Users\Administrator\Documents\DistanceF; Create results stats file: checked, File name: C:\Users\Administrator\Documents\DistanceS). The 'Smearing of distance data' section is also visible, with options for smearing radial line transect data before assigning to intervals, smearing angle parameter (phi), and proportion of distance parameter (s).

# 操作手順その4－結果

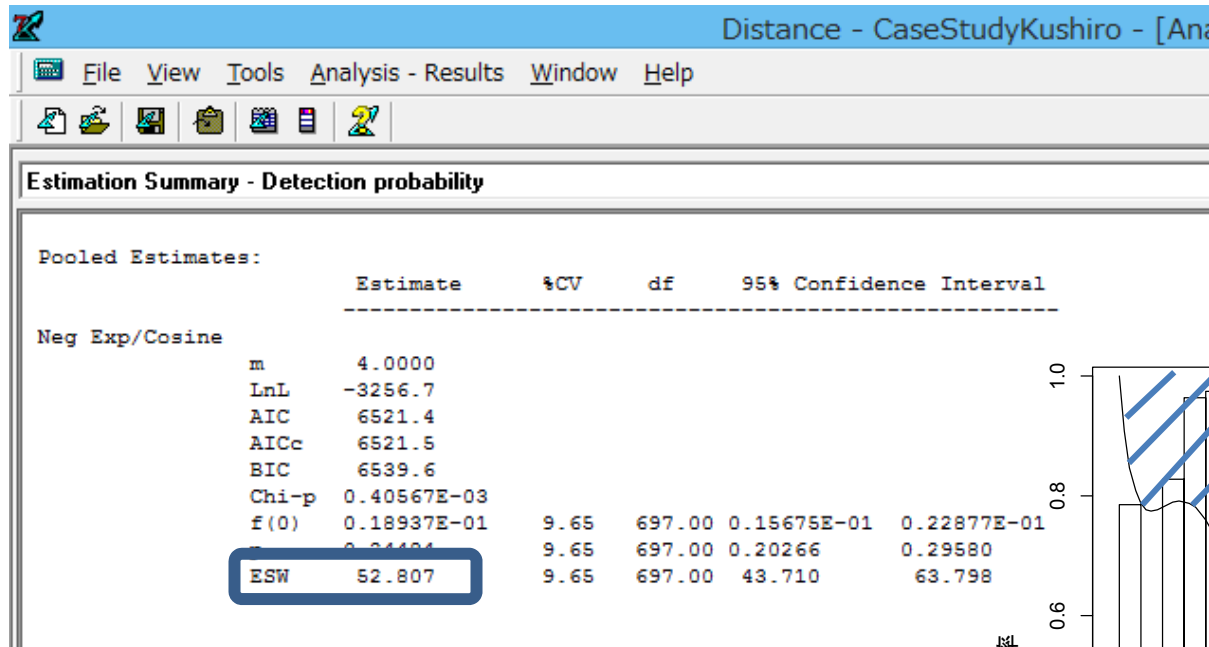


```
Distance - CaseStudyKushiro - [Analysis 1: [New Analysis] Set: [Set 1]]
File View Tools Analysis - Log Window Help
Initializing
Making Data File
Making Data Selection Queries
Making Input File
Engine started with the following command:
C:\PROGRA~2\DISTAN~2\ec "C:\PROGRA~2\DISTAN~2\MCDs.exe 0, C:\Users\MAYUMI~1\AppData\Local\Temp\dstBEE6.tmp \options 2>C:\Users\MAYUMI~1\AppData\Local\Temp\dstBEE5.tmp"
-- Start of Analysis 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\dstBEE5.tmp /NoEcho;
Data will be input from file - [...]APPDATA\LOCAL\TEMP\dstBEE5.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
```

# 発見確率モデルの推定



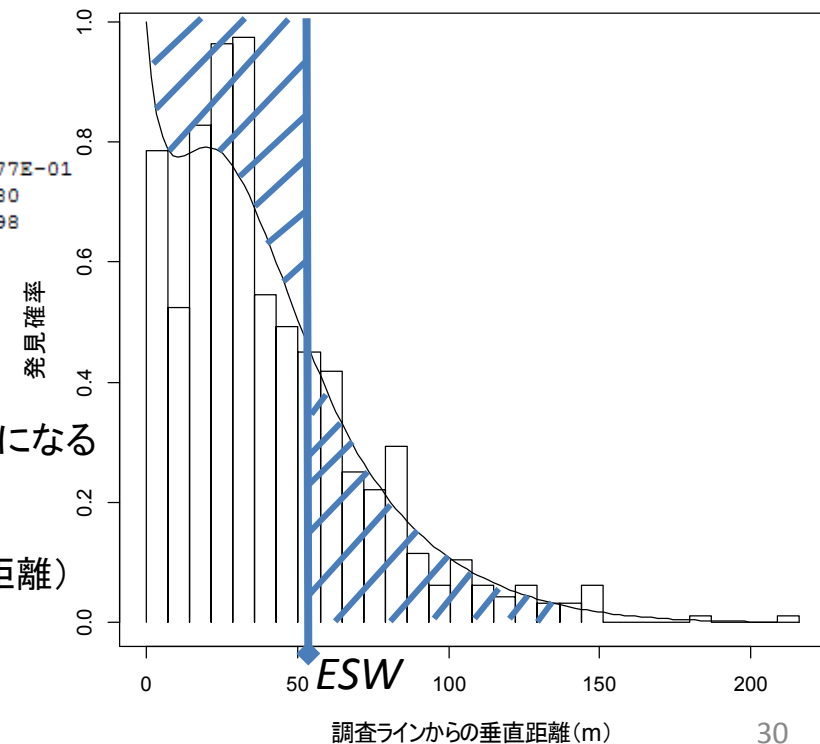
# 有効観察幅 (ESW)



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 ( $2 \times ESW \times$  調査距離)



# 推定密度と推定個体数

Distance - CaseStudyKushiro - [Ana]

File View Tools Analysis - Results Window Help

Estimation Summary - Density&Abundance

	Estimate	%CV	df	95% Confidence Interval	
Stratum: 1. Akkeshi					
Neg Exp/Cosine					
DS	18.551	14.46	0.00	13.995	24.592
D	31.179	16.64	0.00	22.550	43.110
N	2388.0	16.64	0.00	1727.0	3302.0
Stratum: 2. Hamanaka					
Neg Exp/Cosine					
DS	19.164	20.90	0.00	12.779	28.738
D	38.199	17.96	0.00	26.940	54.163
N	1738.0	17.96	0.00	1226.0	2464.0

D: 推定密度  
N: 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 Distance 7.0 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.