Menu-driven software series (No. 1)

CPUE_Manager (ver1.2.0) (2024) Manual

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https://www.esl.co.jp/products/menu

[MENU] is supported by Environmental Simulation Laboratory (Japan)

Contents

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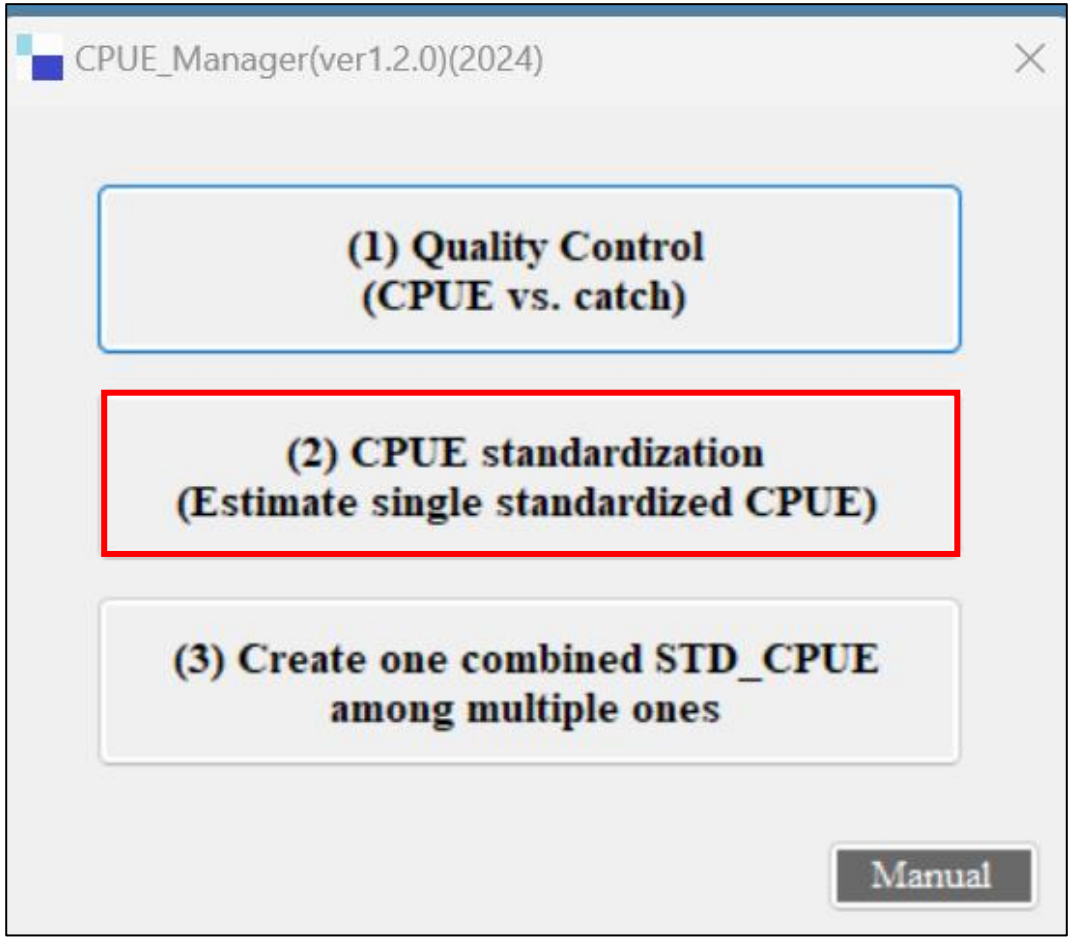
ACRONYMS

ANOVA	Analysis of variance
ASPIC	A Stock-Production Model Incorporating Covariates
ASPM	Age-Structured Production Model
B	Total biomass or Spawning Stock Biomass
B_{MSY}	Total biomass or Spawning Stock Biomass at MSY
CI	Confidence Interval
CPUE	Catch Per Unit Effort
EST	Estimated
F	Fishing mortality
F_{MSY}	Fishing mortality at MSY
GLM	General Linear Model or Generalized Linear Model
GPS	Global Positioning System
ICCAT	International Commission for the Conservation of Atlantic Tunas
IOTC	Indian Ocean Tuna Commission
JABBA	Just Another Bayesian Biomass Assessment
LRP	Limit Reference Point
MCMC	Markov Chain Monte Carlo methods
MSY	Maximum Sustainable Yield
OBS	Observed
QC	Quality Control
RFMO	Regional Fisheries Management Organization
SA	Stock assessment
SAS	Statistical Analysis System
SB or SSB	Spawning Biomass or Spawning Stock Biomass
SB_{MSY} or SSB_{MSY}	Spawning Biomass or Spawning Stock Biomass at MSY
SPSS	Statistical Package for the Social Sciences
SRA	Stock Reduction Analysis
SS3	Stock Synthesis 3
TB	Total Biomass
TB_{MSY}	Total Biomass at MSY
TRP	Target Reference Point
Y/R	Yield per Recruit

1. About : New CPUE_Manager

- The new CPUE has 3 menus.
- The previous CPUE standardization was <u>one independent software,</u>
- It is now in the 2nd menu of the new CPUE_Manager



2. Requirements for PC and Important remarks (1/3)

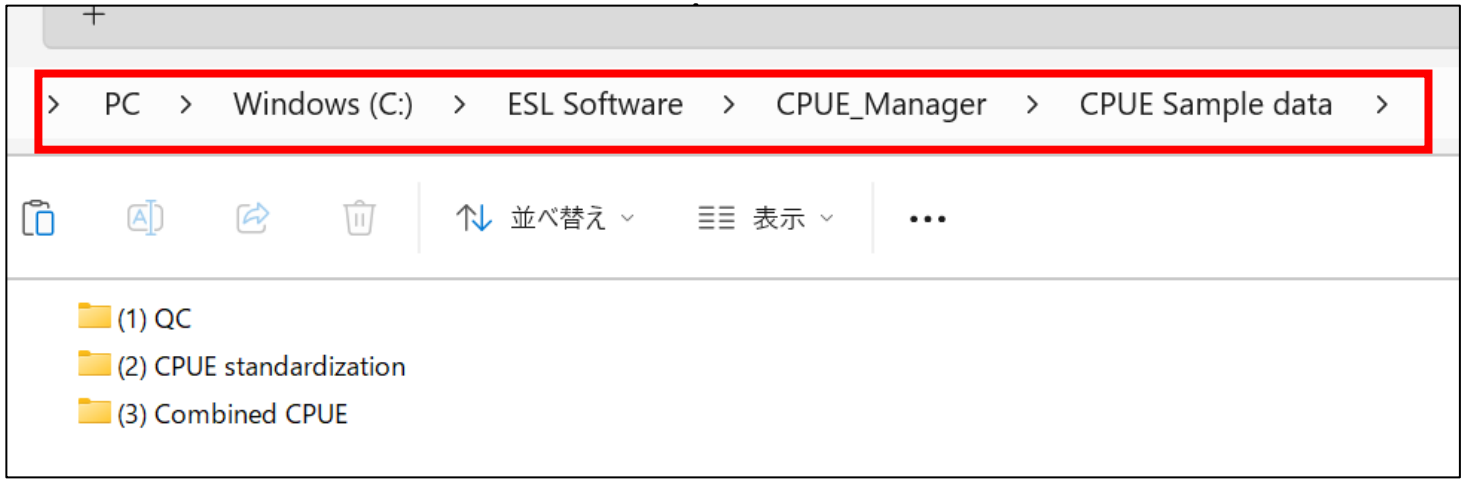
(1) Requirements for PC

- Operation System: MS window 10 or 11 and NOT applicable for MAC (apple) PC.
- 64bit PC.
- RAM: minimum 2GB.
- Basic software (Word, Excel and Notepad)
- R programming language for window (R-4.3.1-win) needs to be installed in advance. Its size is 80MB (zipped) and 180MB (unzipped).
- To make smooth operations, users need at least 30% of empty space of the hard disk.

2. Requirements for PC and Important remarks (2/3)

(2) Important remarks (CPUE sample data)

This manual uses the sample excel data for demos (below). Users can use the sample data for



In the past, albeit rare, excel files could not read under windows

driven by Indonesia & Malaysia languages.

In such case, change to the English window and/or make the same data by your PC.

2. REQUIREMENTS FOR PC AND IMPORTANT REMARKS (3/3)

(3) Other Important remarks

- **Manual**

This PowerPoint is the manual. Manul call button is available.

- **Keep the original files** (important)

Don’t use original files. Make copies & use copies as work files like wk1, wk2, etc.

- **Operation by mouse**

Manual explains operations based on “mouse”.

For “touch panel” or “key board”, follow corresponding manipulations.

- **Save**

Save files frequently.

- **Engines (programs and applications) underpinning this software**

- Microsoft Visual Studio (2019)
- Graphics: C# and. NetFrameWork4.7.2
- R-4.3.1-win (2023)

3. Installation (2 application)

Before installation, uninstall old versions

(1) CPUE_Manager

Please get the installation link from the [MENU] Secretariat at menu.soft.SEC@gmail.com

(2) R-4.3.1-win

Go to https://cran.r-project.org/bin/windows/base/

Then download from Download R-4.3.1 for Windows

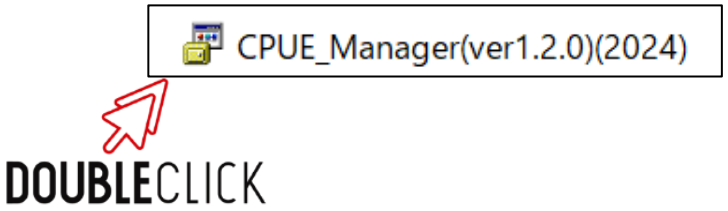
3. Installation: CPUE_Manager

Double click the zipped installer (located folder or desktop)

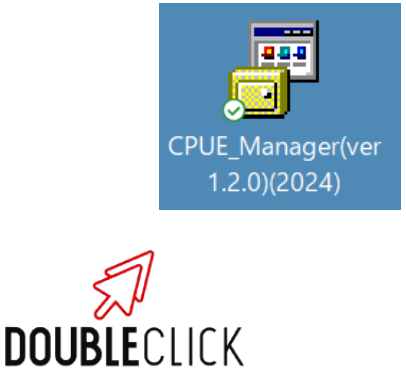
Users can get the download link of the software

from the [MENU] Secretariat at menu.soft.SEC@gmail.com

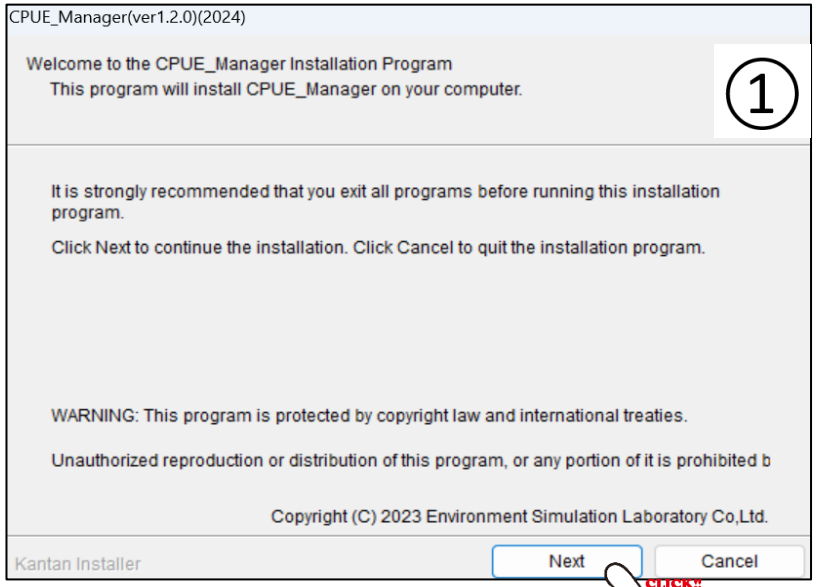
Installer (folder)

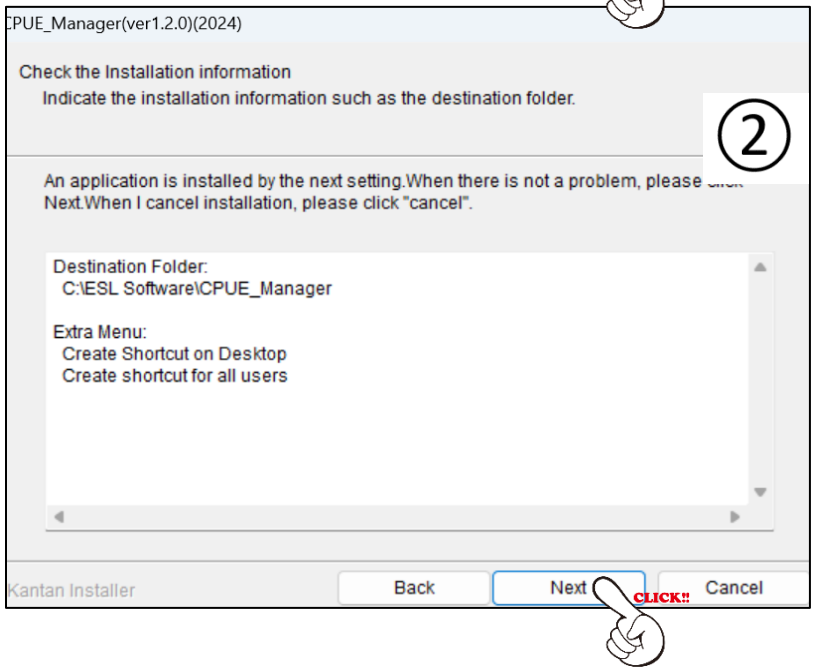


Installer (desktop)

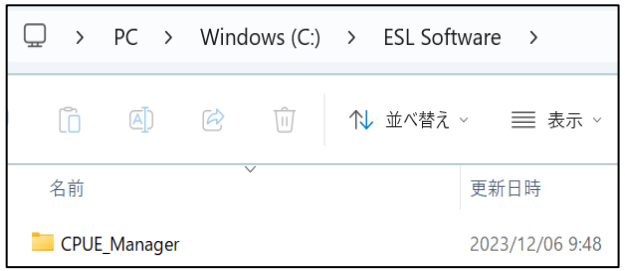


3. Installation_CPUE_Manager: 4 steps

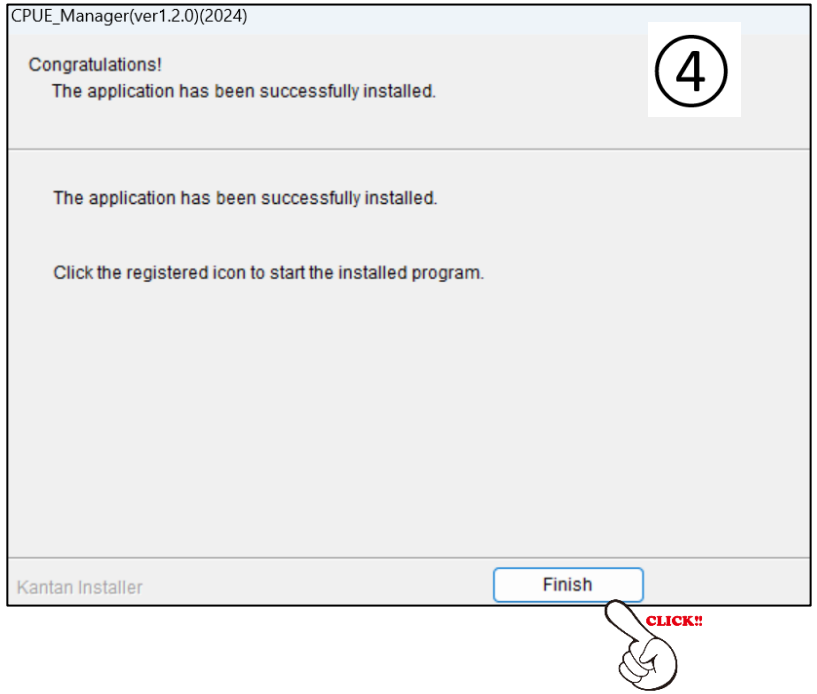




If destination folder “ESL software” exits, this window will not appear.



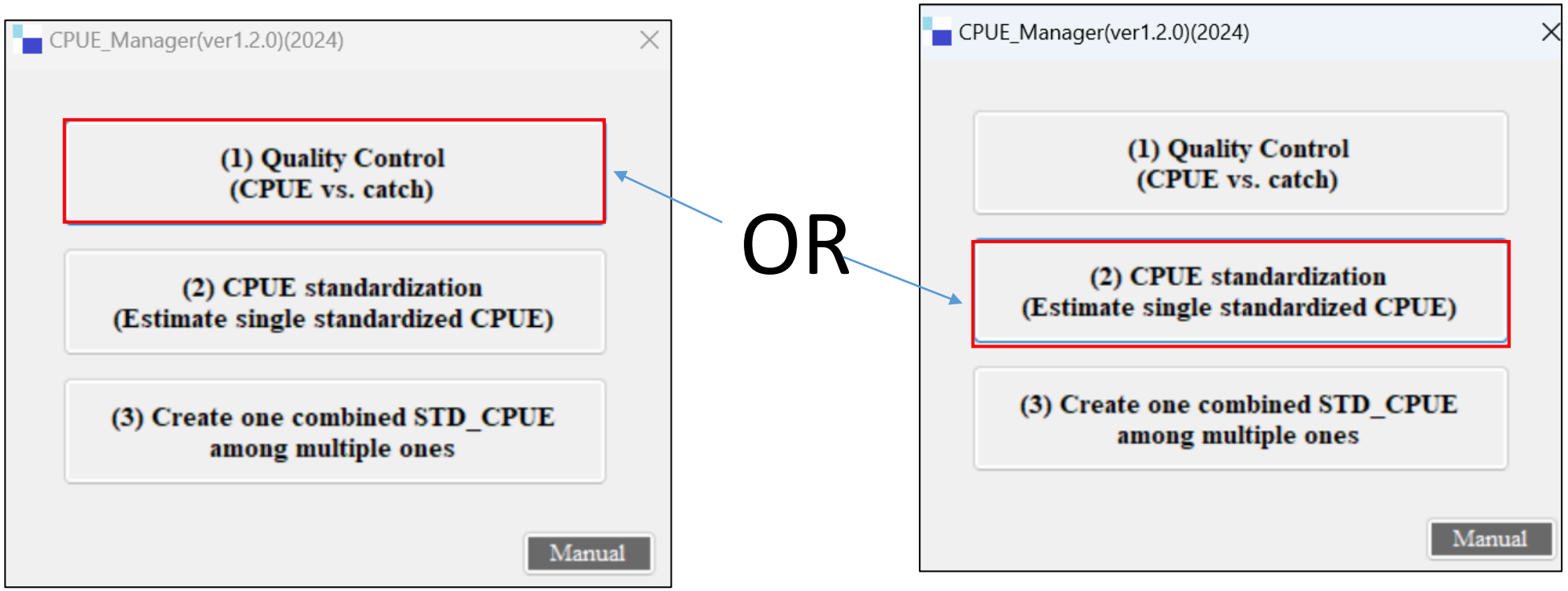
Users will get
the CPUE_Manager folder.



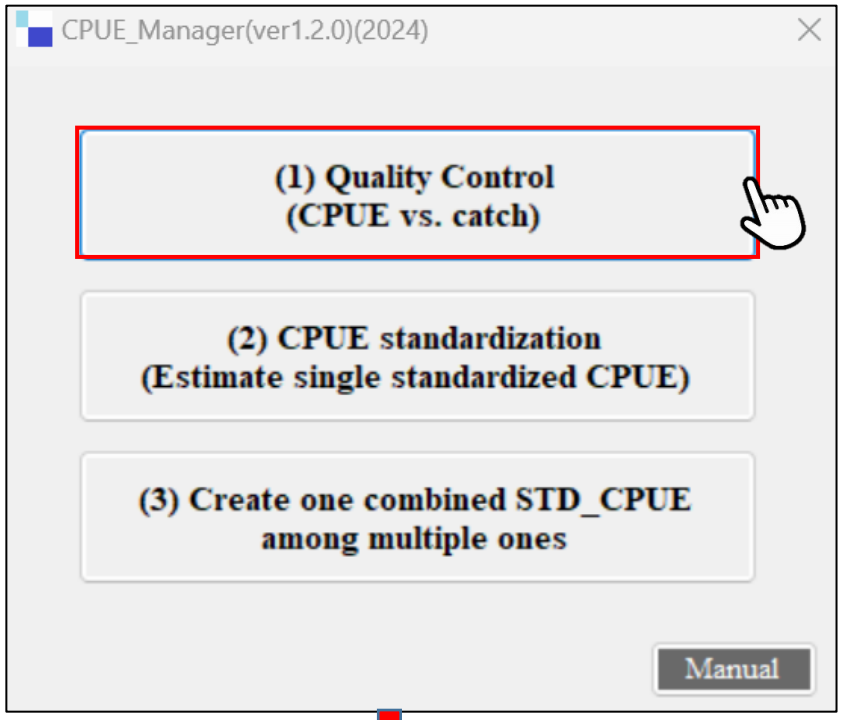
3. Installation: Linking R to CPUE_Manager (2 ways)

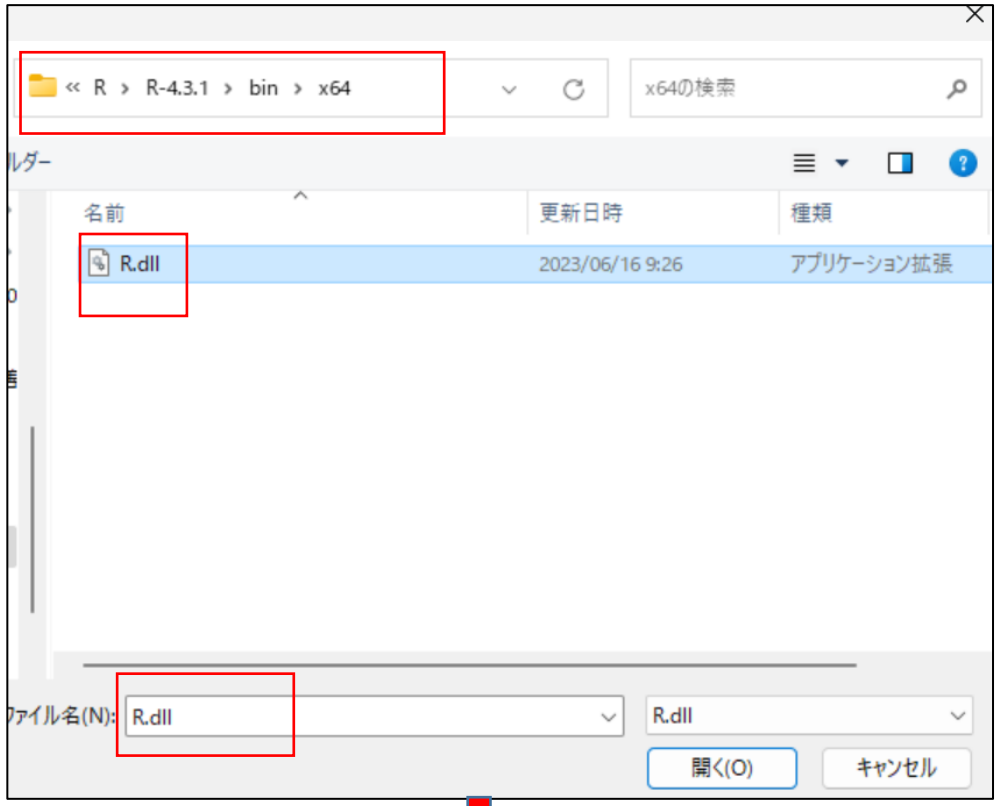
(1) Quality Control (see next slide #12)

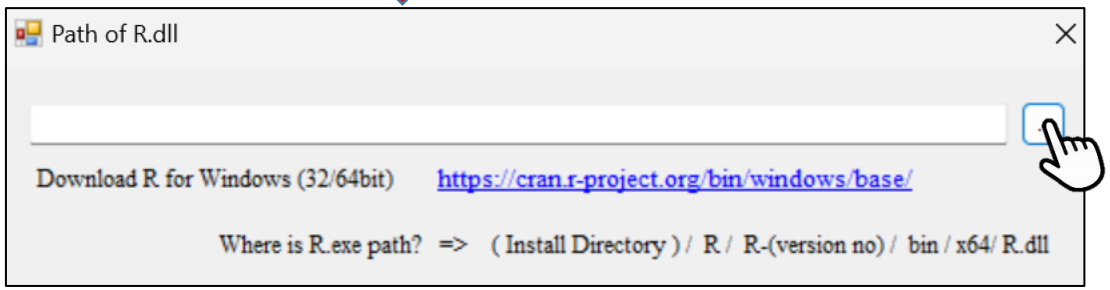
or (2) CPUE standardization (see slide # 13)

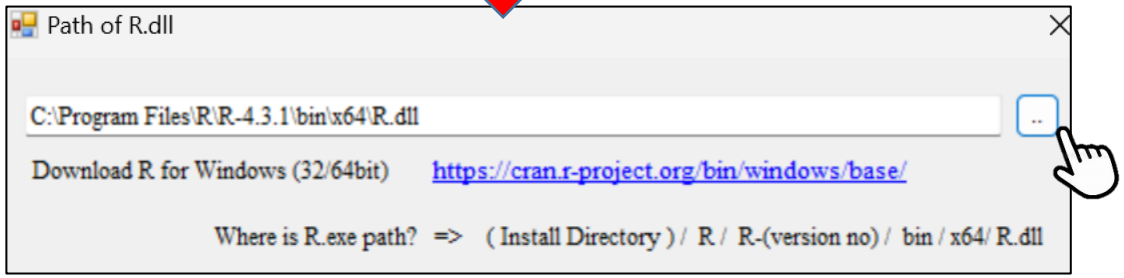


3. Installation : Linking R to CPUE_Manager from menu (1) Quality Control







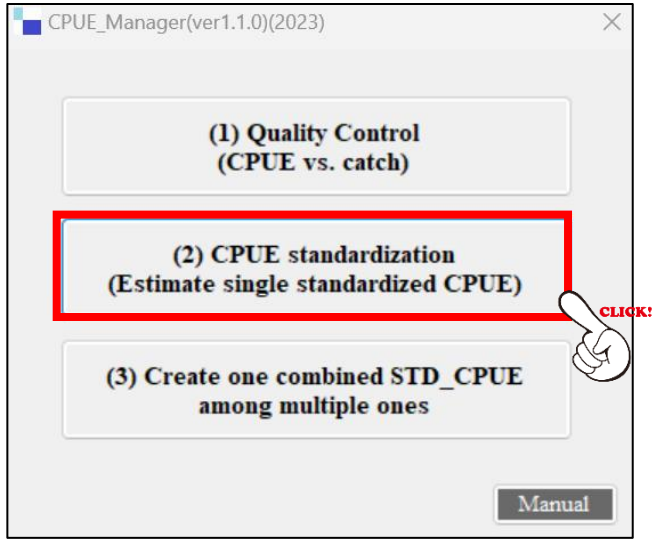


Confirmation window

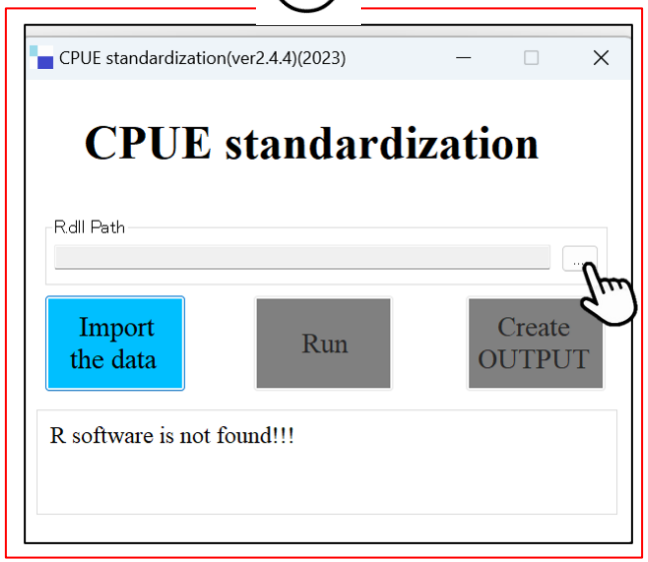
3. Installation

Linking R to CPUE_Manager from menu (2) CPUE standardization
改定

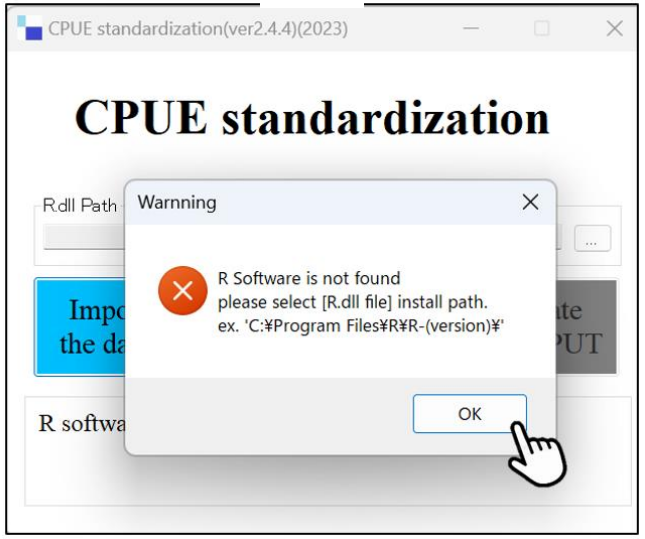
①



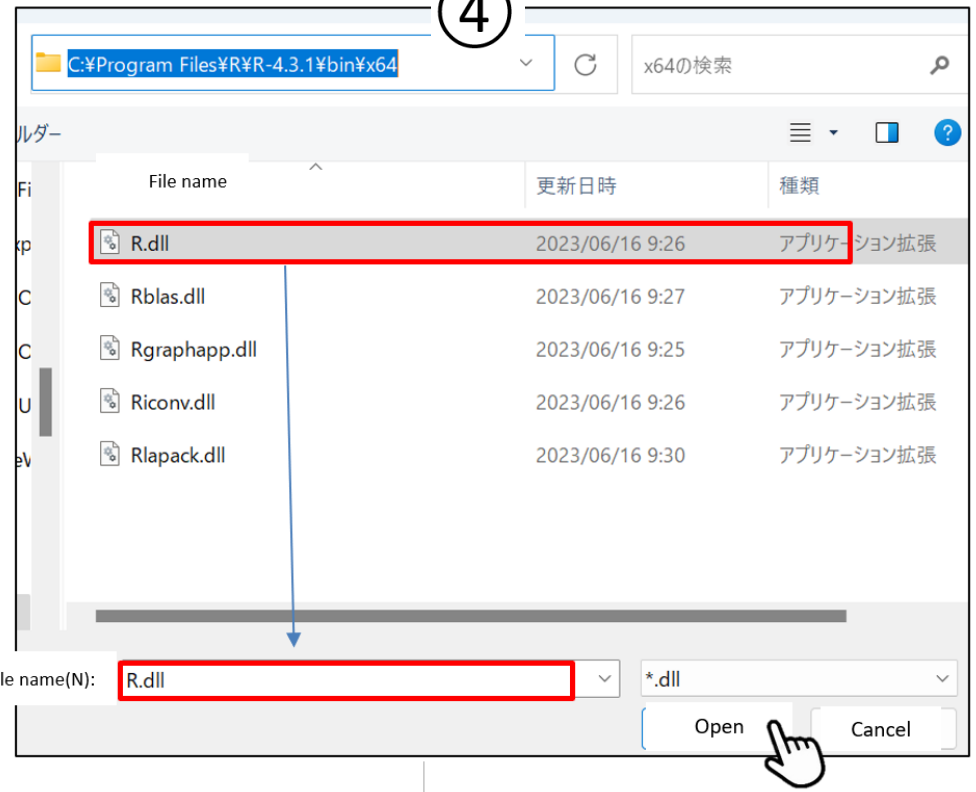
②



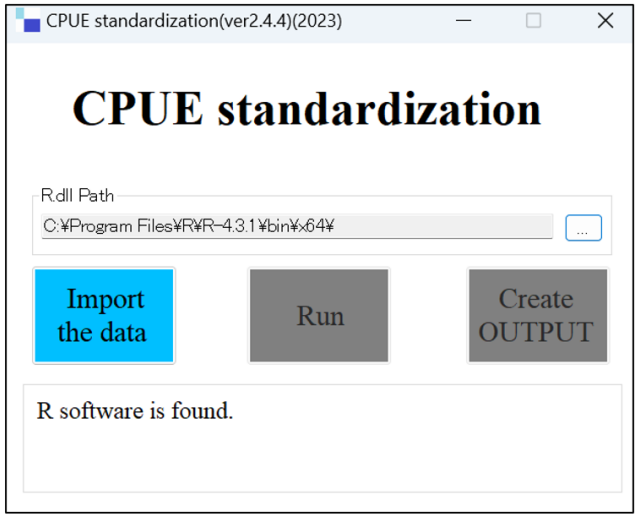
③



④



⑤



4. [1st menu] Data Quality Control (QC)

QC (data massage)

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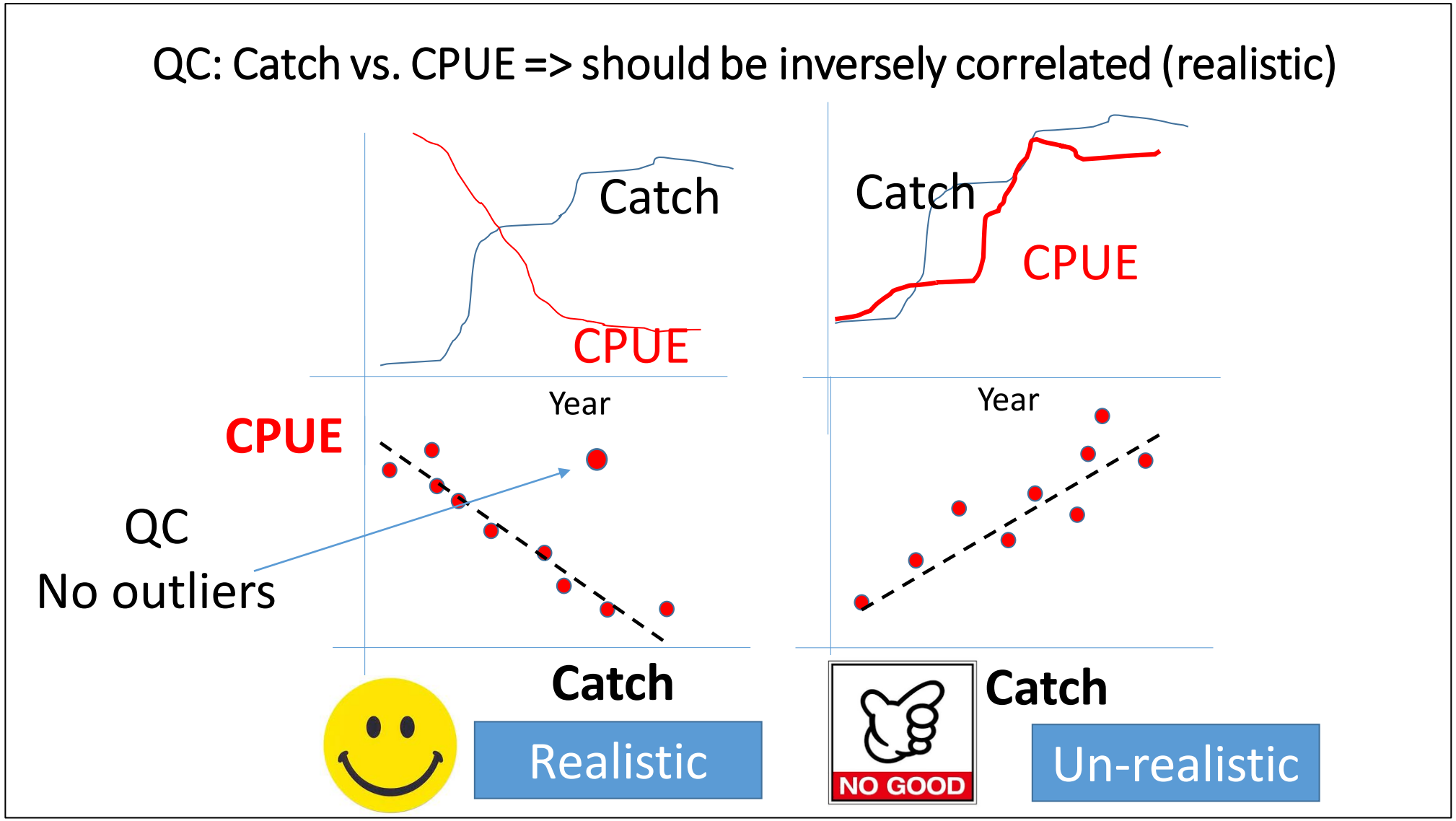
4. [1st menu] Data Quality Control (QC) : CPUE vs Catch

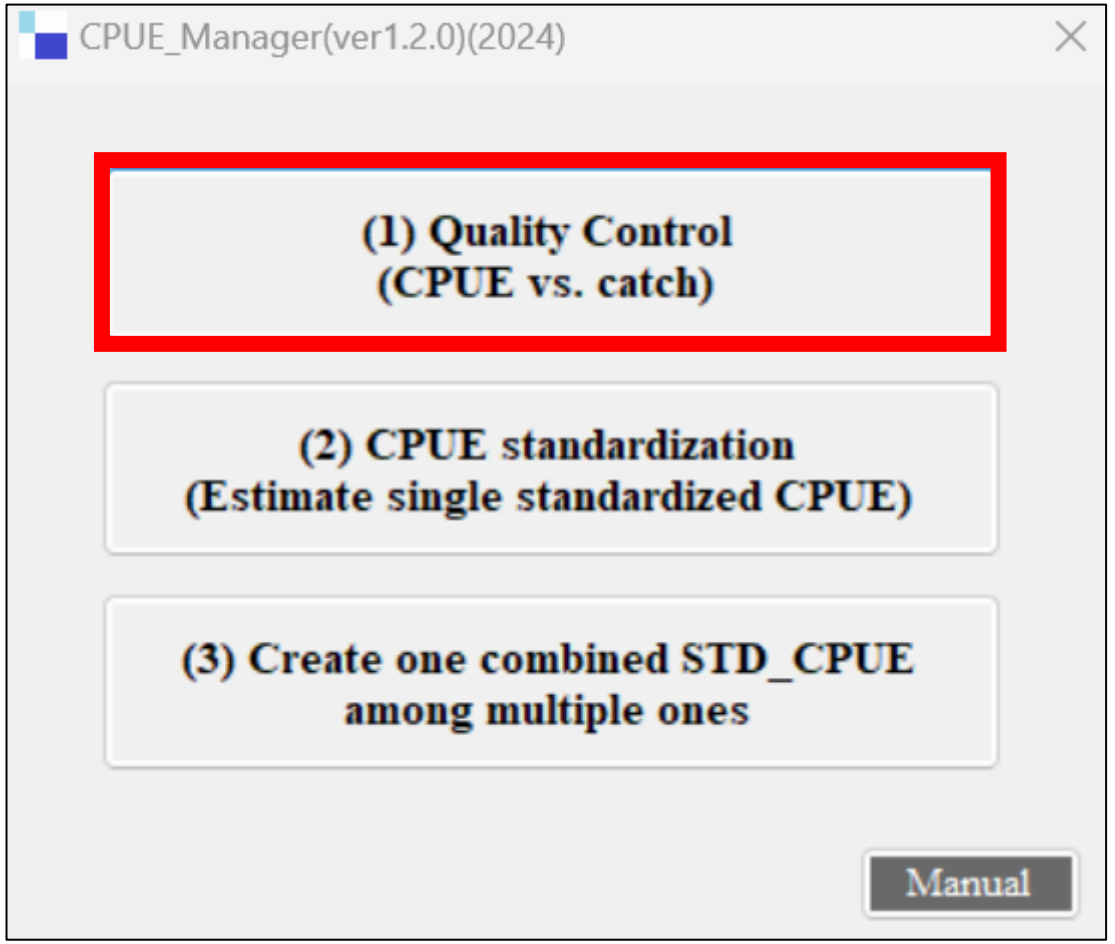


4. [1st menu] Data Quality Control (QC)

To check
relations between CPUE vs. Catch
if there are….
(a) Negative correlations & (b) Outliers

2 ways to do QC based on graphs:
(1) Eye-ball judgments and/or
(2) Statistical judgements
using Prediction Interval(PI)
(for example, 95% PI for predictions)

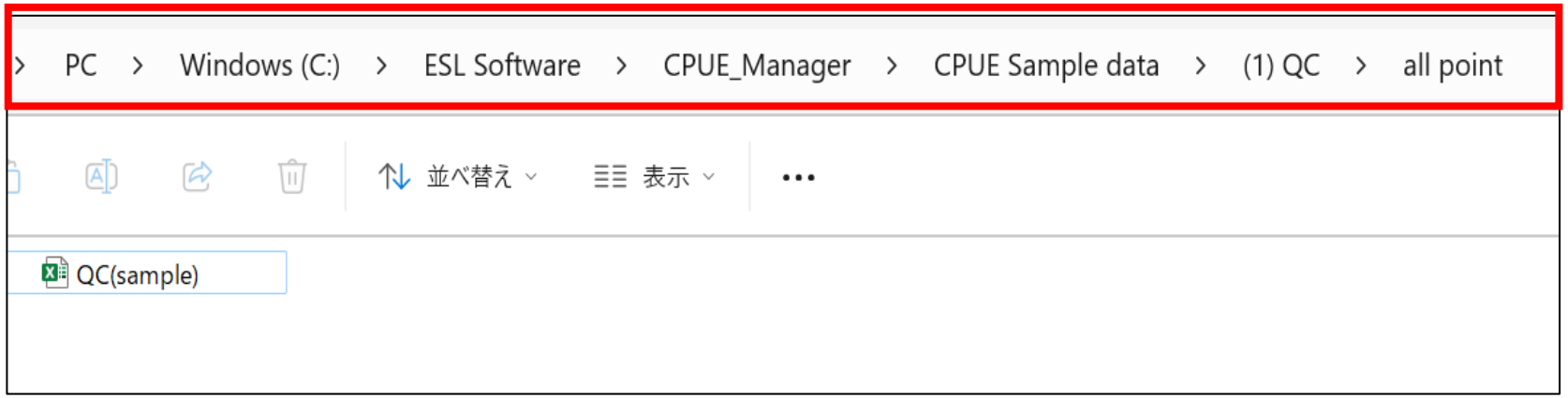
Method (2) will be explained here
using menu (2)



4. [1st menu] Data Quality Control (QC)

Prepare the input data (excel or .csv)

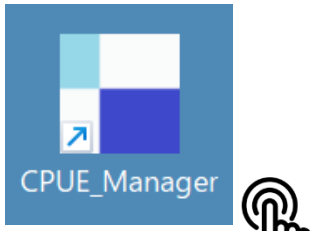
3 variables (year, CPUE, Catch)



	A	B	C
1	year	CPUE	Catch
2	1963	1052	10190
3	1964	380	11258
4	1965	240	8652
5	1966	229	9349
6	1967	278	9107
7	1968	220	9172
8	1969	197	9203
9	1970	219	9495
10	1975	350	8839
11	1976	309	6696
12	1977	337	6409
13	1978	445	11835
14	1979	316	11937
15	1980	252	13558
16	1981	231	11180
17	1982	283	13215
18	1983	222	14527
19	1984	213	12791
20	1985	203	14383
21	1986	195	18486
22	1987	177	20236
23	1988	178	19513
24	1989	171	17250
25	1990	167	15672

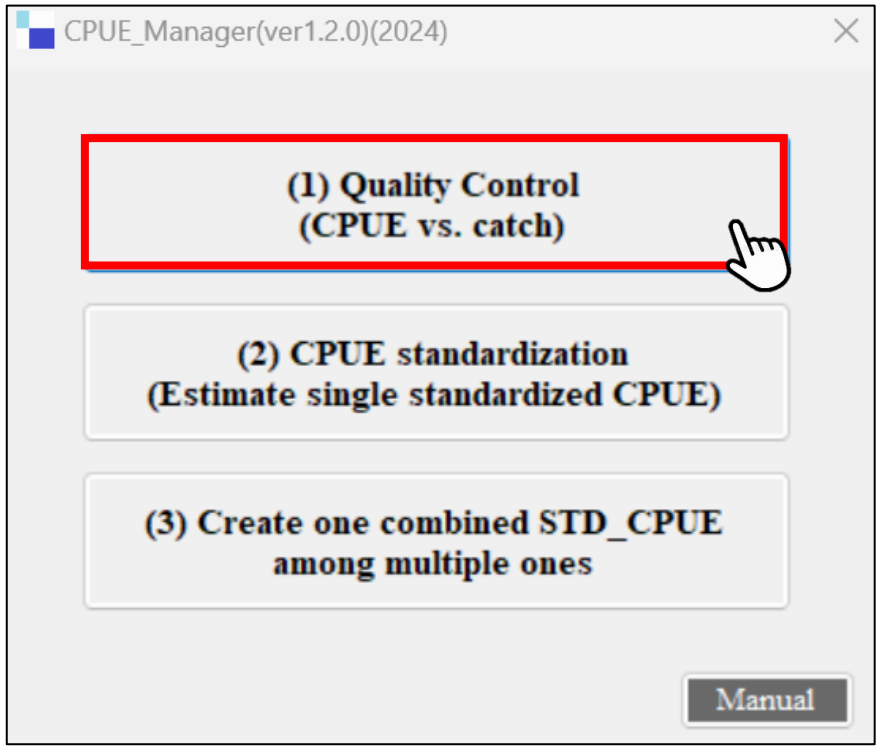
4. [1st menu] Data Quality Control (QC)

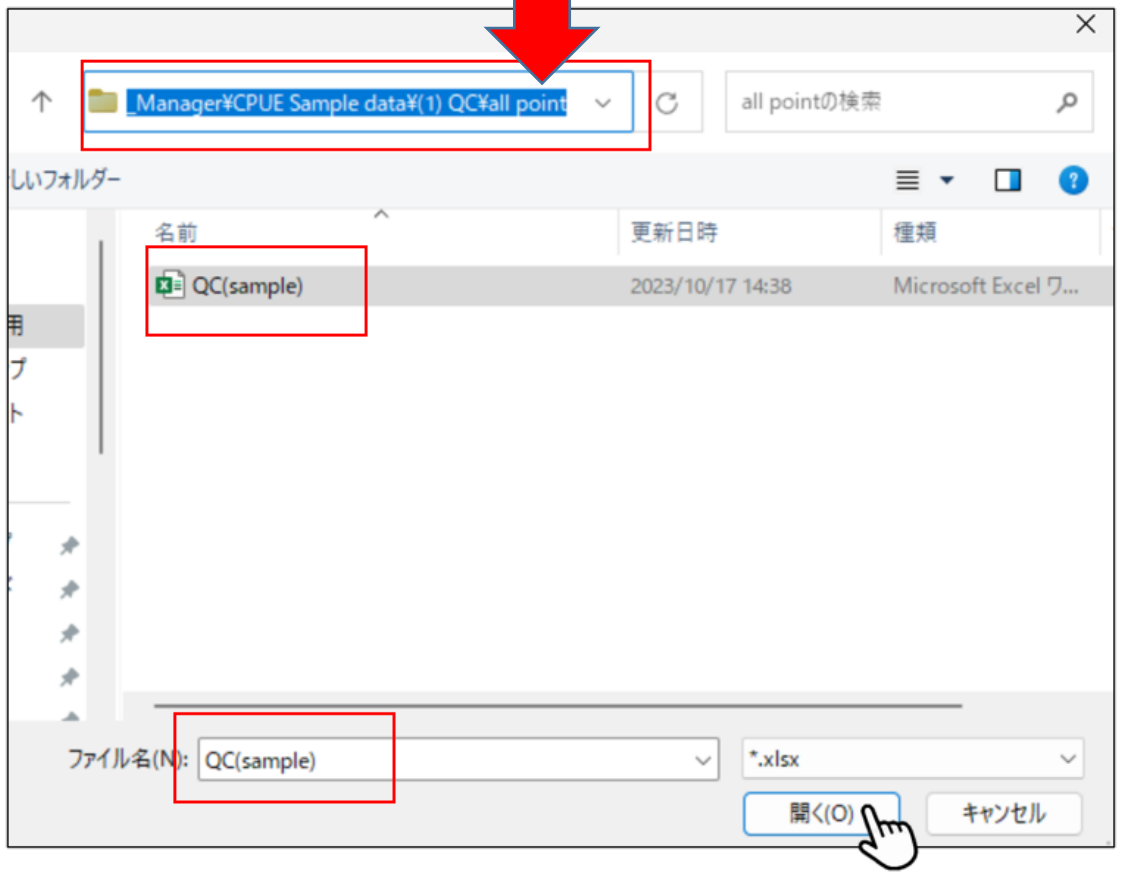
Practice using the sample data ➔ Import the QC(sample) excel file



Remarks

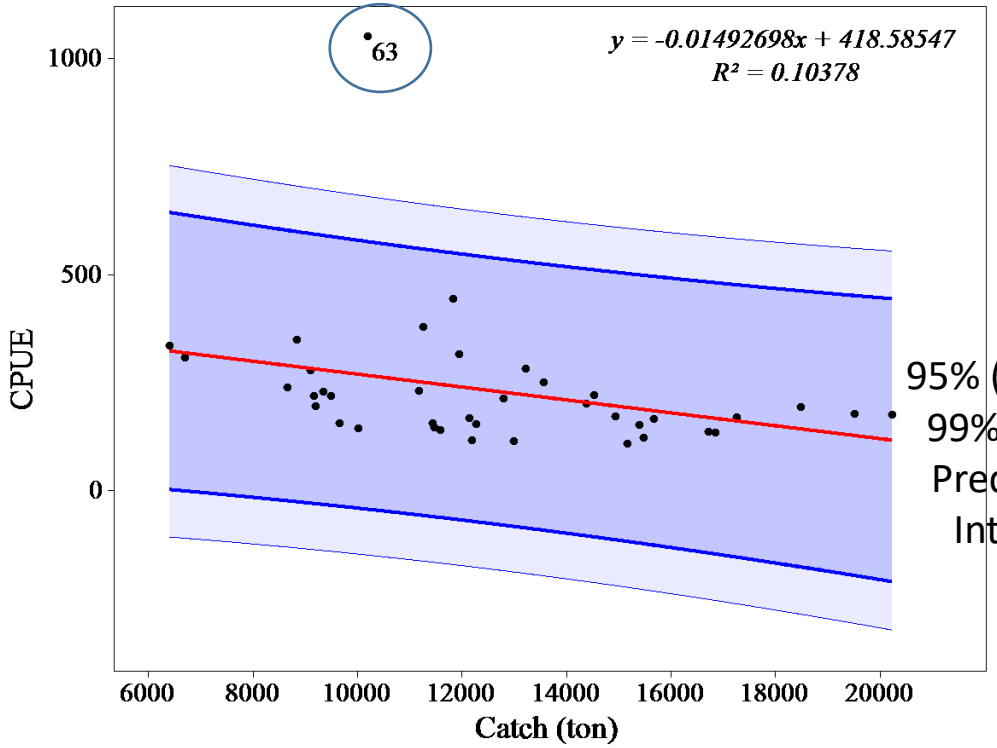
If users use this software at the 1st time, the window requests to link R language to this software, will appear.
In such case, follow steps explained in Slide # 13.





After clicking Open (previous slide), a graph (below) will appear.

4. [1st menu] Data Quality Control (QC)
Practice using the sample data



95% (dark) & 99% (light) Prediction Interval

From the graph

(1) OK for negative CORR (visually and also from the equation➔ negative)

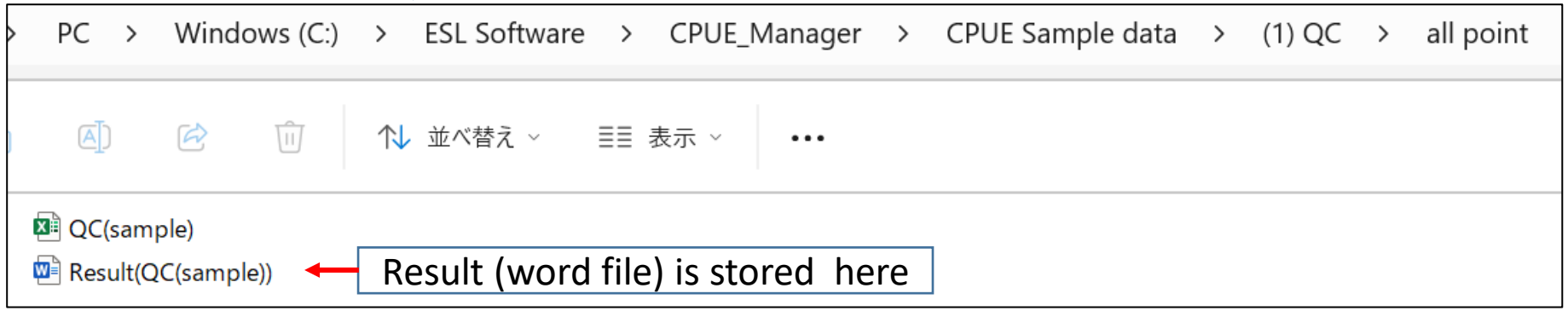
(2) One outlier detected

Such outlier produces biased relations, especially when the sample size is small.

↓

Need to remove

(see next slide)

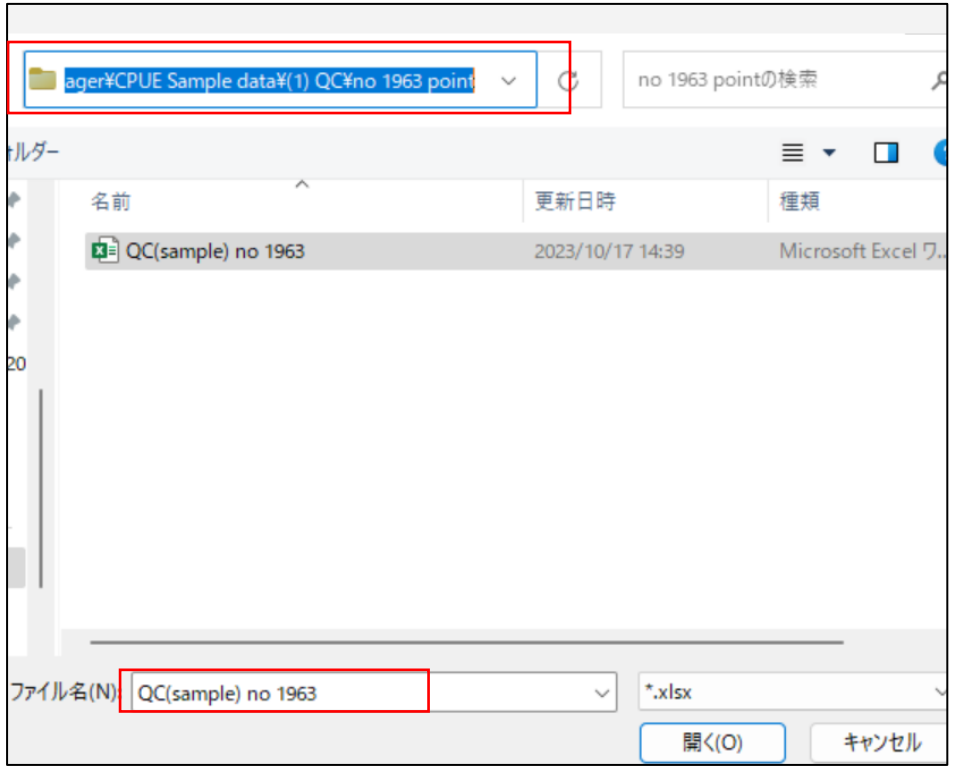


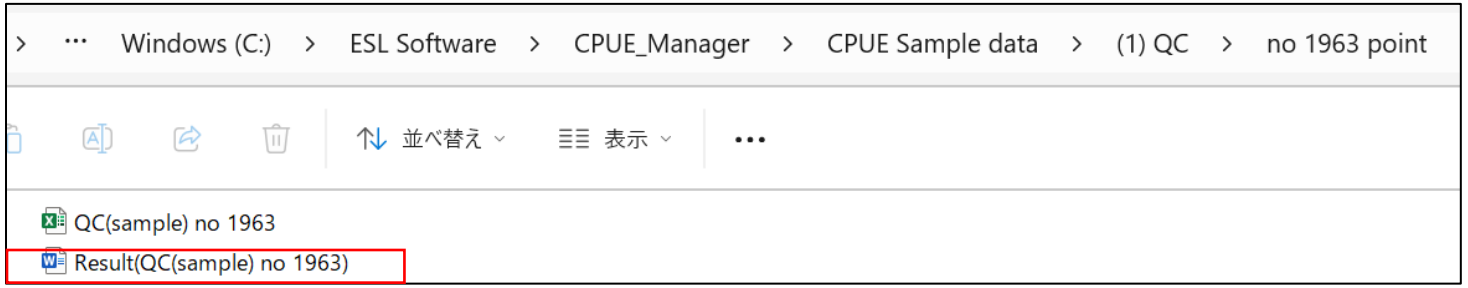
Result (word file) is stored here

4. [1st menu] Data Quality Control (QC) :Practice using the sample data
Further QC without 1963

Make a new excel file, “QC(sample) no 1963”
without the 1963 data point
in the new “no 1963 folder”

Repeat the same operation as before.
Then users get the new result
in the word file (below).



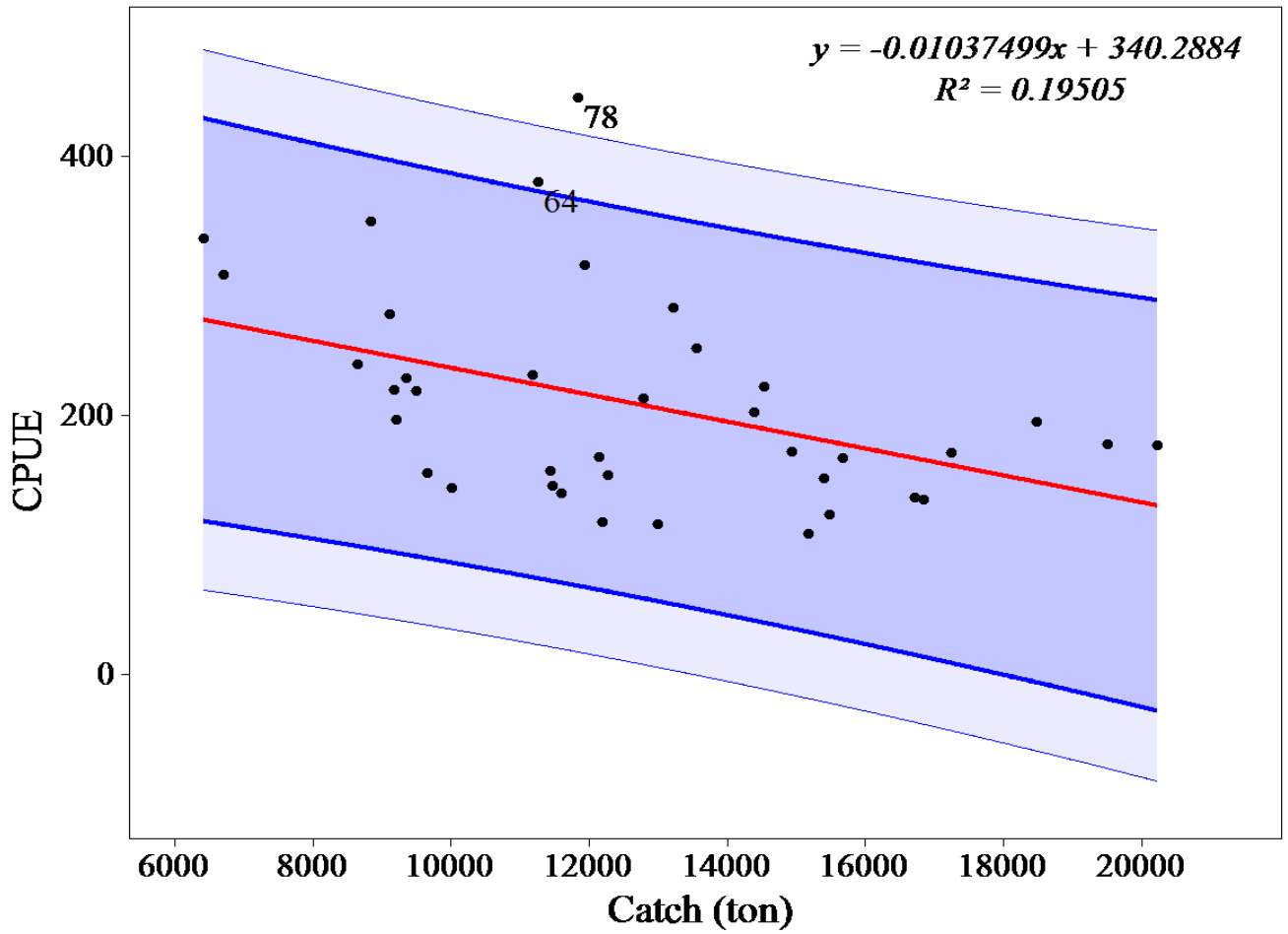


See the next slide for the new graph

4. [1st menu] Data Quality Control (QC)

Practice using the sample data ➔ Results

After removal of one outlier (1963)



RESULTS

Negative CORR relation

<u>is improved</u>, i.e.,

r2 increased (10% to 20%)

No need to remove

the 1978 point as close to

the 99% Confidence band.

4. [1st menu] Data Quality Control (QC)

Handling CPUE & catch data with outliers

Outliers mean that CPUE, catch or both are incorrect.
But we don't know which ones are incorrect.
Thus, we have 3 options.

(1) Both Catch & CPUE should not be used (conservative method)
(2) Use catch but don't use CPUE if users know catch data is reliable.
(3) Use CPUE but don't use catch if users know CPUE is reliable.

Decisions will be made by users as they know quality of the data.

4. [1st menu] Data Quality Control (QC)

QC for the original data set (catch and CPUE)

This is not included in the 1st menu.

Thus users need to do it by themselves.

Original data set includes following variables (example)

➔year, month, day, boat name set, area (e.g. grid, fishing grounds), depth, catch, effort, CPUE, weather etc.

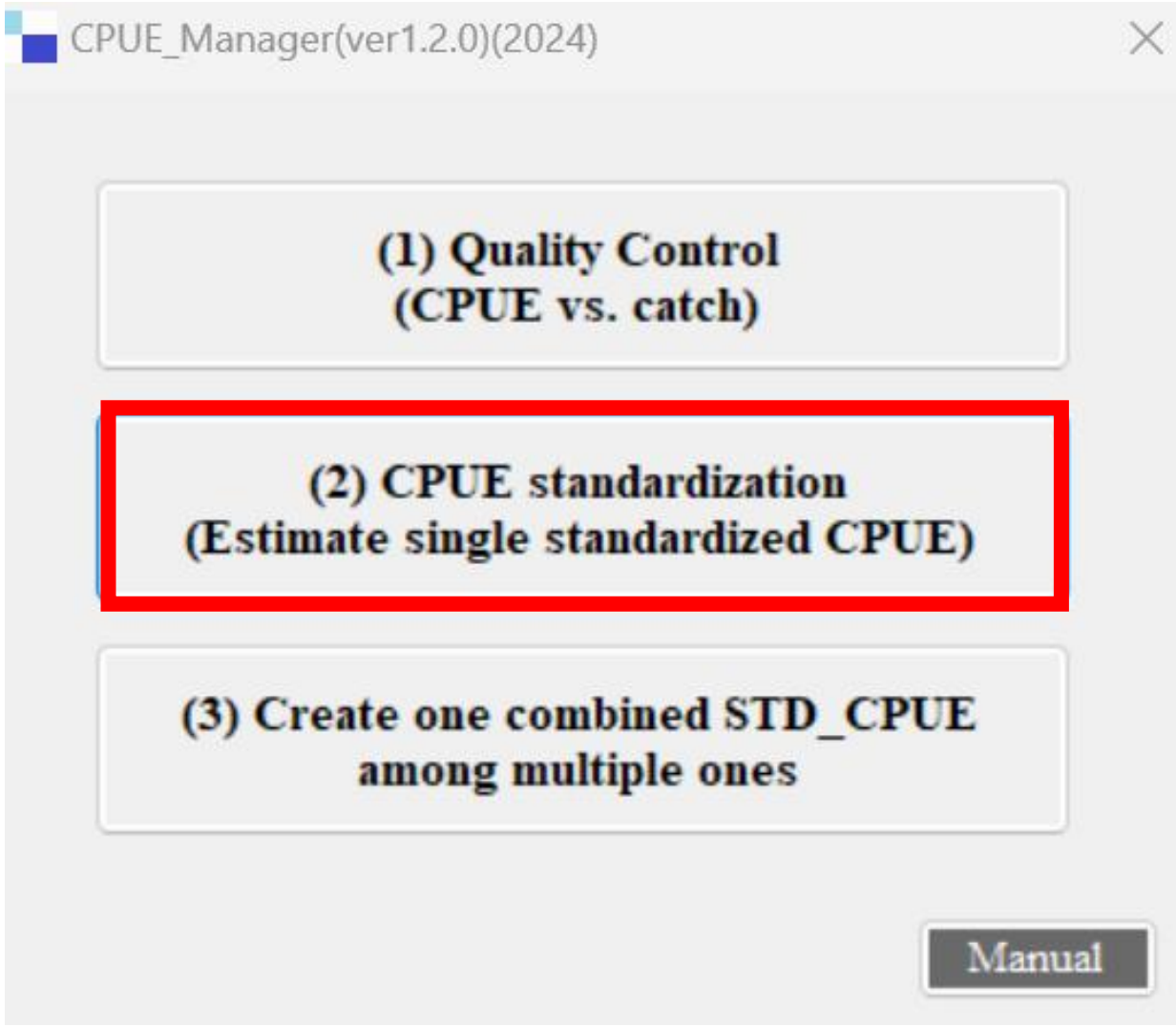
4. [1st menu] Data Quality Control (QC)

QC for the original data set (catch and CPUE)

Try standard QC methods

- Check outliers (catch, effort, CPUE, depth and others) (entry errors)
- Check ranges (e.g. if 1<=month<=12)
- Spatial check by mapping (e.g. if catch/effort is not from land)
- Check typos for names (e.g., boat, gear)
- Other ad hoc QC

5. [2nd menu] CPUE standardization



5.1 Why we need CPUE standardization?

- Nominal (raw) CPUE
  ➔ Bias➔ not real abundance index ➔ not good for SA

- Major bias affected by ➔ Y(Year), S(Season) & A(Area)
  Other bias by ➔ target, ENV, gear, vessel, skipper, mesh size, etc.
  ➔Could be explained by YSA because biases are reflected by time & area

- Thus, 3 Covariates (=factors) (Year, Season & Area)
  ➔ OK as for crude CPUE standardization

5.2 Creating input data
Input data (Excel or CSV) 3 Covariates and nominal CPUE

Covariates (independent variables)
A: **YR** (year)
B: **S** (season): **Q** (quarter), **M** (month) or **S** (Semi-annual)
C: **Area**

Dependent (Response) variable
D: **CPUE** (nominal CPUE)

Example

	A	B	C	D
1	Year	Q	Area	Nominal CPUE (Kg/hour)
2	2011	4	North	83.08
3	2011	4	North	48.00
4	2011	4	North	48.00
5	2011	4	North	48.00
6	2011	4	North	9.38
7	2011	4	North	9.38
8	2011	4	North	9.38

Remarks
(important)

3 covariates are normally Year, Season and Area.

Year is essential as we need to estimate annual standardized CPUE.

However, we can use "mesh size", "boat size" (for example) instead of Season and/or Area, if they are not important (no significant).

5.2 Creating input data
Why only 3 Covariates?

(1) This software is for developing countries➔ data are limited

(2) Basic & general philosophy of menu-driven software

➔ simple for beginners and non-technical users

(3) Year, season and area

➔likely cover other anomalies of q (to some extent)

(mesh size, boat size, targeting, ENV, skipper, gear, boat, etc.)

(4) However, other covariates (see above) with strong statistical significances can be used instead of Season and/or Area if the situation is allowed.

5.2 Creating input data

Missing data

Season & area(example) ➔ use “▪”

Year➔ skip (no data entry)

	A	B	C	D
1	Year	Q	Area	Nominal CPUE (Kg/hour)
2	2011	4	.	83.08
3	2011	4	.	48.00
4	2011	4	.	48.00
5	2011	4	.	48.00
6	2011	4	.	9.38
7	2011	4	.	9.38
8	2011	4	.	9.38

	A	B	C	D
1	Year	Q	Area	Nominal CPUE (Kg/hour)
2	2011	.	North	83.08
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4	2011	.	North	48.00
5	2011	.	North	48.00
6	2011	.	North	9.38
7	2011	.	North	9.38
8	2011	.	North	9.38

	A	B	C	D
1	Year	Q	Area	Nominal CPUE (Kg/hour)
2	2011	.	.	83.08
3	2011	.	.	48.00
4	2011	.	.	48.00
5	2011	.	.	48.00
6	2011	.	.	9.38
7	2011	.	.	9.38
8	2011	.	.	9.38

5.3 Attributes of 3 covariates and nominal CPUE

Attributes

3 Covariates (year, Season & Area) & Nominal CPUE

- Year : Western (Christian) year (AD) 2023, 1950
  If no data ➔ skip (don't put missing value (.)
- Season : Month, quarter or semi-annual
  If no data ➔ assign the missing values (.)
- Area : 3 types (see slide 32-36 for details)
  If no data ➔ assign the missing values (.)
- Nominal CPUE : See slide 37-40 for details

Remarks

Attributes on "Year, Season and Area" are explained here. If other covariates (e.g., mesh size, boat size) instead of Season and/or Area are used, their attributes need to consider ad hoc basis separately.

5.3 Attributes of 3 covariates and nominal CPUE

Area (3 types)

(1) Grids, (2) Fishing grounds and (3) Landing sites

by preferable order

Because more pin-pointed anomalies can be reflected in CPUE standardization

5.3 Attributes of 3 covariates and nominal CPUE

Area (3 types) : Habitat area

Habitat area should be used

➔ Area (e.g. grids, fishing grounds) at least 1 catch in past

If area is larger than the habitat area

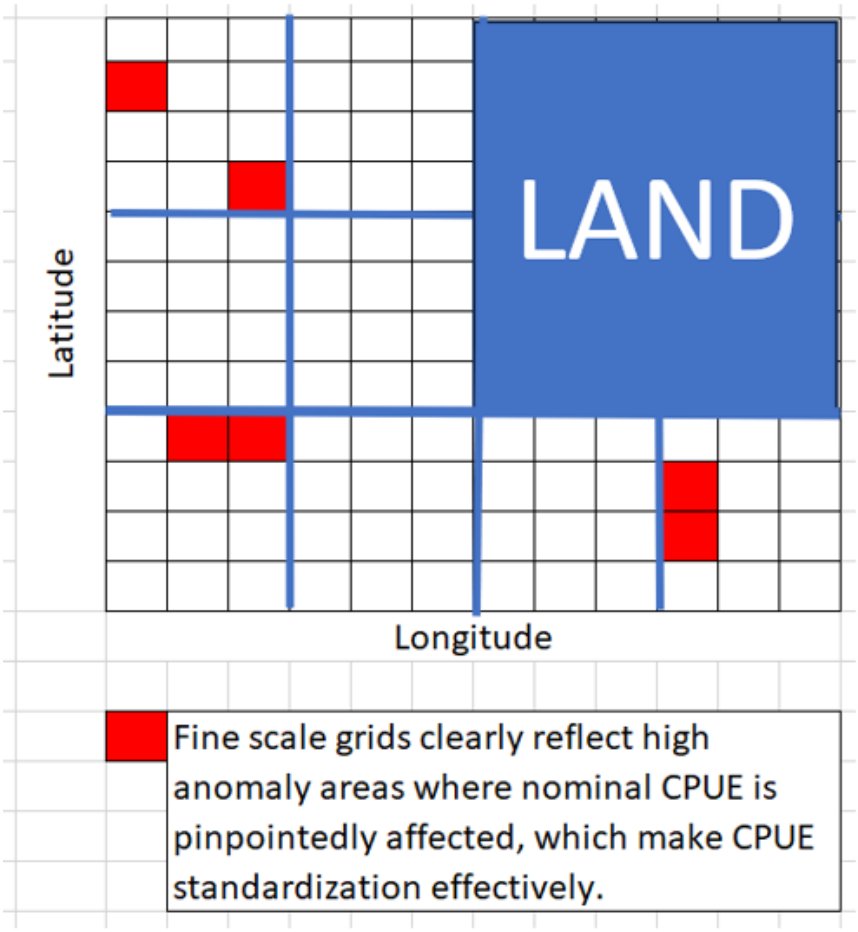
➔many 0 catch (not realistic) ➔ bias

5.3 Attributes of 3 covariates and nominal CPUE: **Area (3 types)**

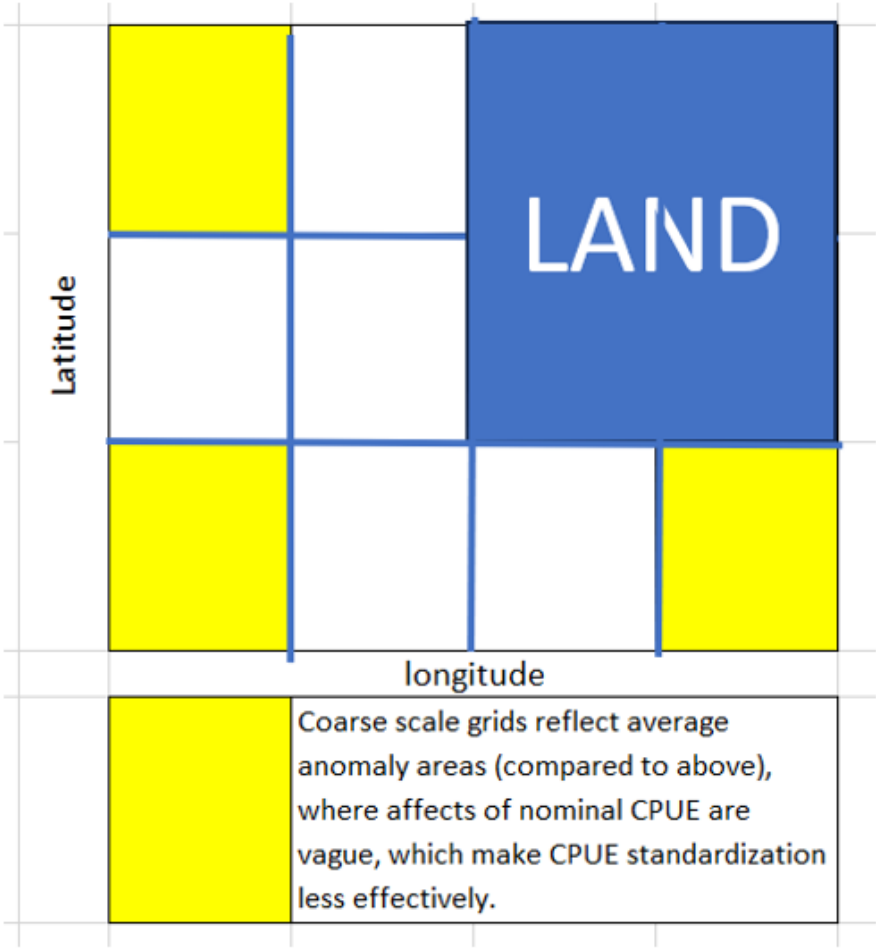
(1) Grid (lat/long) ： Fine scale ➔ better

as more pin-pointed anomalies can be reflected in CPUE standardization

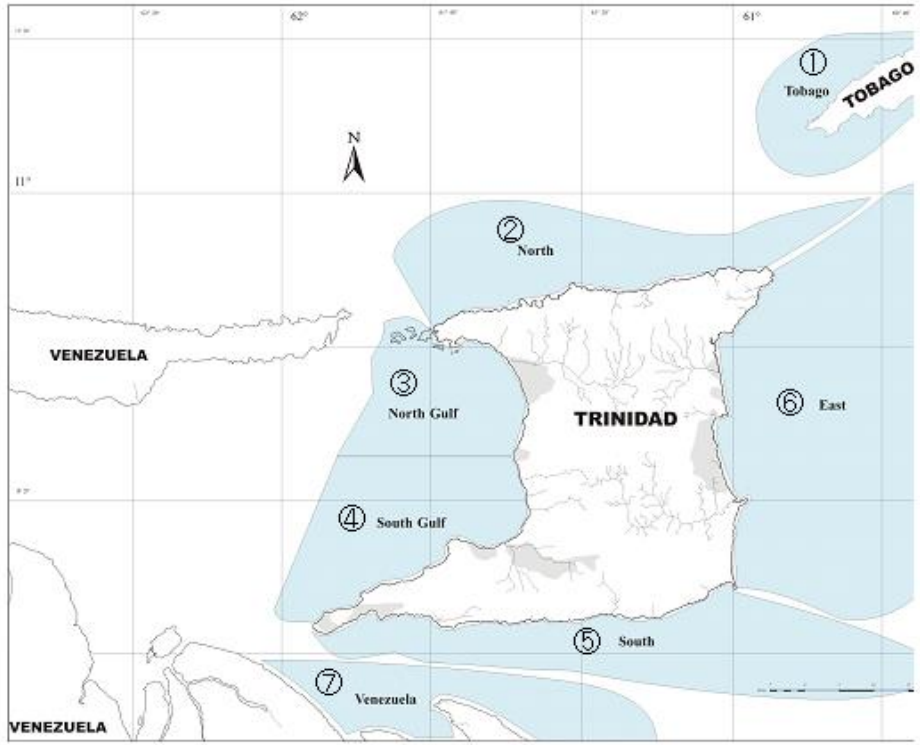
Fine scale grid



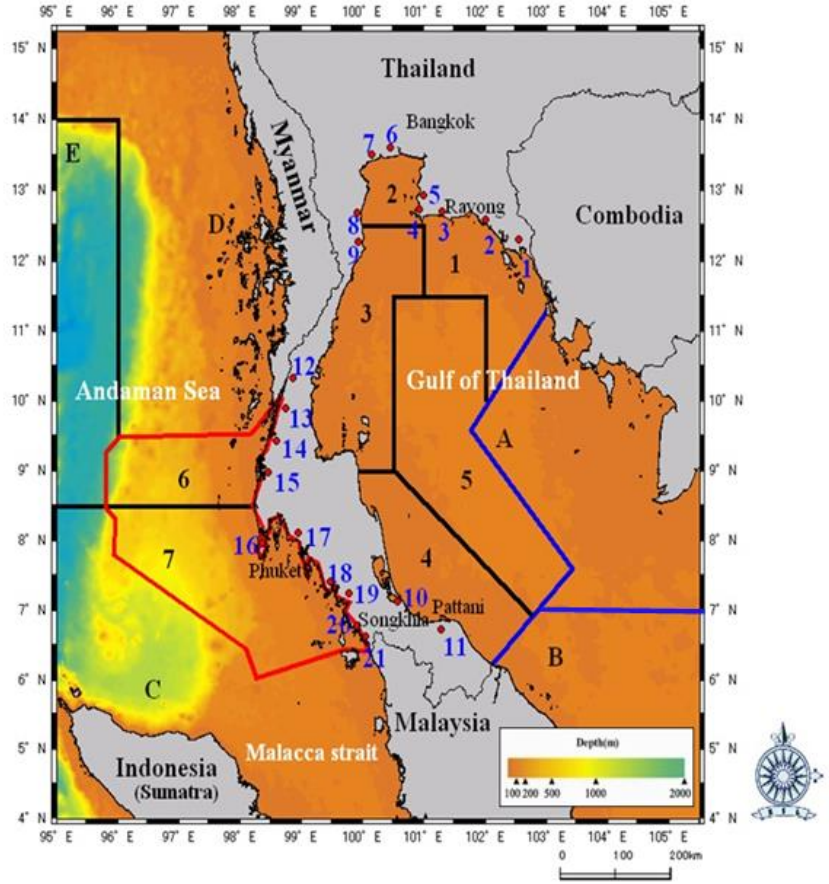
Coarse scale grid



5.3 Attributes of 3 covariates and nominal CPUE **Area (3 types)**
(2) Fishing grounds: finer is better (same reason)



Trinidad and Tobago (area ①～⑦)



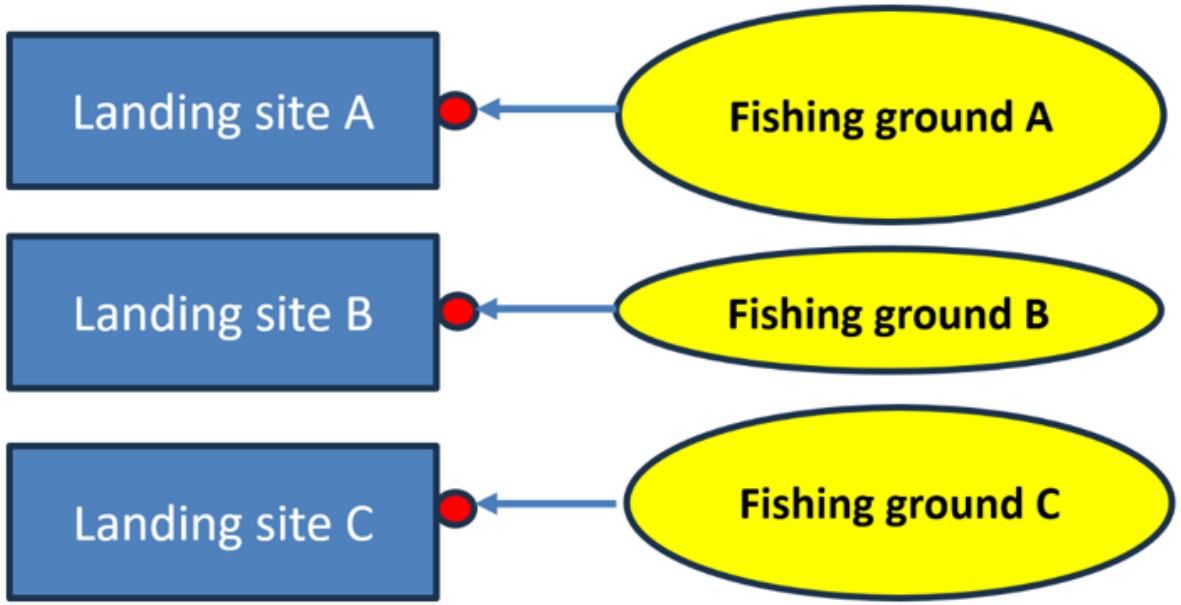
Thailand

Gulf of Thailand (area 1～5, A and B) and Andaman Sea (area 6,7 and C～F)

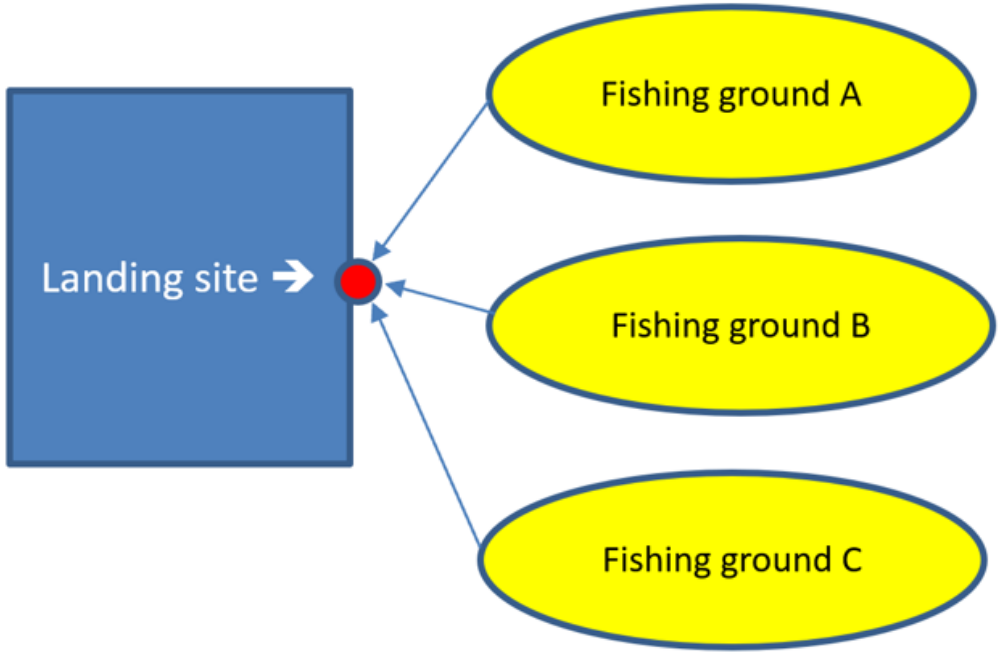
5.3 Attributes of 3 covariates and nominal CPUE: **Area (3 types)**

(3) Landing sites ➔ should represent the fishing grounds [Type A]
[Type B] should not be used.

[Type A] Landing sites represents exact fishing grounds



[Type B] Landing site representing multiple fishing grounds



5.3 Attributes of 3 covariates and nominal CPUE
Nominal CPUE (data set)

<u>Time scale</u>

finer scale better ➔ more pin-pointed (plausible) anomalies can be reflected in CPUE standardization

By preferable order

“set by set”, “daily by boat”, “daily (aggregated)”,

“monthly”, “Quarterly”, and “Semi-annual”.

5.3 Attributes of 3 covariates and nominal CPUE
Important note : Nominal CPUE (data set)

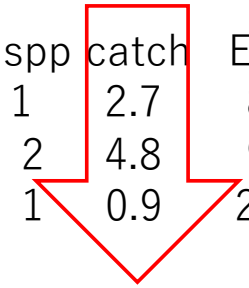
0 (zero) catch (CPUE) data should be included

Don't use vertical data set (below). If 0 catch is included ➔ OK

Data set : Nominal catch and CPUE

Do not use data (the **vertical** data flow)
ONLY with catch > 0

Year	mo	day	boat	set	spp	catch	EFFORT (hours)
2023	4	24	A	1	1	2.7	8.2
2023	4	24	A	1	2	4.8	9.2
2023	4	24	A	2	1	0.9	2.3



You will miss 0 catch ➔ important data
But you can use if 0 catch are included.

5.3 Attributes of 3 covariates and nominal CPUE
Important note : Nominal CPUE (data set)

0 (zero) catch (CPUE) data should be included

Use vertical data set (below) ➔ all catch (incl. 0) (all species) presented

Data set : Nominal catch and CPUE

Use the set by set data (**horizontal** data flow)
➔ you will get 0 (zero) data (It is a better format)
(you cannot ignore 0 in this format)
0 catch is important data !!

CATCH

Year	mo	day	boat	set	sp1	sp2	sp3…	EFFORT (hours)
2023	4	24	A	1	0	2.7	9.3	8.2
2023	4	24	A	2	1.3	0	8.3	

Another example (Thai seerfish data)

0 and other catch are very important !
Horizonal data flow (3 types of effort)

Thailand Pacific stock Gear :GILL Area: 5 (Gulf of Thailand)

year	month	date	boat name	set	catch (kg)			effort		
					King	Spanish	others	hours	hauls	days
1999	1	1	A	1	34	0	234	12	4	2
1999	1	1	A	2	0	0	566	23	4	4
2015	12	27	C	1	0	0	999	44	5	5
2015	12	27	C	2	0	0	234	23	3	4
2015	12	28	C	1	23	11	333	12	4	5

5.4 Implementing CPUE standardization

5.4 Implementing CPUE standardization

This software uses 2 models for CPUE standardization
depending upon 0 catch (CPUE) rate(below).

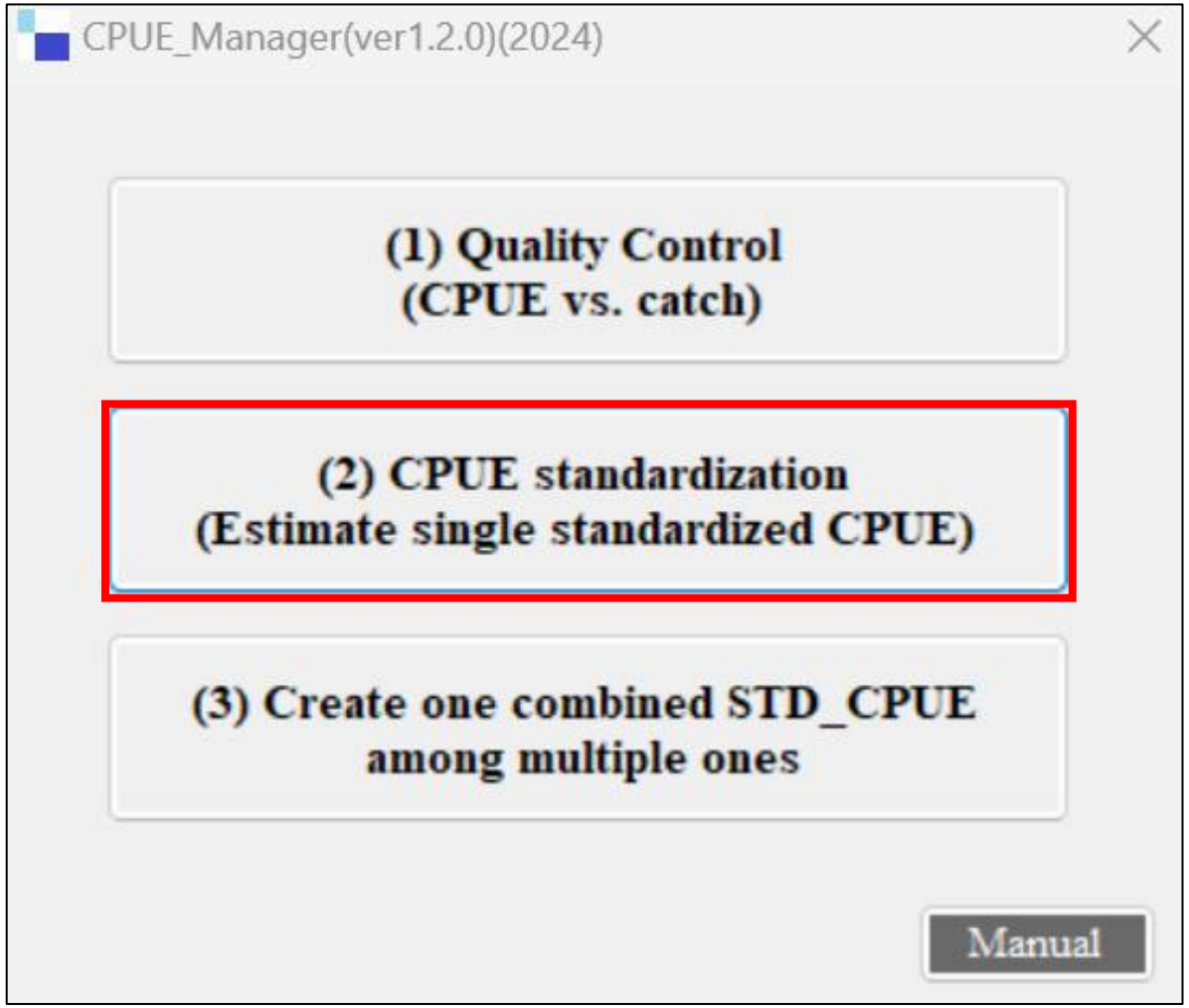
0 catch rate (%)	Model	Short name	Details (Manual)
0% ～ 30%	Log normal GLM	Log normal model	Section 5.4.1
30% ～	Zero (0) inflated Delta 2 steps log normal GLM	Delta model	Section 5.4.2

The software will automatically let users inform 0 catch rates
and corresponding model after users start the menu (2).

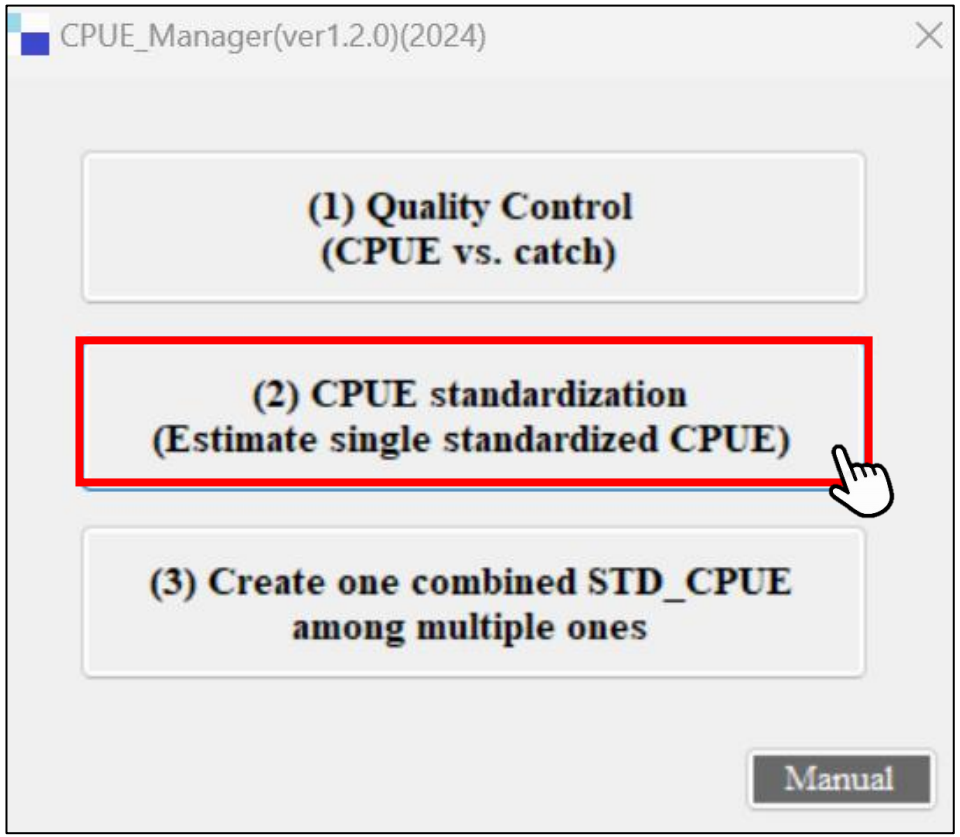
5.4.1 Implementing CPUE standardization

Log normal GLM

5.4.1 Implementing CPUE standardization log normal GLM



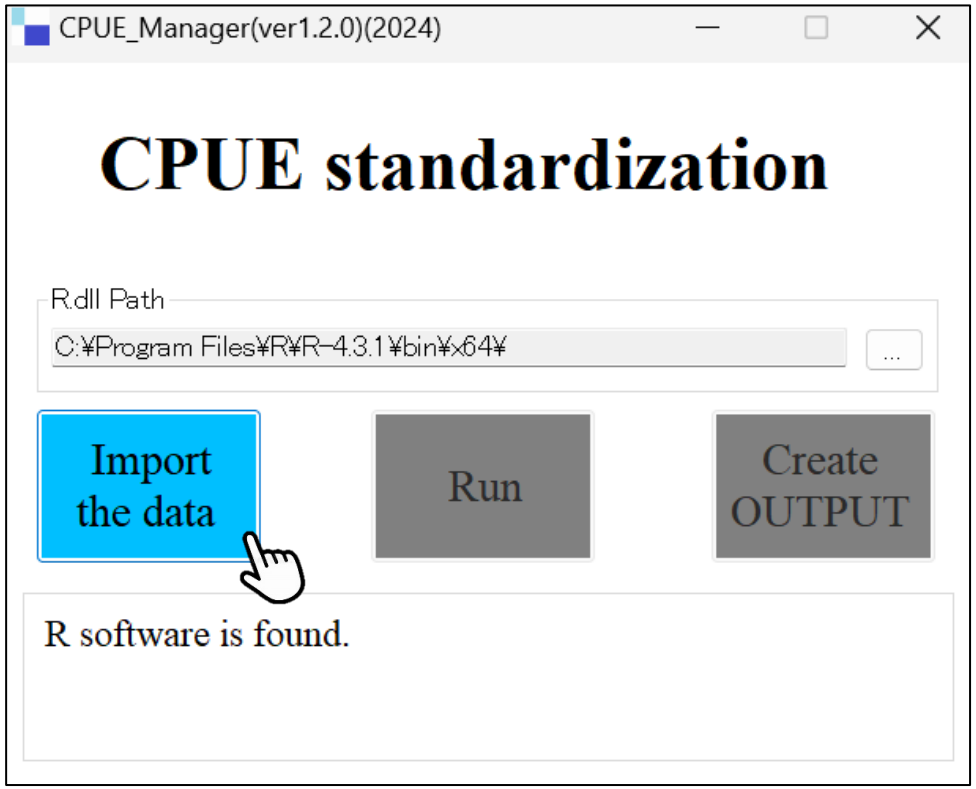
5.4.1 Implementing CPUE standardization (log normal GLM) Importing the nominal CPUE data set



Remarks

If users use this software at the 1st time, the window requests users to link R language to this software, will appear.

In such case, follow steps explained in Slide # 14.



5.4.1 Implementing CPUE standardization (log normal GLM): 1st window

'nformation of 0 (zero) catch, Selection of the model, and Selection of the covariates.

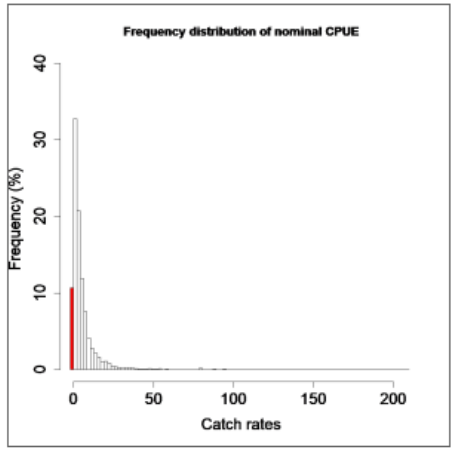
① **Sample size (n=)**

Year	Sample size (n=)
2011	60
2012	48
2013	86
2014	310
2015	533
2016	518
2017	499
2018	514
2019	447
2020	60
2021	202
2022	257
2023	529

Month	Sample size (n=)
1	297
2	242
3	297
4	296

② **0 (zero) CPUE (catch) rate (red bar) = 11%**

% frequency distribution of nominal CPUE



③ **Select model**

- (●) Log normal GLM: 0 (zero) CPUE (catch) rate < around 30%
- ( ) Delta type 2 steps log-normal model: 0 (zero) CPUE (catch) rate > around 30%

④ **Select covariates**

- [✓] Year
- [✓] Month
- [✓] Area
- [✓] Month * Area

Note: Selection of covariates (for details, refer to the Manual)

OK Cancel

5.4.1 Implementing CPUE standardization (log normal GLM)

① **Sample size (n=)**

If sample size is not enough (n < 10), follow suggestions as below:

If year(n) < 10

➔ Better not conduct “CPUE standardization” nor “ stock assessment”

If year(n)≥ 10 and n < 10 (2 other covariates) ➔ Change to larger category

For example, in case of Season (month) & Area (5 areas)

If month(n) < 10 ➔ Change to Quarter

If 5 areas(n) <10 ➔ change to 3 areas

so that enough sample sizes can be secured.

For other covariates, use the similar approaches.

5.4.1 Implementing CPUE standardization (log normal GLM)

②　**0 (zero) catch (CPUE) rate**

Red bar (% frequency distribution)

(in the nominal CPUE data set)

↓

0 catch (CPUE) rate

↓

To be utilized in ③ (model selection).

5.4.1 Implementing CPUE standardization (log normal GLM)

③ **Selection of GLM model by 0 catch rate**

0 catch rate (%)	Model	Short name
0% ～ 30%	Log normal GLM	Log normal model
30% ～	Zero (0) inflated Delta 2 steps log normal GLM	Delta model

5.4.1 Implementing CPUE standardization (log normal GLM)

④ **Selection of covariates (1/3)**

3 Covariates ➔ year and 2 other covariates

Y(year) is the essential covariate to estimate annual CPUE standardization

2 other covariates

Normally “Season (e.g., month, quarter)” & “Area (e.g., fishing grounds, stat area)

But other covariates (e.g., mesh size, boat size)

can be used if season and/or area not considered to be important.

Why only 2 covariates?

➔ Because this soft is mainly used in the developing countries where data are limited.

5.4.1
Implementing CPUE standardization
log normal GLM
④ Selection of covariates (2/3)

Selection of covariates according to the situation of missing values using season & area (example)

Y(year) ➔ Always selected (masked)
(to estimate annual standardized CPUE)

If users have other covariate names
(e.g., mesh size, boat size),
the same are applied.

Missing values		Selection of Covariates
Season	Area	
no	no	☑ Y (Year) ☑ S (Season: Month, Quarter etc.) ☑ A (Area) ☑ S * A
all	all	☑ Y (Year) ☐ S (Season: Month, Quarter etc.) ☐ A (Area) ☐ S * A
some	some	☑ Y (Year) ☑ S (Season: Month, Quarter etc.) ☑ A (Area) ☐ S * A
all	some	☑ Y (Year) ☐ S (Season: Month, Quarter etc.) ☑ A (Area) ☐ S * A
some	all	☑ Y (Year) ☑ S (Season: Month, Quarter etc.) ☐ A (Area) ☐ S * A

5.4.1 Implementing CPUE standardization(log normal GLM)

④ **Selection of covariates (3/3)**

Y(year) related interaction (e.g., year*month & year*area) ➔ NO need

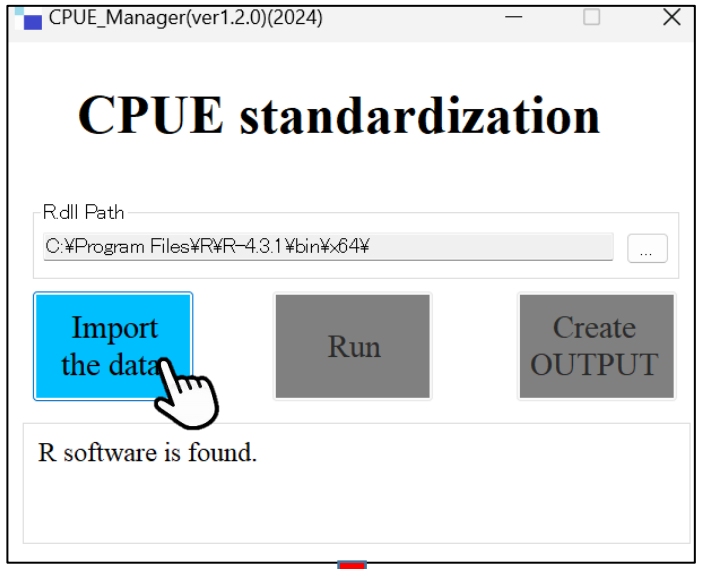
Because interpretations are difficult due to complex situation
(see 2 reference papers).

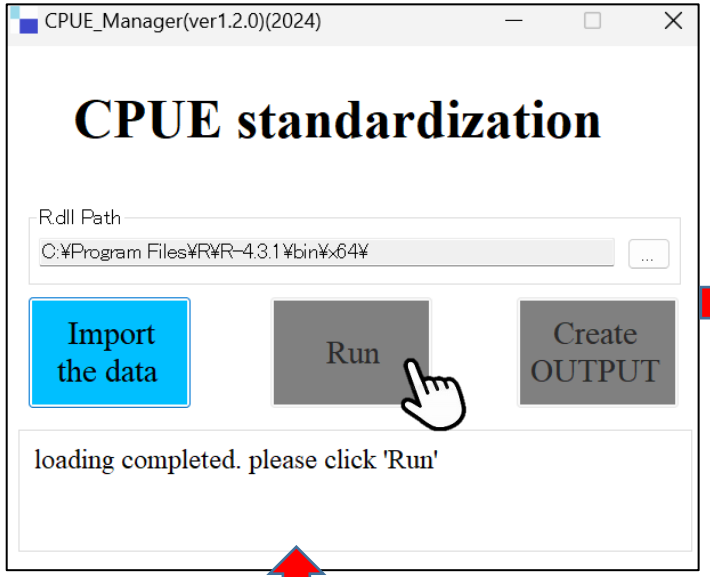
Hinton & Maunder (2004) ➔ invalid

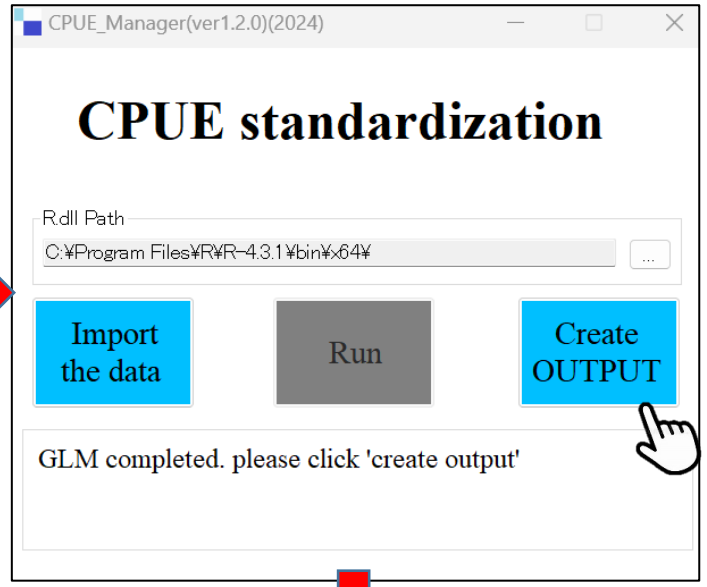
⇩

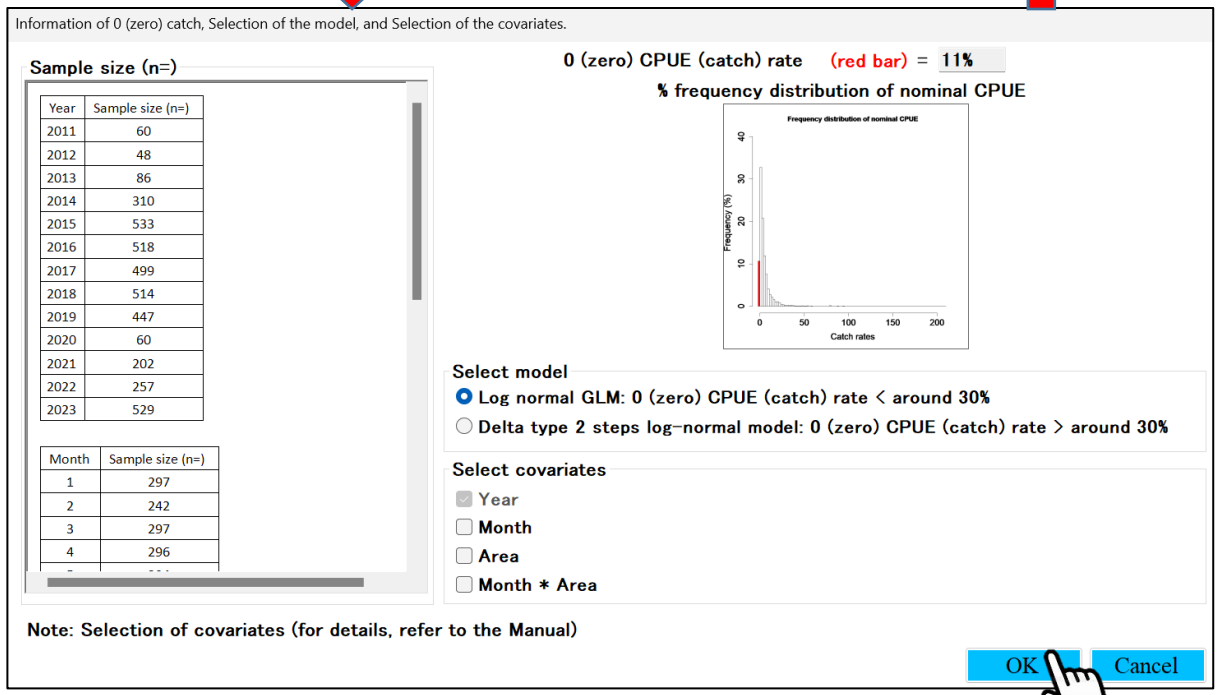
Maunder & Punt (2004)
Identifying significant interactions with year
➔ no need (impossible to explain)

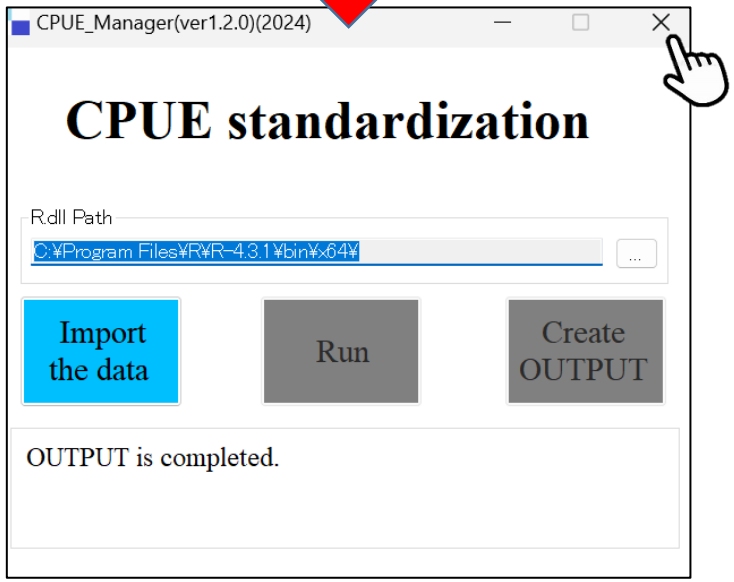
5.4.1 Implementing CPUE standardization(log normal GLM) : Steps





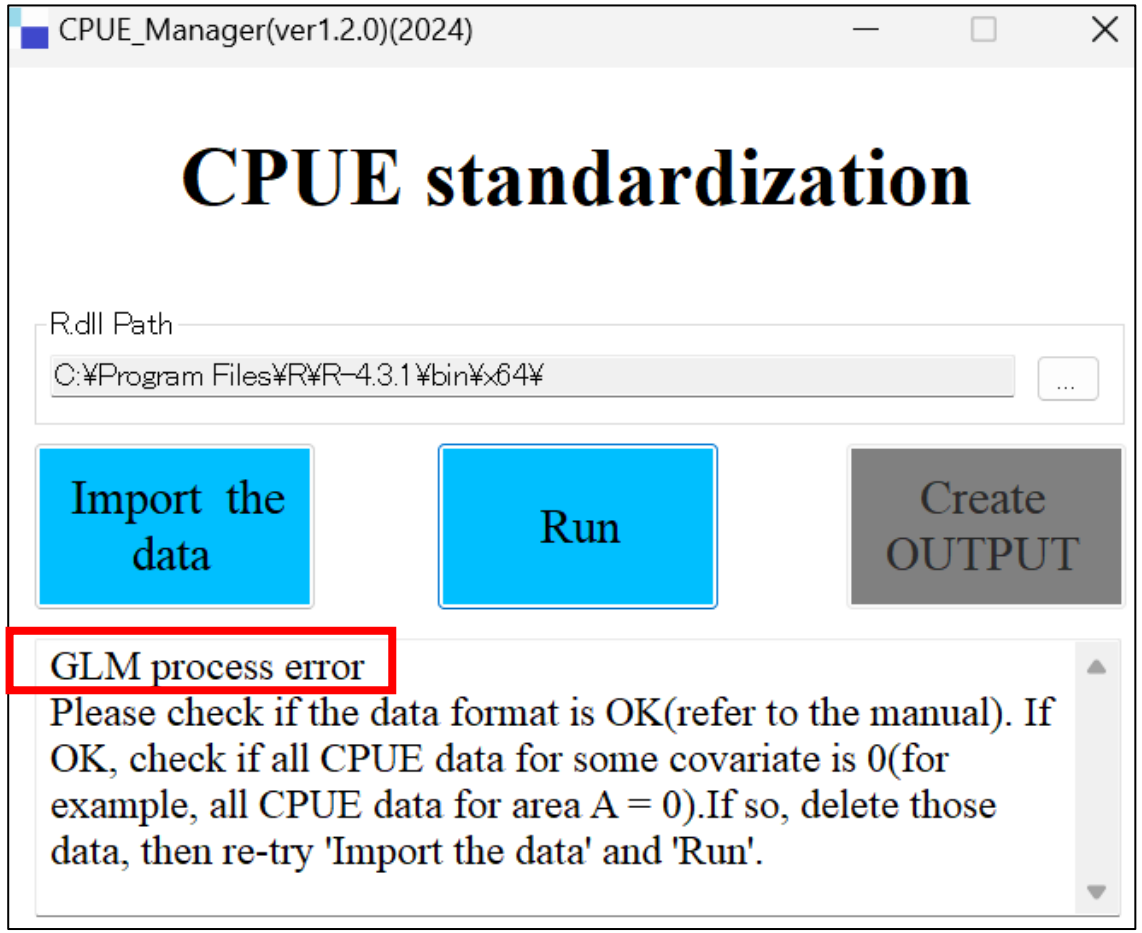






5.4.1 Implementing CPUE standardization(log normal GLM) : Process error

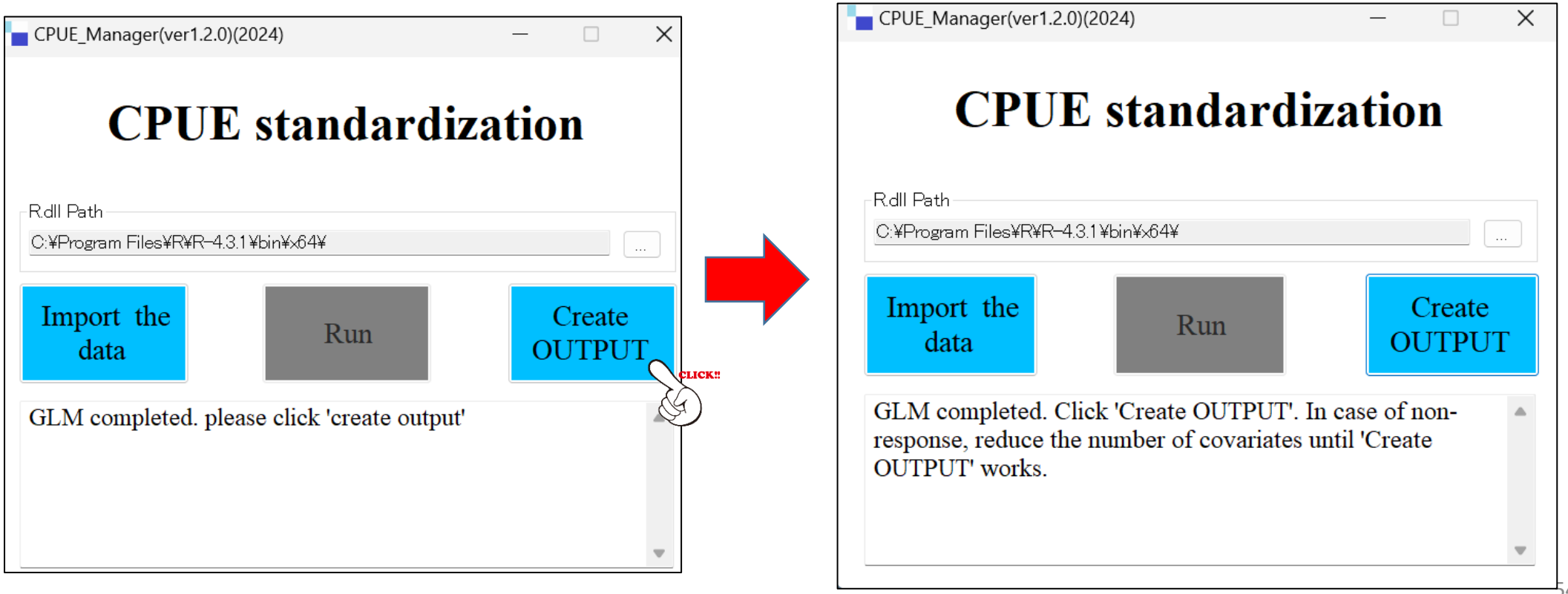
Users will see "Process error" message (below) if input data has some problems. In such case, follow the instruction and re-try again.



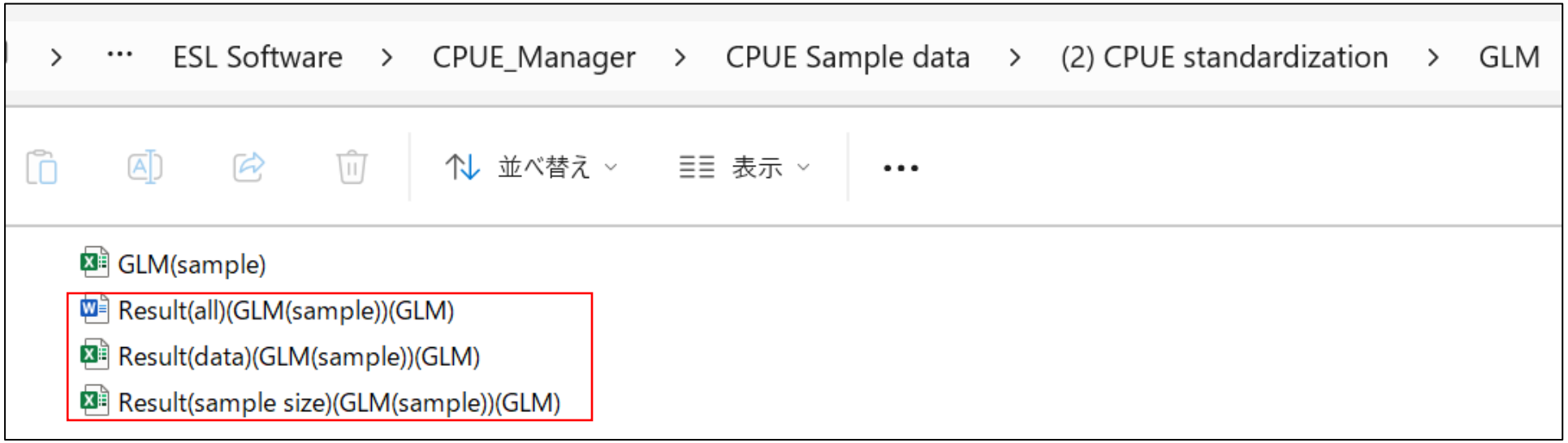
5.4.1 Implementing CPUE standardization(log normal GLM)

In case of non-response after clicking Create OUTPUT

If, after 'Importing data' & 'Run' has been completed successfully, no responses from 'Create OUTPUT' even after clicking, then reduce the number of covariates until 'Create OUTPUT' works. This will happen if sample sizes are too small for some covariates.



5.4.1 Implementing CPUE standardization (log normal GLM) : result files



5.4.1 Implementing CPUE standardization(log normal GLM):OUTPUT

Output file #	Results	Contents	Type	File name
(1)	① Sample size of covariates	Year, season, area, and interaction (season*area)	Data	Result(sample size)(Sample)(GLM)
(2)	① Standardized CPUE (Original scale)	Standardized CPUE and 95% CI with nominal CPUE		Result(data)(Sample)(GLM)
	② Standardized CPUE (Scaled as average values =1)			
(3)	① 0 (zero) catch rate	% freq. distribution of nominal CPUE with 0 catch rate	Graphs	Result(all)(Sample)(GLM)
	② ANOVA Table (Analyses Of Variances)	Statistical test for model & covariates	Table	
	③ Standardized CPUE Real values and Scaled (Average values =1)	Standardized CPUE and 95% CI with nominal CPUE	Graphs	
	④ Residual analyses Histogram and QQ (Quantile-Quantile) plot	To test suitability of GLM using the error distribution		

5.4.1 Implementing CPUE standardization (log normal GLM):OUTPUT (1) Sample size (Covariates)

Result(sample size)(Sample)(GLM)

Area	Sample size (n=)
NTS	3,291
STS	772

Year | Month | Area | Month x Area

Year	Sample size (n=)
2011	60
2012	48
2013	86
2014	310
2015	533
2016	518
2017	499
2018	514
2019	447
2020	60
2021	202
2022	257
2023	529

Year | Month | Area

Month	Sample size (n=)
1	297
2	242
3	297
4	296
5	294
6	266
7	313
8	417
9	413
10	389
11	475
12	364

Year | Month | Area | Month x Area

Month*Area	Sample size(n=)	
	Area	
Month	NTS	STS
1	244	53
2	186	56
3	223	74
4	212	84
5	213	81
6	201	65
7	252	61
8	327	90
9	344	69
10	341	48
11	429	46
12	319	45

Year | Month | Area | Month x Area

5.4.1 Implementing CPU standardization (log normal GLM): Output

(2) Standardized CPUE with its 95% CI (Confidence Interval) and nominal CPUE

numerical results 2 sheet (excel)

Result(data)(Sample)(GLM)

Original scale

	A	B	C	D	E
1		Observed (nominal) CPUE	Estimated (standardized) CPUE	Lower boundary of 95% CI (2.5%)	Upper boundary of 95% CI (97.5%)
2	2011	6.20	4.97	3.66	6.69
3	2012	9.98	7.95	5.73	10.95
4	2013	10.18	5.02	3.90	6.44
5	2014	4.77	4.91	4.30	5.60
6	2015	5.61	5.80	5.25	6.40
7	2016	5.98	6.40	5.79	7.07
8	2017	7.55	6.41	5.78	7.09
9	2018	4.66	4.78	4.31	5.30
10	2019	3.37	3.61	3.21	4.04
11	2020	6.20	4.97	3.66	6.69
12	2021	3.18	2.68	2.23	3.19
13	2022	8.52	7.61	6.61	8.75
14	2023	3.35	3.72	3.35	4.12
15					

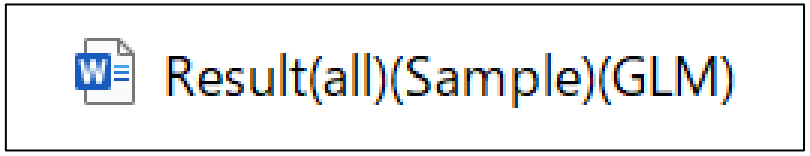
Original scale | Scaled CPUE (Ave=1)

Scaled as Ave=1

	A	B	C	D	E
1		Observed (nominal) CPUE	Estimated (standardized) CPUE	Lower boundary of 95% CI (2.5%)	Upper boundary of 95% CI (97.5%)
2	2011	1.01	0.94	0.82	1.06
3	2012	1.63	1.50	1.29	1.73
4	2013	1.66	0.95	0.88	1.02
5	2014	0.78	0.93	0.97	0.88
6	2015	0.92	1.10	1.18	1.01
7	2016	0.98	1.21	1.30	1.12
8	2017	1.23	1.21	1.30	1.12
9	2018	0.76	0.90	0.97	0.84
10	2019	0.55	0.68	0.72	0.64
11	2020	1.01	0.94	0.82	1.06
12	2021	0.52	0.51	0.50	0.50
13	2022	1.39	1.44	1.49	1.38
14	2023	0.55	0.70	0.75	0.65
15	Average	1	1	1	1
16					

Original scale | Scaled CPUE (Ave=1)

5.4.1 Implementing CPUE standardization (log normal GLM)
(3) Output : Report (word) file



① % frequency distribution of 0 (zero) catch (CPUE) and % of 0 catch (CPUE)

② ANOVA Table

③ Trends of 4 annual CPUE (nominal, standardized and its 95% CI)

④ Evaluation of log normal GLM model
(2 Residual analyses by histogram and QQ plots)

5.4.1 Implementing CPUE standardization (log normal GLM)
(3) Output : Report (word) file

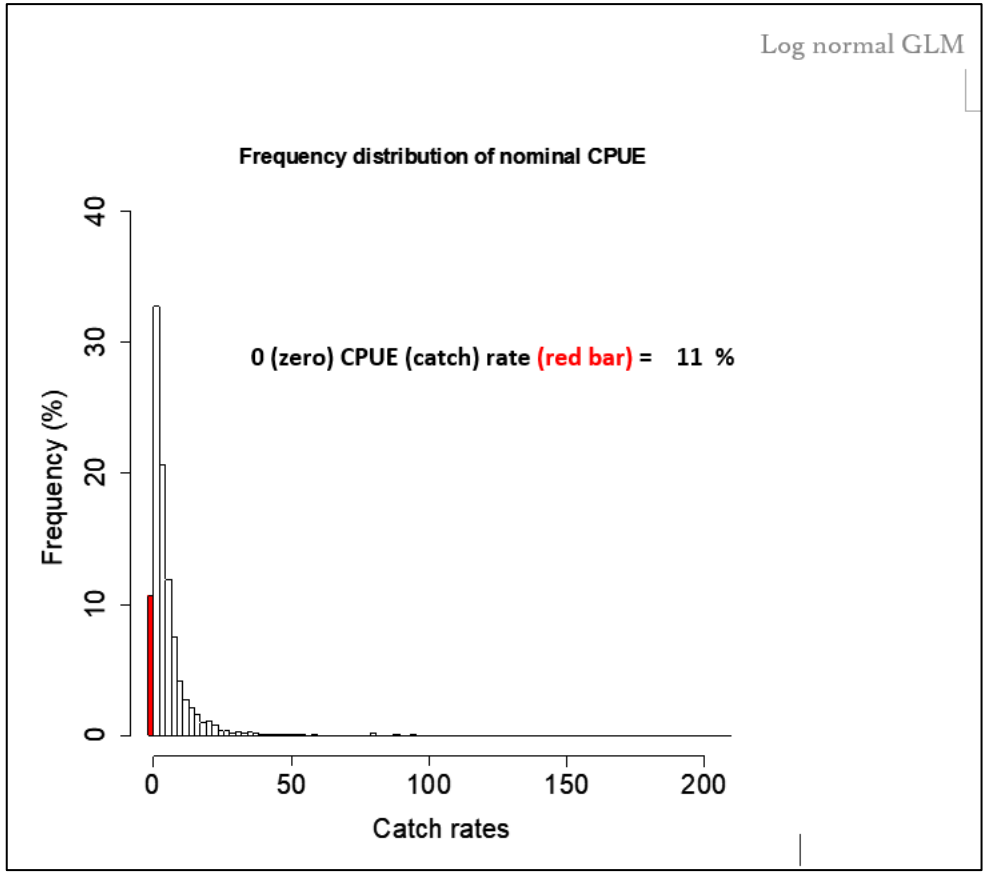
①

% frequency distribution of nominal CPUE

Red bar

0 CPUE (catch) rate

if < 30%, use log normal GLM model



5.4.1 Implementing CPUE standardization (log normal GLM)

② ANOVA Table

if Pr. < 0.05 for model & all covariates (significant)

⇓

use log normal GLM

Otherwise (non-significant)

➔use nominal CPUE

ANOVA (Analysis Of Variance) Table for log normal GLM to test statistical significances on nominal CPUE

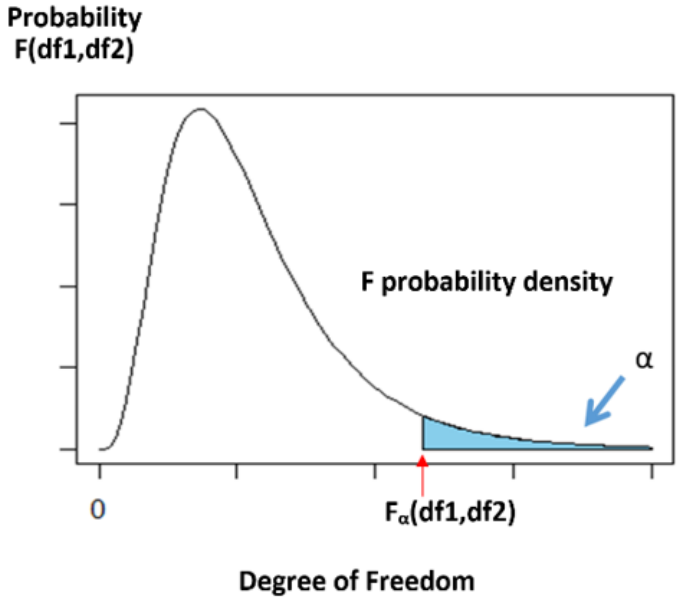
Adjusted R^2 = 0.05

Sources	df1	df2	Type III SS (Sum of Square)	Mean Square	F (test statistic)	<α:Probabaility (>F) (*)
Model	12		243.29	20.27	17.70	0.000
Year	12		243.29	20.27	17.71	0.000
Error		4,050	4,637.70	1.15		

[Note]

df Degrees of Freedom

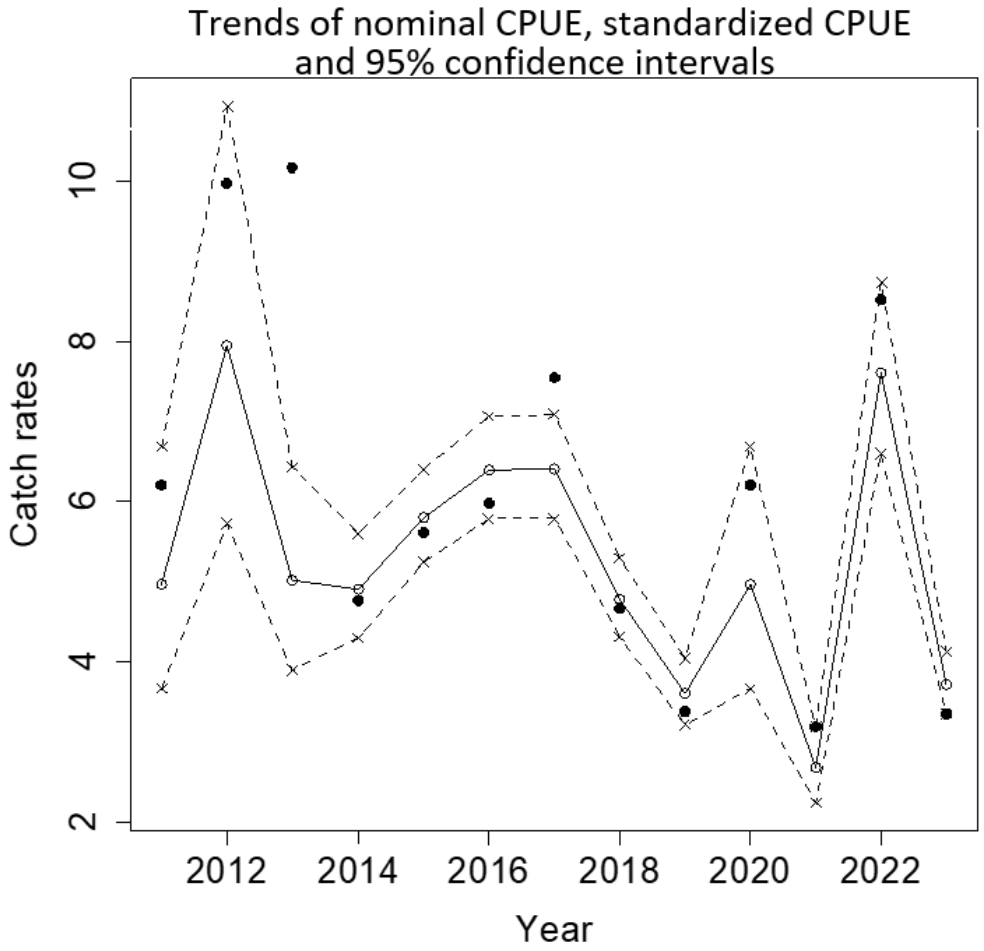
(*) Yellow marker Indicates $\alpha < 0.05$ (5%)



5.4.1 Implementing CPUE standardization (log normal GLM): Output

③
Annual trends

Nominal CPUE and Standardized CPUE with 95% CI



Legend

Point	(•)	: Nominal CPUE
Line	(o—o)	: Standardized CPUE (point estimate)
Dotted line	(×—×)	: 95% Confidence intervals

5.4.1 Implementing CPUE standardization (log normal GLM): Output

④-1

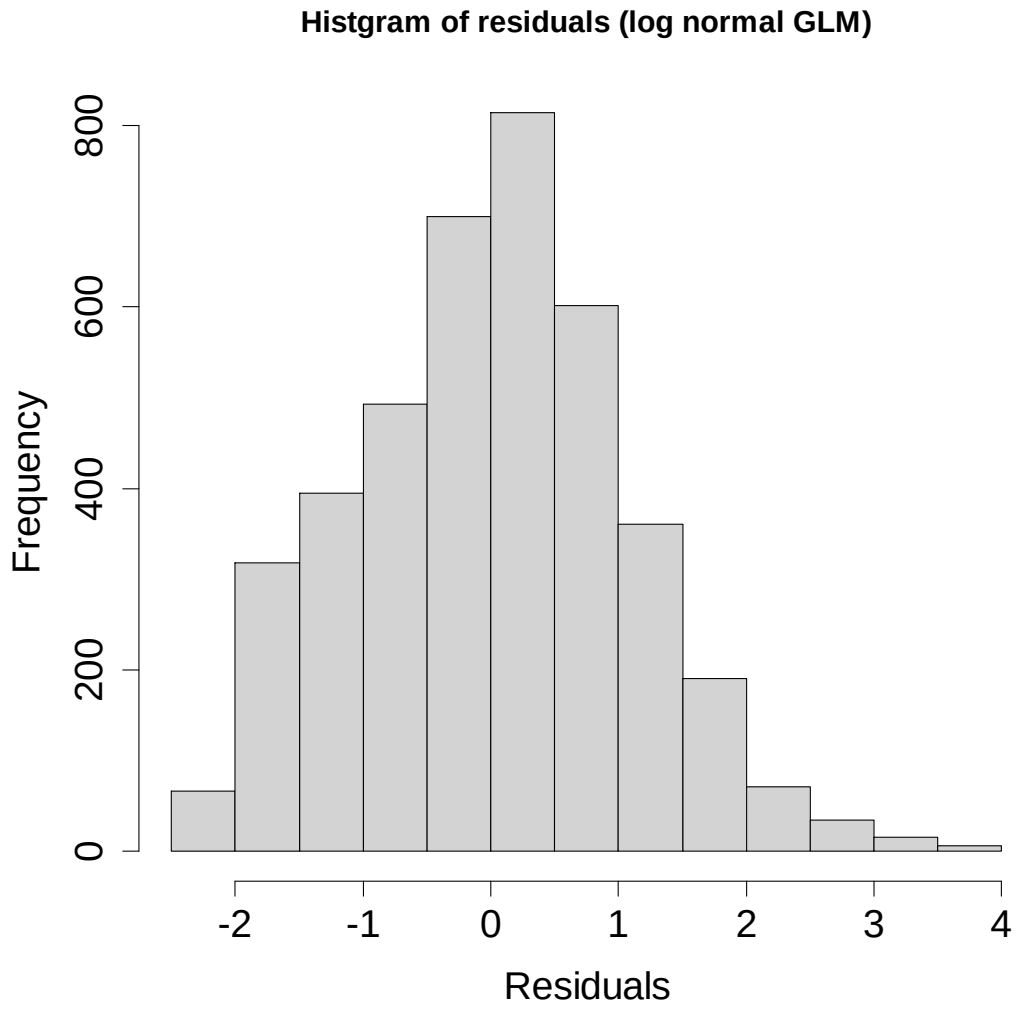
Evaluation of log normal GLM model (Residual analyses)

if Bell shape

↓

model is OK

if not, change model



5.4.1 Implementing CPUE standardization (log normal GLM): Output

④-2
Evaluation of log normal GLM model
(Residual analysis)
QQ plot

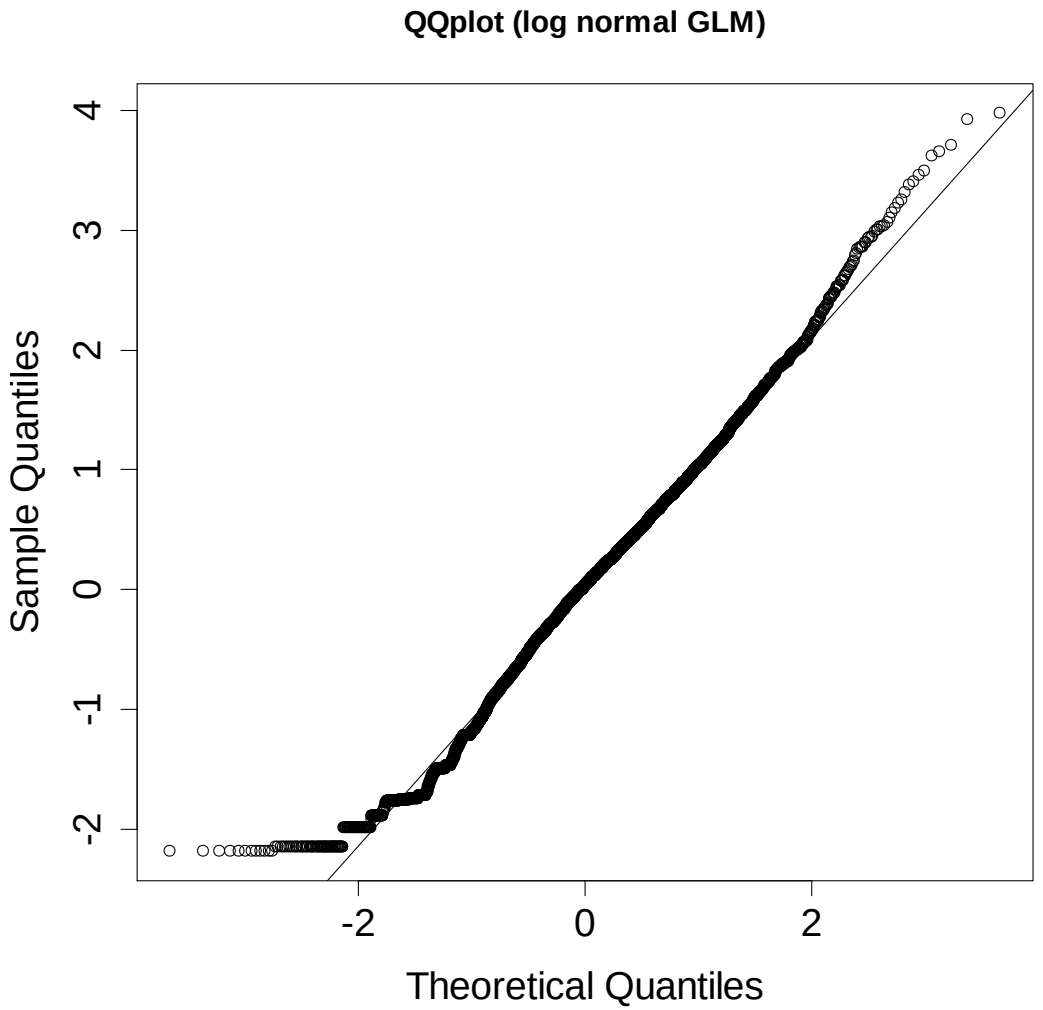
↓

If residuals close to the straight line

↓

Model is OK

if not, change model



5.4.2 Implementing CPUE standardization (Delta model)

Zero inflated Delta 2 steps log normal GLM

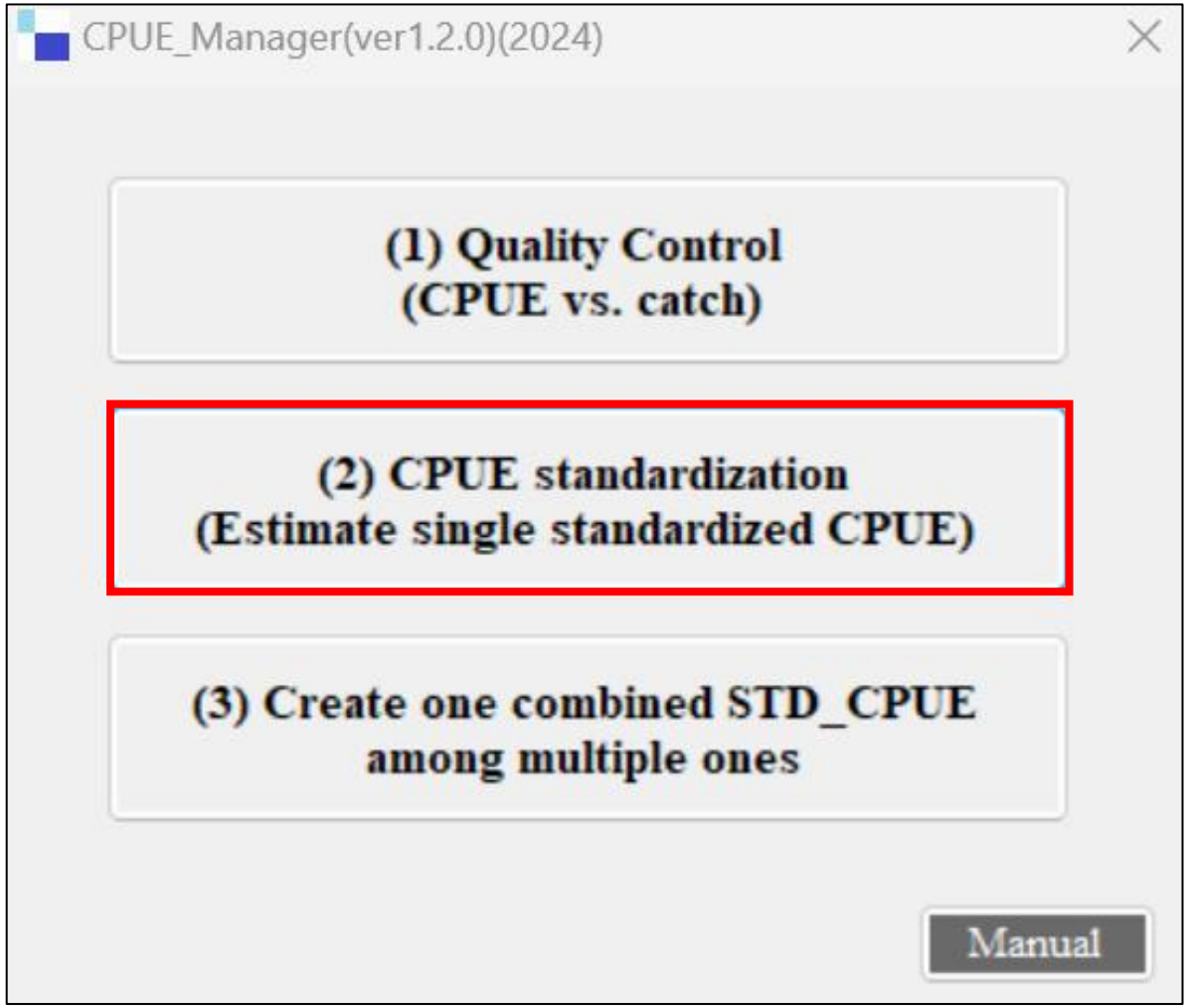
5.4.2 Implementing CPUE standardization (Delta model)

This software uses 2 models for CPUE standardization
depending upon 0 catch (CPUE) rate(below).

0 catch rate (%)	Model	Short name	Details (Manual)
0% ～ 30%	Log normal GLM	Log normal model	Section 5.4.1
30% ～	Zero (0) inflated Delta 2 steps log normal GLM	Delta model	Section 5.4.2

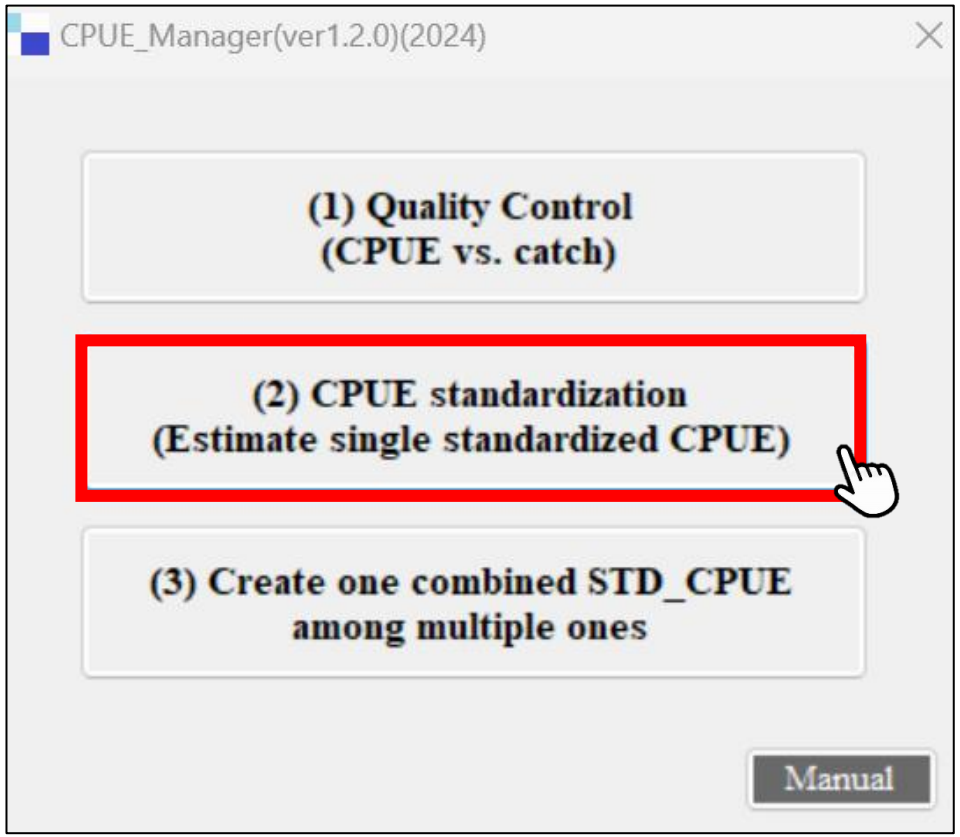
The software will automatically let users inform 0 catch rates
and corresponding model after users start the menu (2).

5.4.2 Implementing CPUE standardization(Delta model)



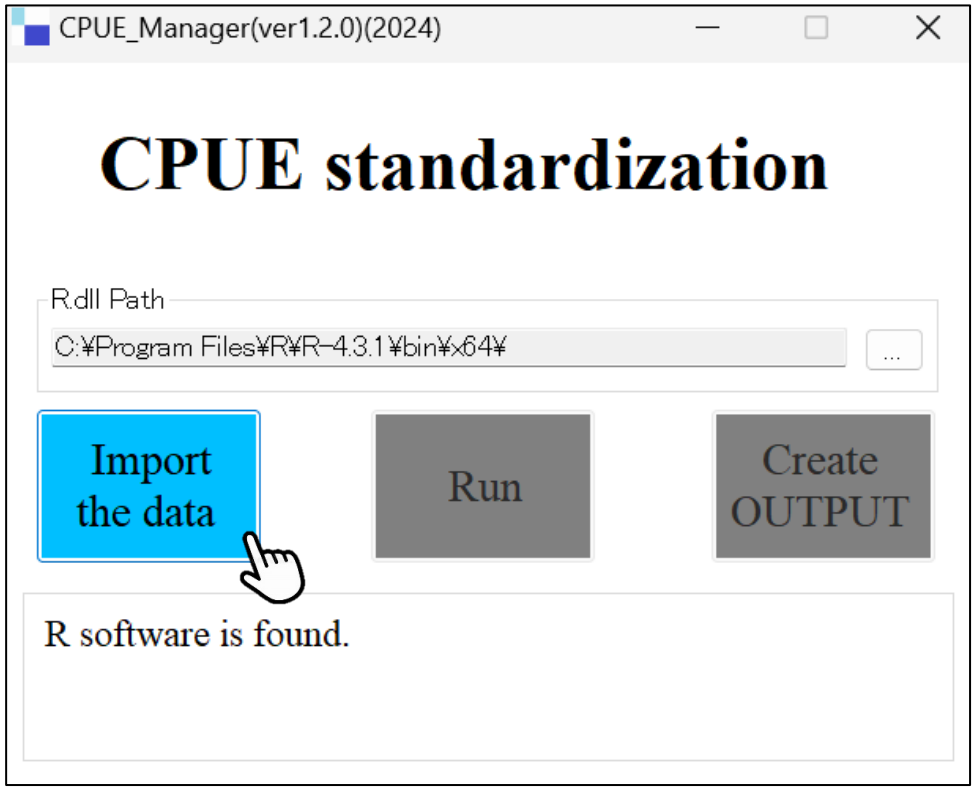
5.4.2 Implementing CPUE standardization (Delta model)

Importing the nominal CPUE data set



Remarks

If users use this software at the 1st time,
the window requests users to link R language
to this software, will appear.
In such case, follow steps explained in Slide # 14.



5.4.2 Implementing CPUE standardization (Delta model): 1st window

Information of 0 (zero) catch, Selection of the model, and Selection of the covariates.

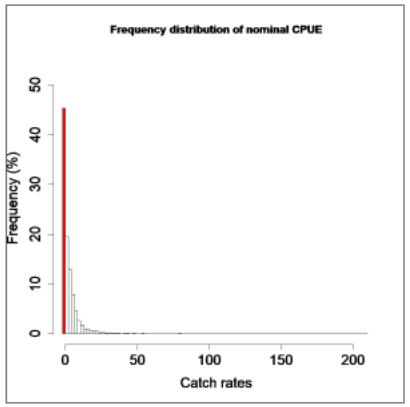
① **Sample size (n=)**

Year	Sample size (n=)
2009	333
2010	825
2011	326
2012	390
2013	467
2014	685
2015	921
2016	850
2017	768
2018	811
2019	771
2020	679
2021	787
2022	603
2023	649

Month	Sample size (n=)
1	840
2	689

② (zero) CPUE (catch) rate (red bar) = 45%

% frequency distribution of nominal CPUE



③ **Select model**

- ○ Log normal GLM: 0 (zero) CPUE (catch) rate < around 30%
- ◉ Delta type 2 steps log-normal model: 0 (zero) CPUE (catch) rate > around 30%

④ **Select covariates**

- ☑ Year
- ☐ Month
- ☐ Area
- ☐ Month * Area

Note: Selection of covariates (for details, refer to the Manual)

OK Cancel

5.4.2 Implementing CPUE standardization **(Delta model)**

① **Sample size (n=)**

If sample size is not enough (n < 10), follow suggestions as below:

If year(n) < 10

➔ Better not conduct “CPUE standardization” nor “ stock assessment”

If year(n)≥ 10 and n < 10 (2 other covariates) ➔ Change to larger category

For example, in case of Season (month) & Area (5 areas)

If month(n) < 10 ➔ Change to Quarter

If 5 areas(n) <10 ➔ change to 3 areas

so that enough sample sizes can be secured.

For other covariates, use the similar approaches.

5.4.2 Implementing CPUE standardization (Delta model)

② **0 (zero) catch (CPUE) rate**

Red bar (% frequency distribution)

(in the nominal CPUE data set)

↓

0 catch (CPUE) rate

↓

To be utilized in ③ (model selection).

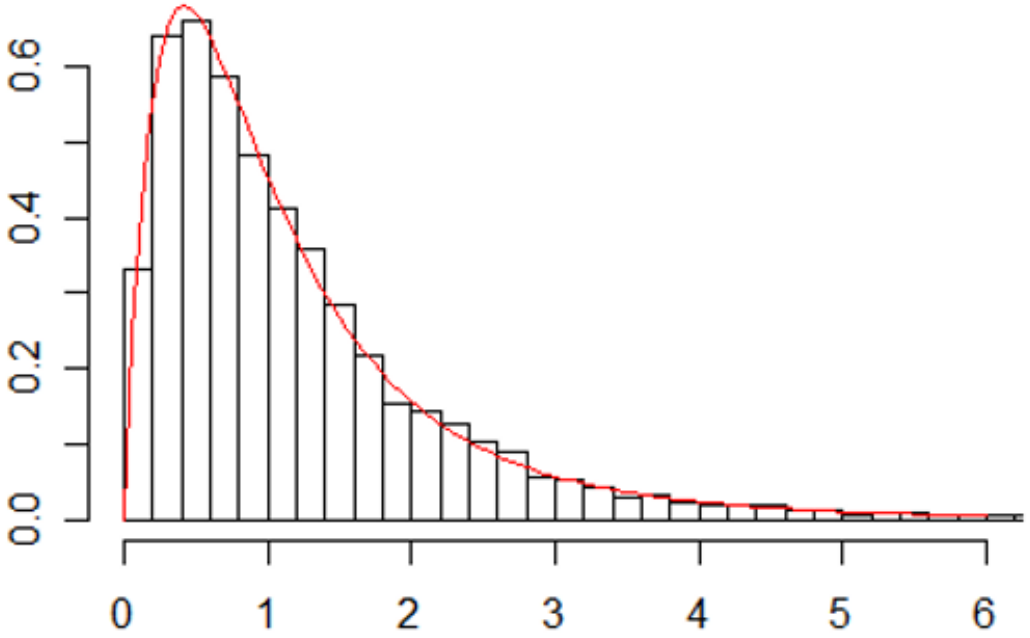
5.4.2 Implementing CPUE standardization(Delta model)

③ **Selection of GLM model by 0 catch rate**

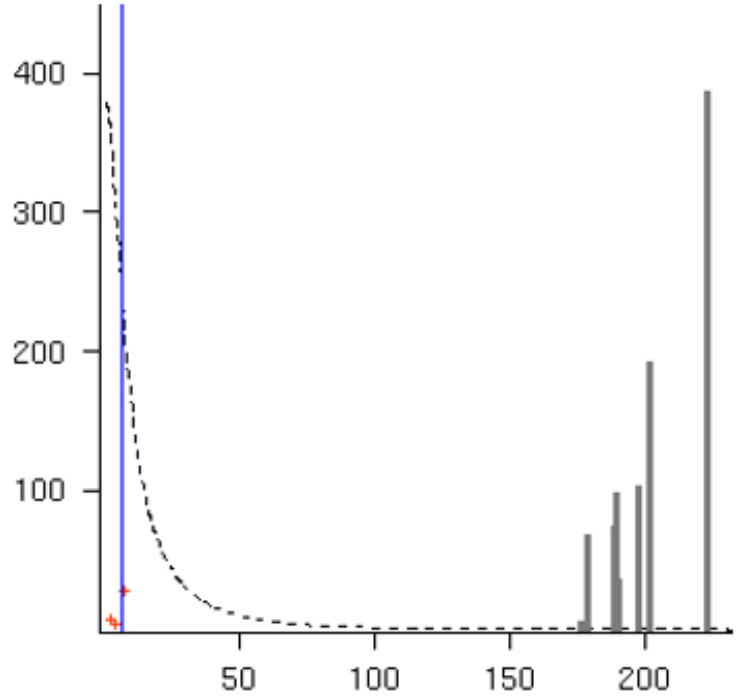
0 catch rate (%)	Model	Short name
0% ～ 30%	Log normal GLM	Log normal model
30% ～	Zero (0) inflated Delta 2 steps log normal GLM	Delta model

5.4.2 Implementing CPUE standardization (Delta model)
③ **Selection of GLM model by 0 catch rate**

Frequency distributions (like below)➔ do not use.
but never happened in the past (16 years)



Long (fat) tail



Non-monotonic decreasing trend with pulse at the end

5.4.2 Implementing CPUE standardization(Delta model)

④ **Selection of covariates (1/3)**

3 Covariates ➔ year and 2 other covariates

Y(year) is the essential covariate to estimate annual CPUE standardization

2 other covariates

Normally “Season (e.g., month, quarter)” & “Area (e.g., fishing grounds, stat area)

But other covariates (e.g., mesh size, boat size)

can be used if season and/or area not considered to be important.

Why only 2 covariates?

➔ Because this soft is mainly used in the developing countries & data is limited.

5.4.2 Implementing CPUE standardization
（Delta model）

④ Selection of covariates (2/3)

Selection of covariates according to the situation of missing values using season & area (example)

Y(year) ➔ Always selected (masked)
(to estimate annual standardized CPUE)

If users have other covariate names
(e.g., mesh size, boat size),
the same are applied.

Missing values		Selection of Covariates
Season	Area	
no	no	☑ Y (Year) ☑ S (Season: Month, Quarter etc.) ☑ A (Area) ☑ S * A
all	all	☑ Y (Year) ☐ S (Season: Month, Quarter etc.) ☐ A (Area) ☐ S * A
some	some	☑ Y (Year) ☑ S (Season: Month, Quarter etc.) ☑ A (Area) ☐ S * A
all	some	☑ Y (Year) ☐ S (Season: Month, Quarter etc.) ☑ A (Area) ☐ S * A
some	all	☑ Y (Year) ☑ S (Season: Month, Quarter etc.) ☐ A (Area) ☐ S * A

5.4.2 Implementing CPUE standardization(Delta model)

④ **Selection of covariates (3/3)**

Y(year) related interaction (e.g., year*month & year*area) ➔ NO need

Because interpretations are difficult due to complex situation
(see 2 reference papers).

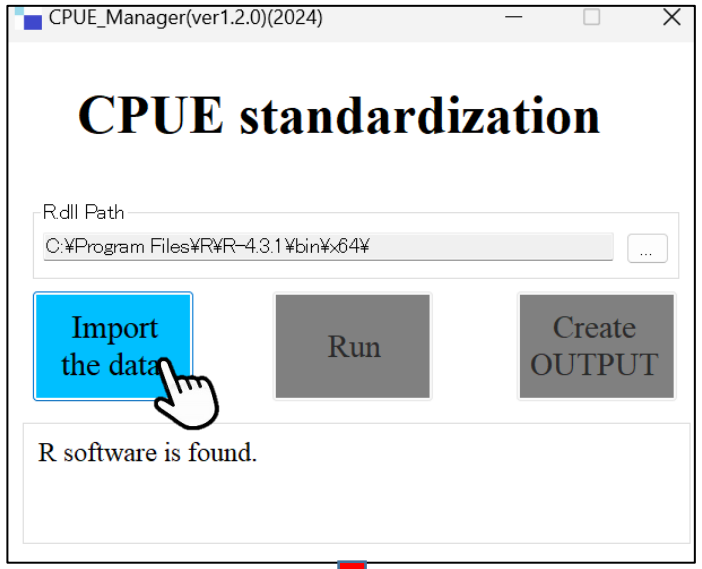
Hinton & Maunder (2004) ➔ invalid

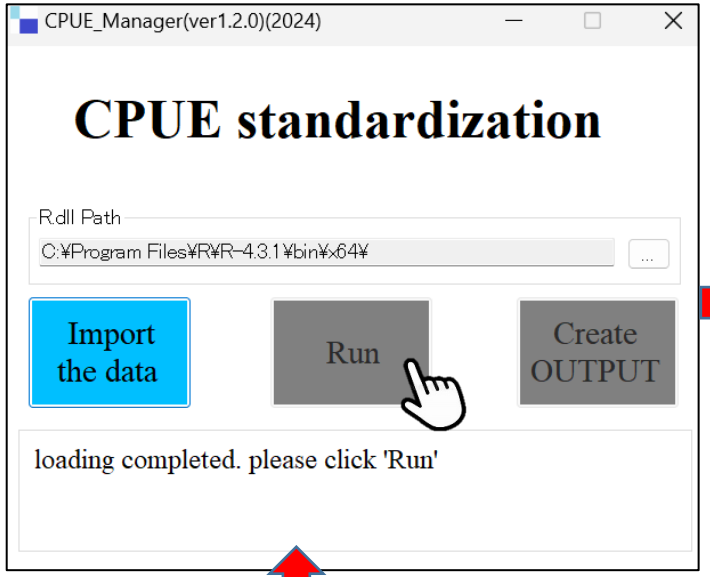
Maunder & Punt (2004)

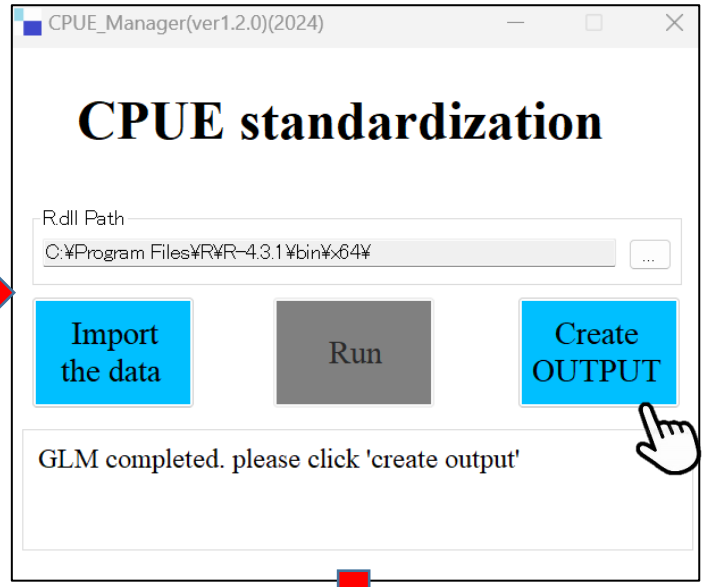
Identifying significant interactions with year

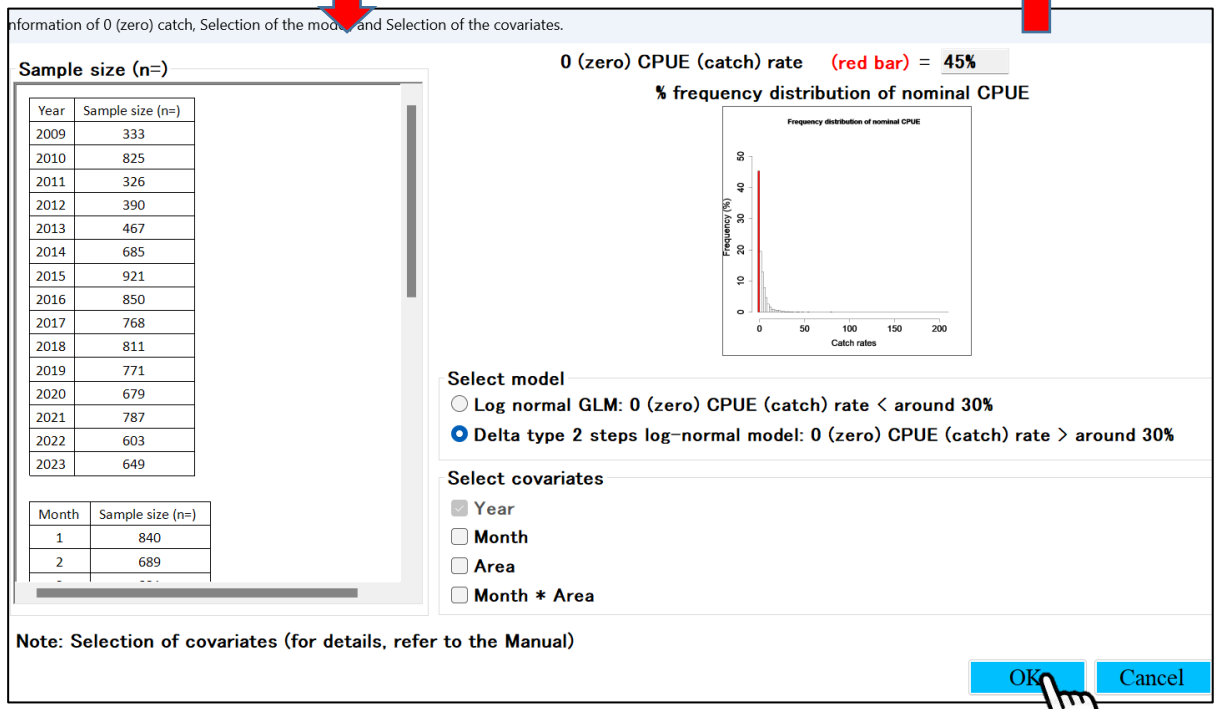
➔ no need (impossible to explain)

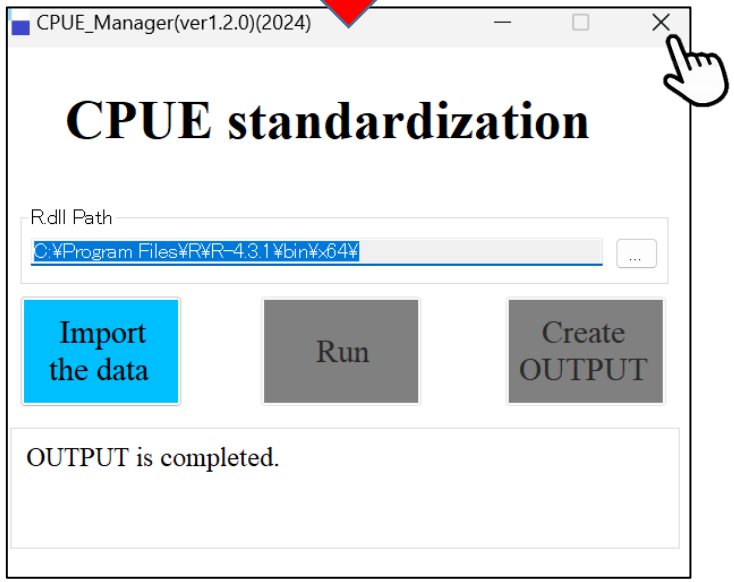
5.4.2 Implementing CPUE standardization (Delta model): Steps











5.4.2 Implementing CPUE standardization (Delta model): 3 outputs

Output file #	Results	Contents	Type	File name
(1)	① Sample size of covariates	Year, season, area, and interaction (season*area)	Data	Result(sample size)(Sample)(Delta)
(2)	① Standardized CPUE (Real values)	Standardized CPUE and 95% CI with nominal CPUE		Result(data)(Sample)(Delta)
	② Standardized CPUE (Scaled as average =1)			
(3)	① 0 (zero) catch rate	% freq. distribution of nominal CPUE with 0 catch rate	Graph	Result(all)(Sample)(Delta)
	② Two ANOVA Tables (Analyses Of Variances)	Statistical tests for a) delta (0 CPUE) model. b) log normal GLM & covariates (non 0 CPUE data)	Tables	
	③ Standardized CPUE Real values and Scaled (As average=1)	Standardized CPUE and 95% CI with nominal CPUE	Graphs	
	④ Residual analyses (Histograms and QQ plot)	To evaluate delta model and log normal GLM (non-zero CPUE data)		

5.4.2 Implementing CPUE standardization (Delta model): Output (1) Sample size (Covariates)

	A	B	C	D	E
1	Area	Sample size (n=)			
2	NTS	6,172			
3	STS	3,693			
4					

Year | Month | Area | Month x Area

Result(sample size)(Sample)(Delta)

	A	B	C
1	Year	Sample size (n=)	
2	2009	333	
3	2010	825	
4	2011	326	
5	2012	390	
6	2013	467	
7	2014	685	
8	2015	921	
9	2016	850	
10	2017	768	
11	2018	811	
12	2019	771	
13	2020	679	
14	2021	787	
15	2022	603	
16	2023	649	
17			

Year | Month | Area

	A	B	C	D
1	Month	Sample size (n=)		
2	1	840		
3	2	689		
4	3	831		
5	4	806		
6	5	698		
7	6	638		
8	7	741		
9	8	895		
10	9	988		
11	10	974		
12	11	928		
13	12	837		
14				
15				
16				
17				

Year | Month | Area | Month x Area

	Month*Area	Sample size(n=)	
2		Area	
3	Month	NTS	STS
4	1	566	274
5	2	399	290
6	3	518	313
7	4	469	337
8	5	387	311
9	6	366	272
10	7	439	302
11	8	557	338
12	9	644	344
13	10	609	365
14	11	669	259
15	12	549	288
16			

Year | Month | Area | Month x Area

5.4.2 Implementing CPUE standardization (Delta model): Output

(2) Standardized CPUE with its 95% CI (Confidence Interval) and nominal CPUE

Numerical results 2 sheet (excel)

Result(data)(Sample)(Delta)

Original scale

	A	B	C	D	E
1		Observed (nominal) CPUE	Estimated (standardized) CPUE	Lower boundary of 95% CI (2.5%)	Upper boundary of 95% CI (97.5%)
2	2009	3.61	1.60	1.41	1.82
3	2010	3.16	1.57	1.43	1.71
4	2011	1.14	0.26	0.18	0.36
5	2012	1.23	0.19	0.13	0.27
6	2013	1.87	0.32	0.24	0.44
7	2014	2.16	0.63	0.55	0.72
8	2015	3.25	0.95	0.86	1.05
9	2016	3.64	1.25	1.13	1.38
10	2017	4.91	1.99	1.80	2.20
11	2018	2.96	1.59	1.44	1.75
12	2019	1.96	0.90	0.81	1.00
13	2020	2.23	0.69	0.61	0.79
14	2021	3.92	1.30	1.18	1.43
15	2022	5.03	1.75	1.57	1.94
16	2023	5.84	2.36	2.14	2.61
17					

Original scale | Scaled CPUE (Ave=1)

Scaled as Ave=1

	A	B	C	D	E
1		Observed (nominal) CPUE	Estimated (standardized) CPUE	Lower boundary of 95% CI (2.5%)	Upper boundary of 95% CI (97.5%)
2	2009	1.15	1.38	1.36	1.40
3	2010	1.01	1.35	1.39	1.32
4	2011	0.36	0.22	0.18	0.28
5	2012	0.39	0.16	0.13	0.20
6	2013	0.60	0.28	0.23	0.34
7	2014	0.69	0.54	0.53	0.55
8	2015	1.04	0.82	0.83	0.81
9	2016	1.16	1.08	1.10	1.07
10	2017	1.57	1.72	1.74	1.70
11	2018	0.95	1.37	1.39	1.35
12	2019	0.63	0.77	0.78	0.77
13	2020	0.71	0.60	0.59	0.61
14	2021	1.25	1.12	1.14	1.10
15	2022	1.61	1.51	1.53	1.49
16	2023	1.87	2.04	2.07	2.01
17	Average	1	1	1	1

Original scale | Scaled CPUE (Ave=1)

5.4.2 Implementing CPUE standardization（Delta model）: Output

(3) Report (word) file

Result(all)(Sample)(Delta)

① % frequency distribution of 0 (zero) catch (CPUE) and % of 0 catch (CPUE)

② ANOVA Table

③ Trends of 4 annual CPUE (nominal, standardized and its 95% CI)

④ Evaluate model suitability (3 residual analyses)

-2 histogram analyses for log normal GLM & Delta model

-QQ plot for log normal GLM

5.4.2 Implementing CPUE standardization（Delta model）
Output(3) Report (word) file

①

% frequency distribution of nominal CPUE

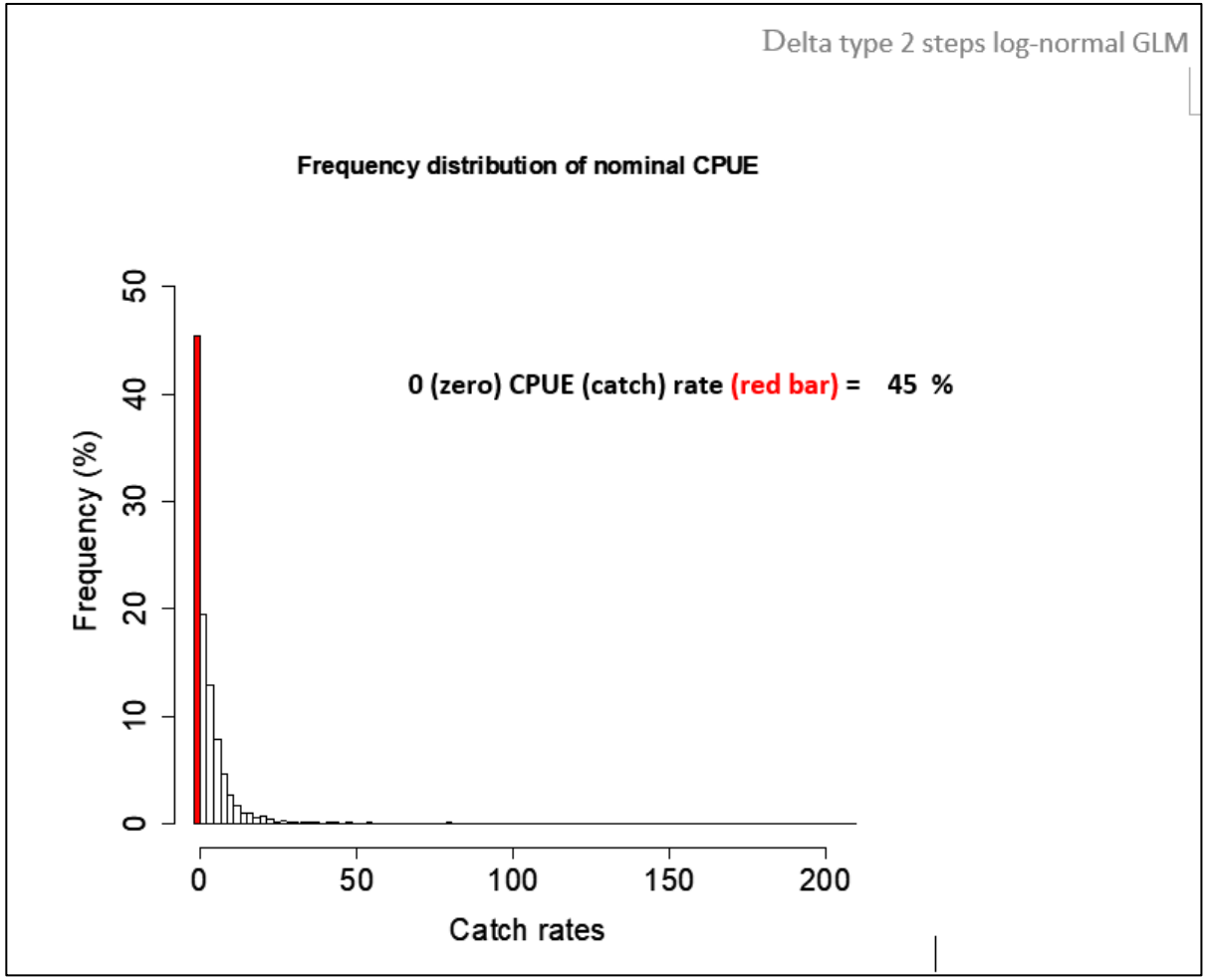
Red bar

0 CPUE (catch) rate

↓

if > 30%

use the delta mode



5.4.2 Implementing CPUE standardization (Delta model) Output(3) Report (word) file

② ANOVA Table (a)
if Pr < 0.05
for all covariates
(significant)

⇩

use Delta model

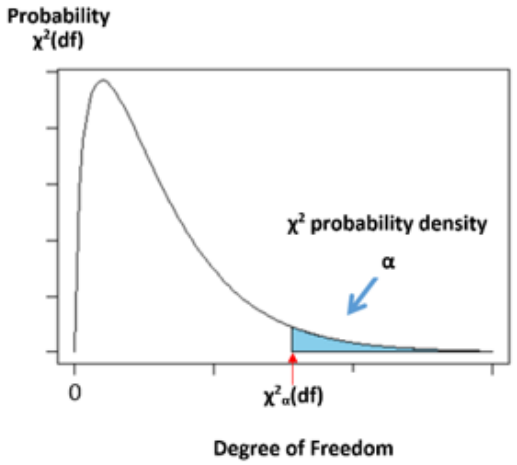
Otherwise
(No 0 CPUE affect)
➔skip 2nd step
and use log normal
GLM for original data
including 0 catch

ANOVA (Analysis Of Variance) table for delta model to test statistical significances on 0 (zero) CPUE (1st step)

Adjusted R^2 = 0.38

Source	df (Degree of Freedom)	χ^2 (Chi square) (test statistic)	<α:Probabaility (>χ^2) (*)
Year	14	1,368.40	0.000
Month	11	179.62	0.000
Area	1	179.97	0.000
Month*Area	11	140.23	0.000
Intercept (mean)	1	135.73	0.000

[Note] (*) Yellow maker indicates α ＜ 0.05 (5%)



5.4.2 Implementing CPUE standardization （Delta model）
Output(3) Report (word) file

② ANOVA Table (b)

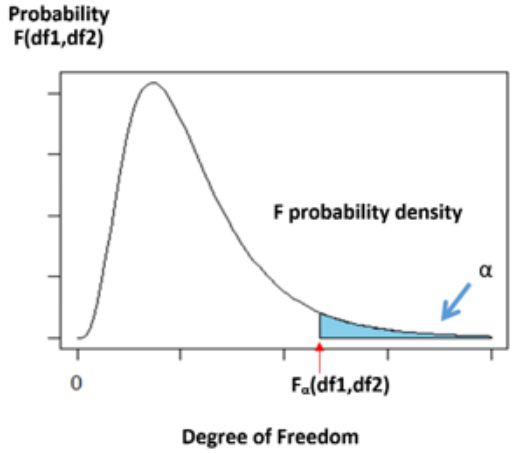
if Pr < 0.05
for model & all covariates
(Significant)

⬇

use log normal GLM

ANOVA (Analysis Of Variance) Table for log normal GLM model to test statistical significances on positive (non zero) nominal CPUE (2nd step)						
Adjusted R^2 = 0.31						
Sources	df1	df2	Type III SS (Sum of Square)	Mean Square	F (test statistic)	<α:Probabaility (>F) (*)
Model	37		1,306.11	35.30	31.36	0.000
Year	14		291.92	20.85	18.52	0.000
Month	11		589.00	53.55	47.57	0.000
Area	1		139.67	139.67	124.07	0.000
*Month*Area*	11		285.52	25.96	23.06	0.000
Error		5,351	6,023.54	1.13		

[Note] (*) Yellow maker indicates α ＜ 0.05 (5%)

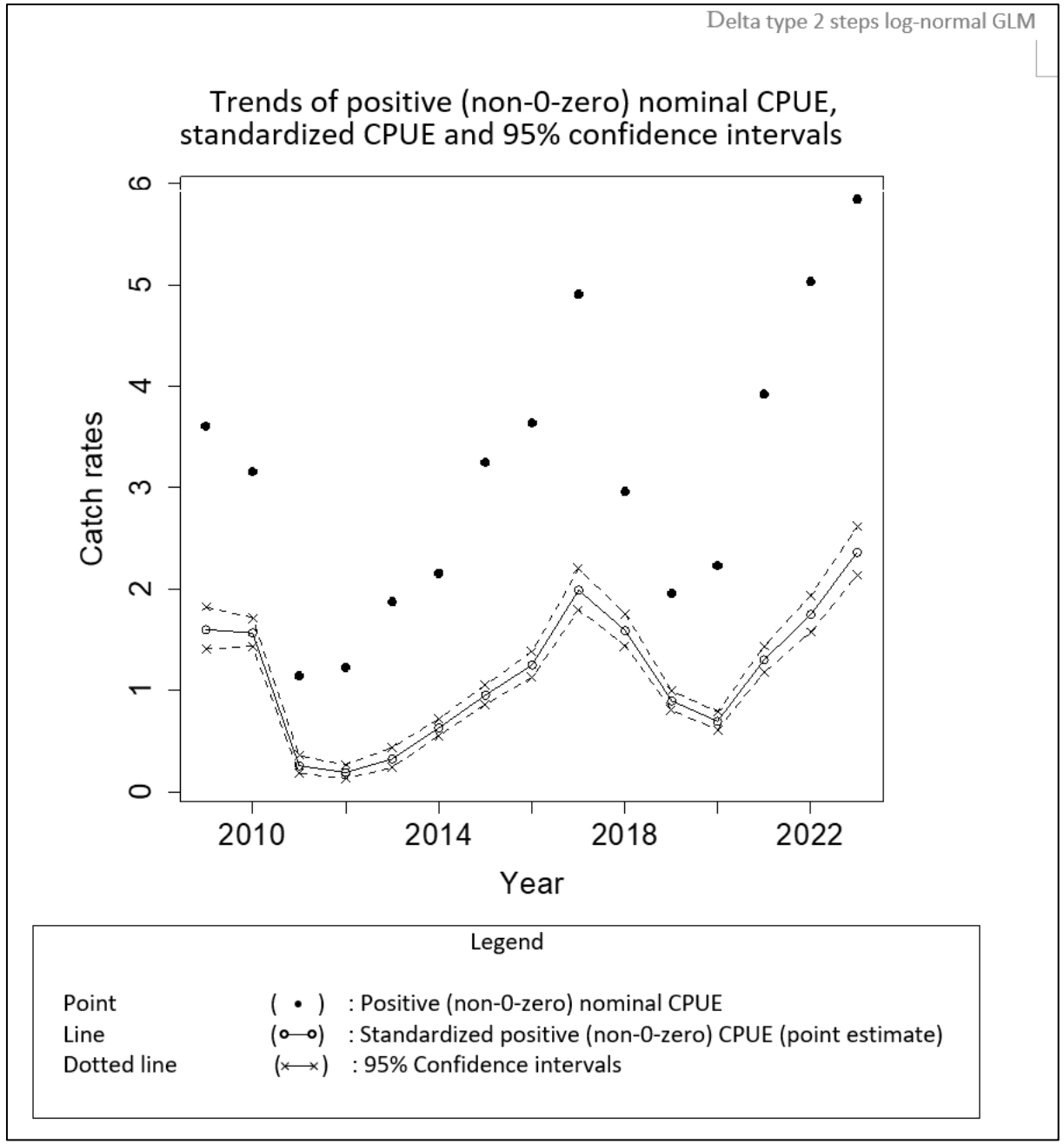


5.4.2 Implementing CPUE standardization（Delta model）
Output(3): Report (word) file

③

Annual trends

Nominal CPUE
and
Standardized CPUE
with 95% CI



5.4.2 Implementing CPUE standardization (Delta model)
Output(3) : Report (word) file

④-1

Evaluation (1st step)

delta normal

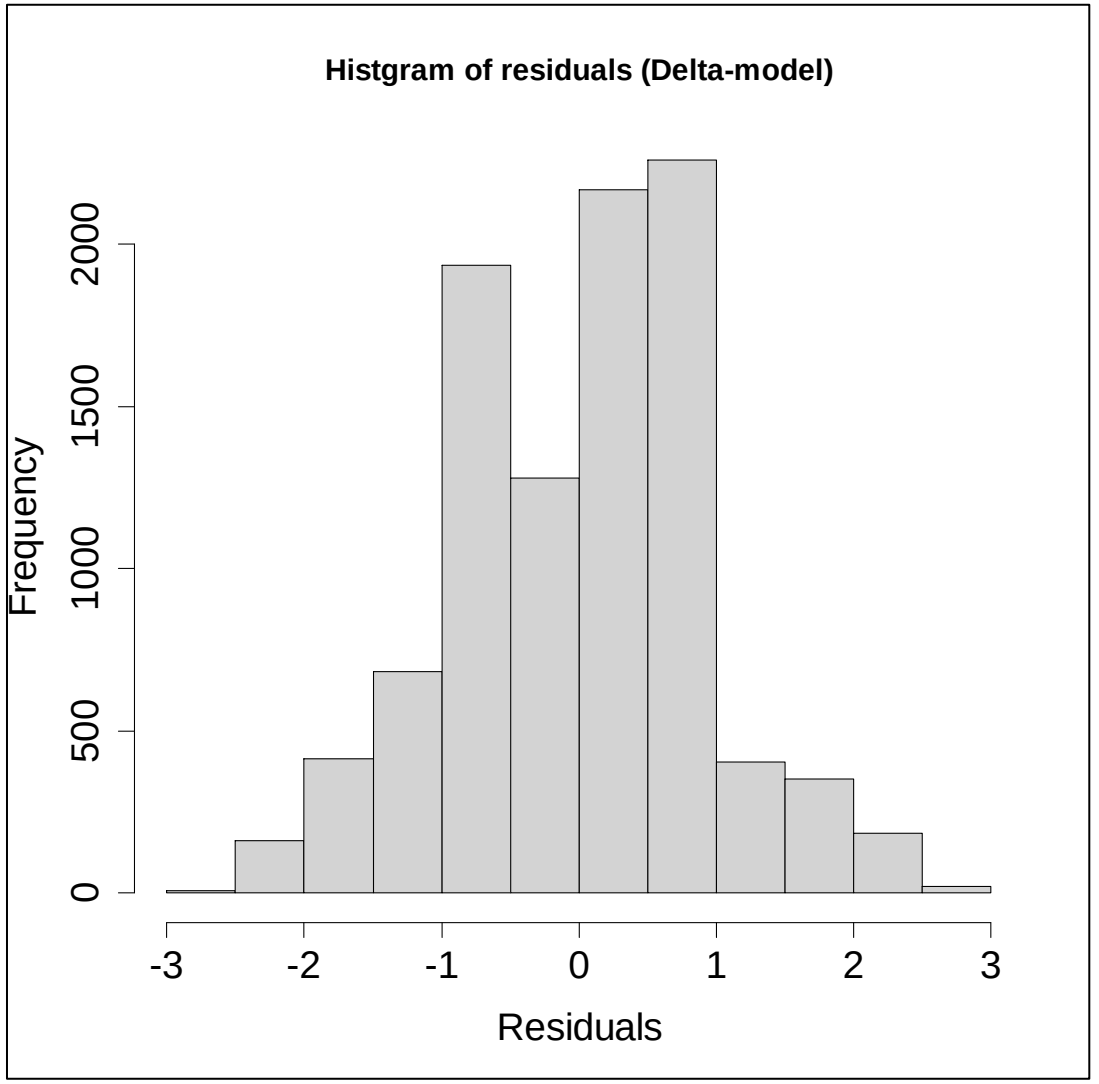
(Residual analyses)

if Bell shape

↓

model is OK

if not, change model



5.4.2 Implementing CPUE standardization (Delta model)
Output(3): Report (word) file

④-1

Evaluation (2nd step)

non zero 0

log normal GLM

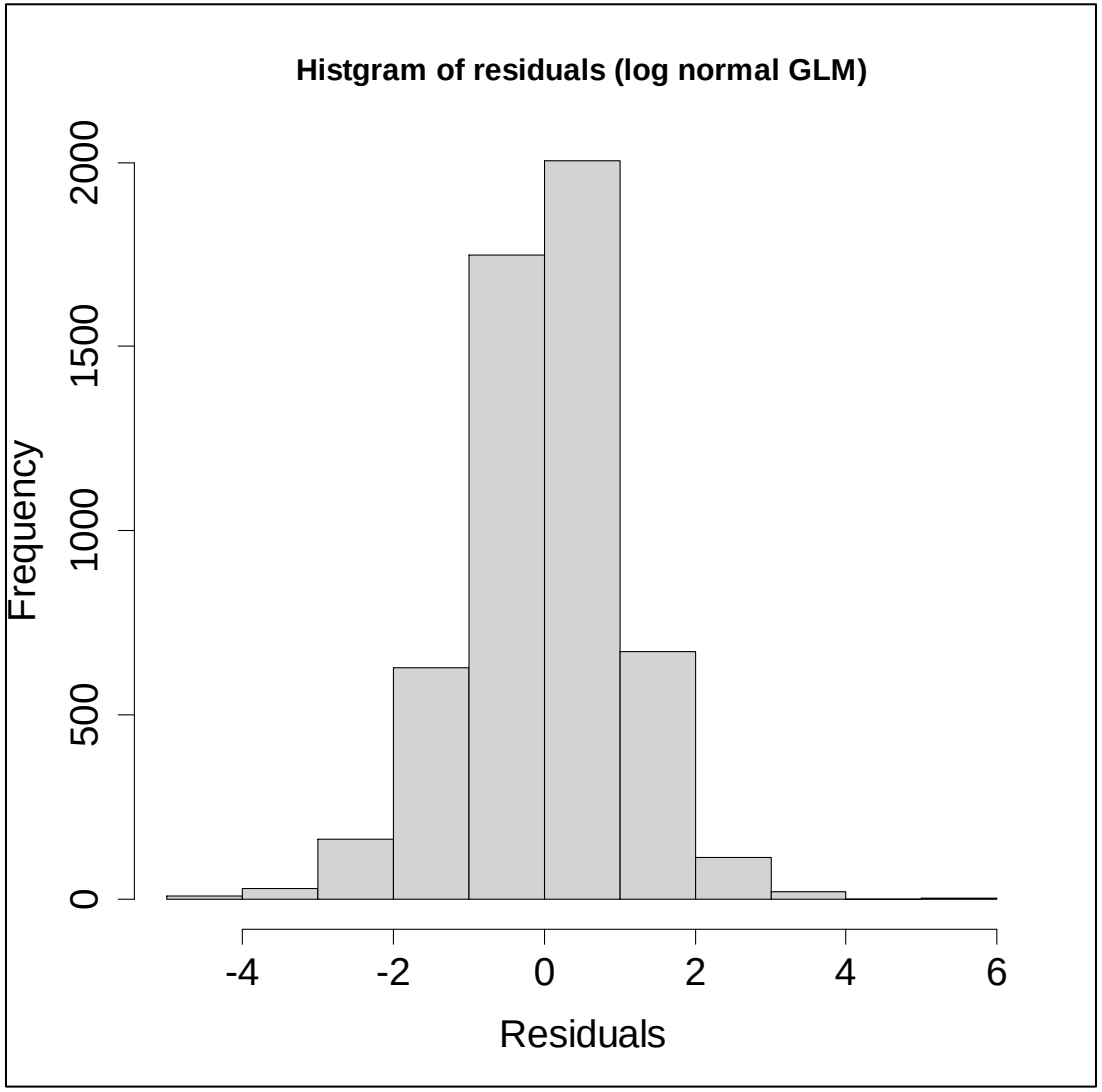
(Residual analyses)

if Bell shape

⇩

model is OK

if not, change model



5.4.2 Implementing CPUE standardization（Delta model）
Output(3) : Report (word) file

④-2

Evaluation of log normal GLM model (non 0 CPUE)
(Residual analysis)
QQ plot

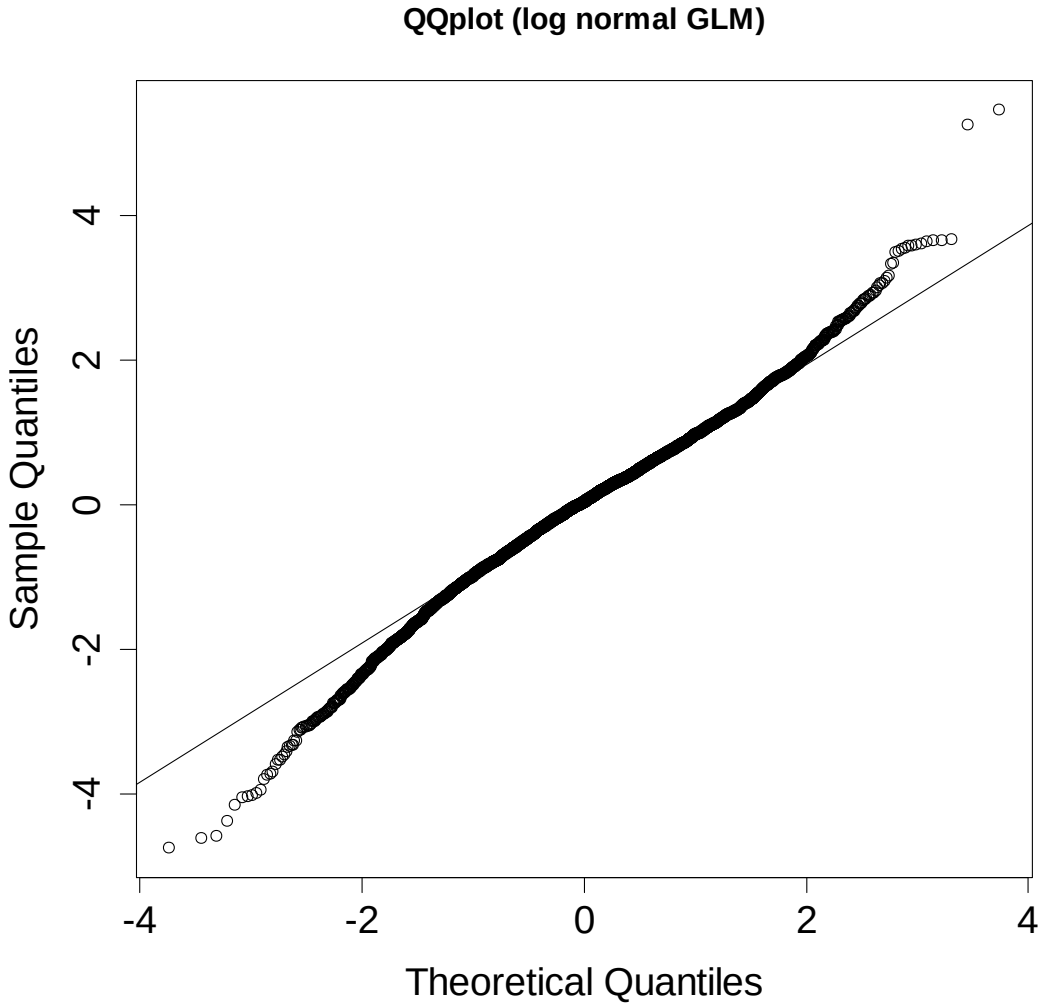
⇩

If residuals close to the straight line

⇩

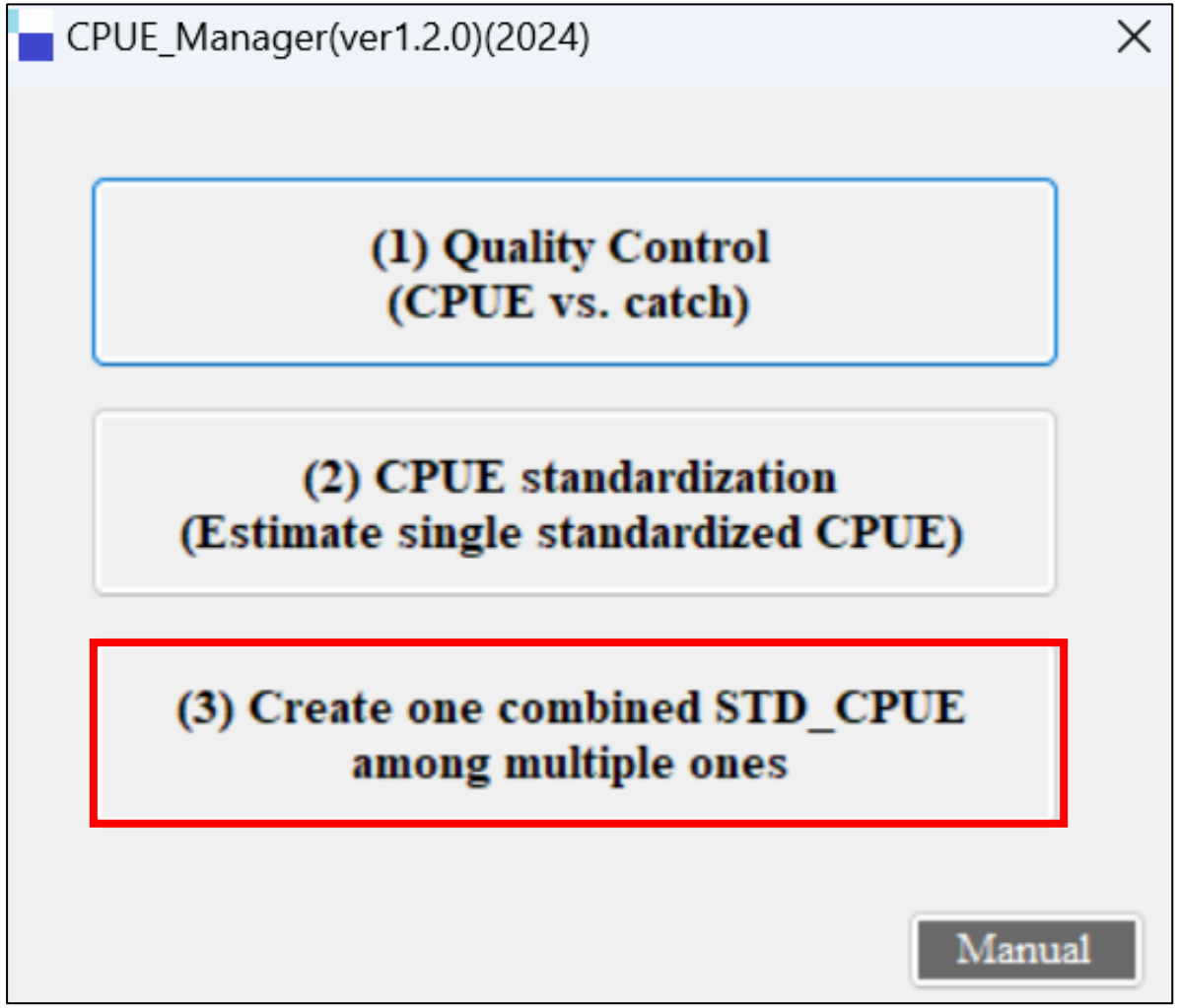
Model is OK

if not, change model



6. [3rd menu] Creating one common standardized CPUE

6. [3rd menu] Creating one common standardized CPUE



6. [3rd menu] Creating one common standardized CPUE

If multiple CPUE is available, which CPUE should be used in production models, "One average CPUE" or "Multiple CPUE"? : Pros and Cons

	Multiple CPUE	Combined single CPUE
Pros	Consistent with the model setup (assumptions)	Model converges easily
Cons	May not converged easily because of complexity of the model	Difficult to explain consistency between model settings (assumptions) and CPUE

ASPIC➔ Difficulty in achieving convergence in the case of multiple CPUE due to lack of data and/or complexity as a simple model. Therefore, a combined CPUE (weighted average by catch) is often used as an alternative.

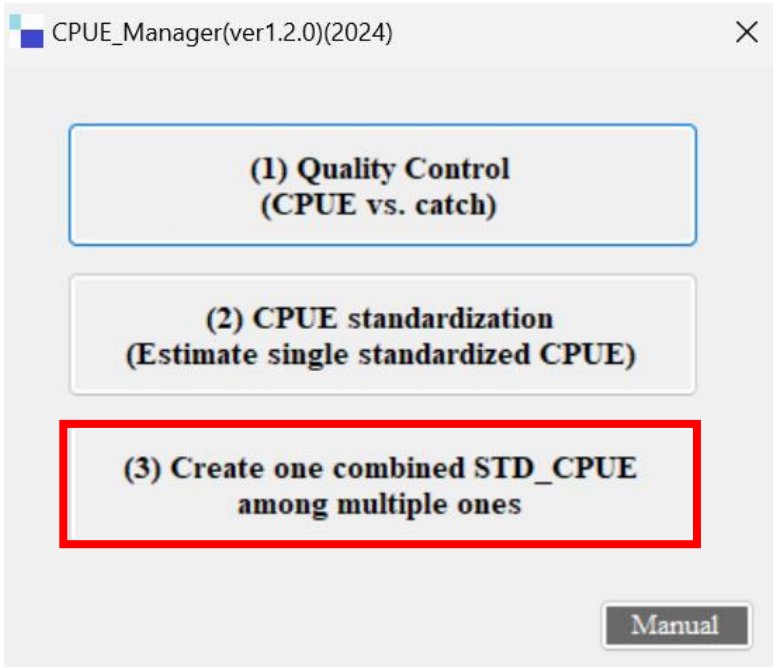
JABBA➔ Can handle better than ASPIC with technical treatments.

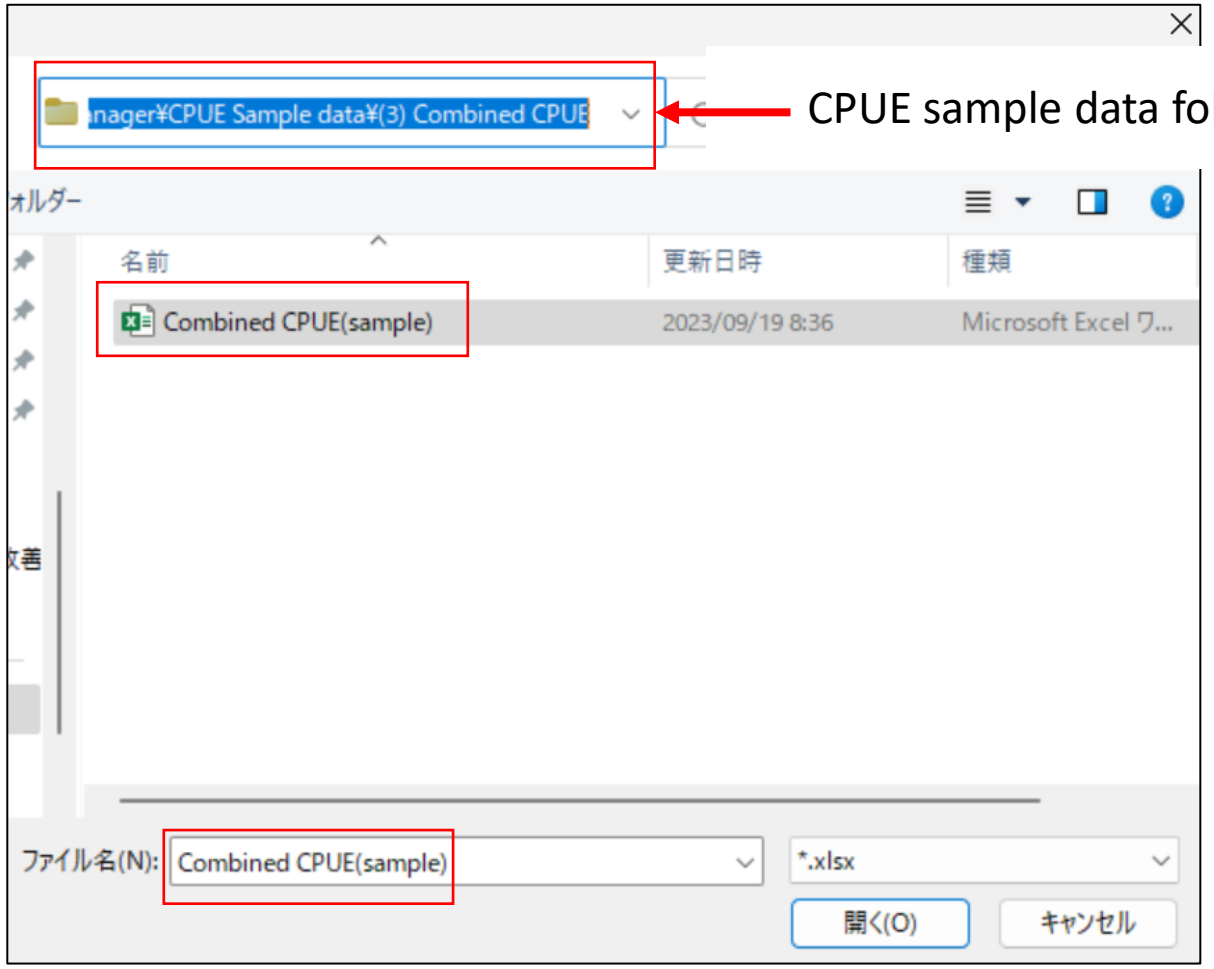
6. [3rd menu] Creating one common standardized CPUE

Preparation of multiple CPUE & Catch data sets (see sample data below)

	CPUE1	Catch 1	CPUE2	Catch 2	CPUE3	Catch 3
2011	1.27	13128	1.14	24	.	454654
2012	2.04	9797	0.59	435	1.98	223
2013	.	2308	1.57	354	0.93	23243
2014	0.98	2987	0.62	76	.	8856
2015	1.15	4523	1.14	43534	1.16	64564
2016	1.22	243432	1.84	354	1.47	54645
2017	.	9879	1.88	445	0.91	4654564
2018	0.96	9898	0.88	34	0.66	675
2019	0.69	65465	.	3543	1.21	68787
2020	1.27	4567	1.10	5654	0.62	3432
2021	0.65	876786	1.39	6876	1.66	345
2022	1.75	25443	.	123	0.65	34534
2023	0.69	98	0.62	234432	1.21	788978

6. [3rd menu] Creating one common standardized CPUE Importing the data



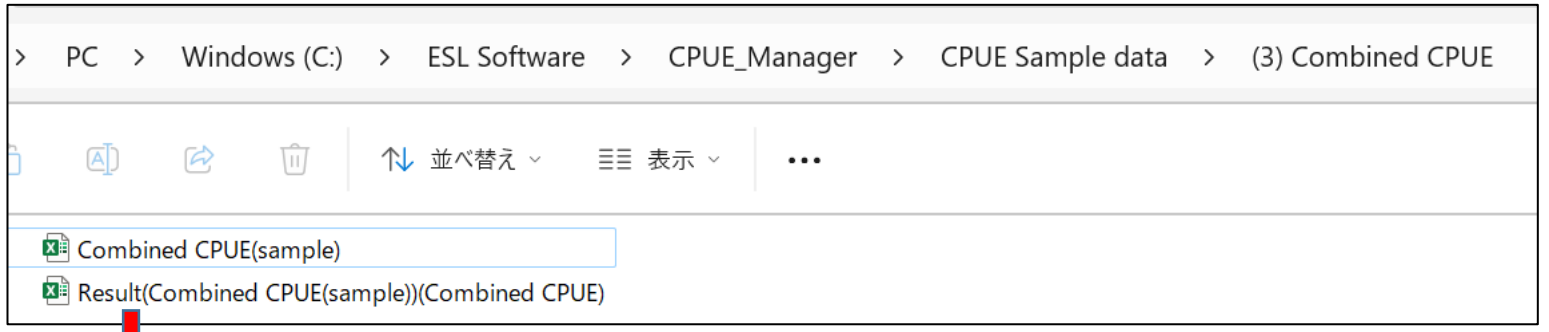


Importing the sample data (3 CPUE/Catch data sets)

6. [3rd menu]

Creating one common standardized CPUE

Results
(1st sheet)
Weighted & scaled CPUE



	A	B	C	D	E	F	G	H	I
1		CPUE1	Catch1	CPUE2	Catch2	CPUE3	Catch3	Weighted average CPUE by catch	Scaled CPUE (Ave=1)
2	2011	1.27	13128	1.14	24	.	454654	1.27	1.16
3	2012	2.04	9797	0.59	435	1.98	223	1.98	1.81
4	2013	.	2308	1.57	354	0.93	23243	0.94	0.85
5	2014	0.98	2987	0.62	76	.	8856	0.97	0.88
6	2015	1.15	4523	1.14	43534	1.16	64564	1.16	1.05
7	2016	1.22	243432	1.84	354	1.47	54645	1.27	1.16
8	2017	.	9879	1.88	445	0.91	4654564	0.91	0.83
9	2018	0.96	9898	0.88	34	0.66	675	0.94	0.85
10	2019	0.69	65465	.	3543	1.21	68787	0.96	0.87
11	2020	1.27	4567	1.10	5654	0.62	3432	1.04	0.95
12	2021	0.65	876786	1.39	6876	1.66	345	0.66	0.60
13	2022	1.75	25443	.	123	0.65	34534	1.12	1.02
14	2023	0.69	98	0.62	234432	1.21	788978	1.07	0.98
15								1.10	1.00
16									
17									
18									
19									
20									

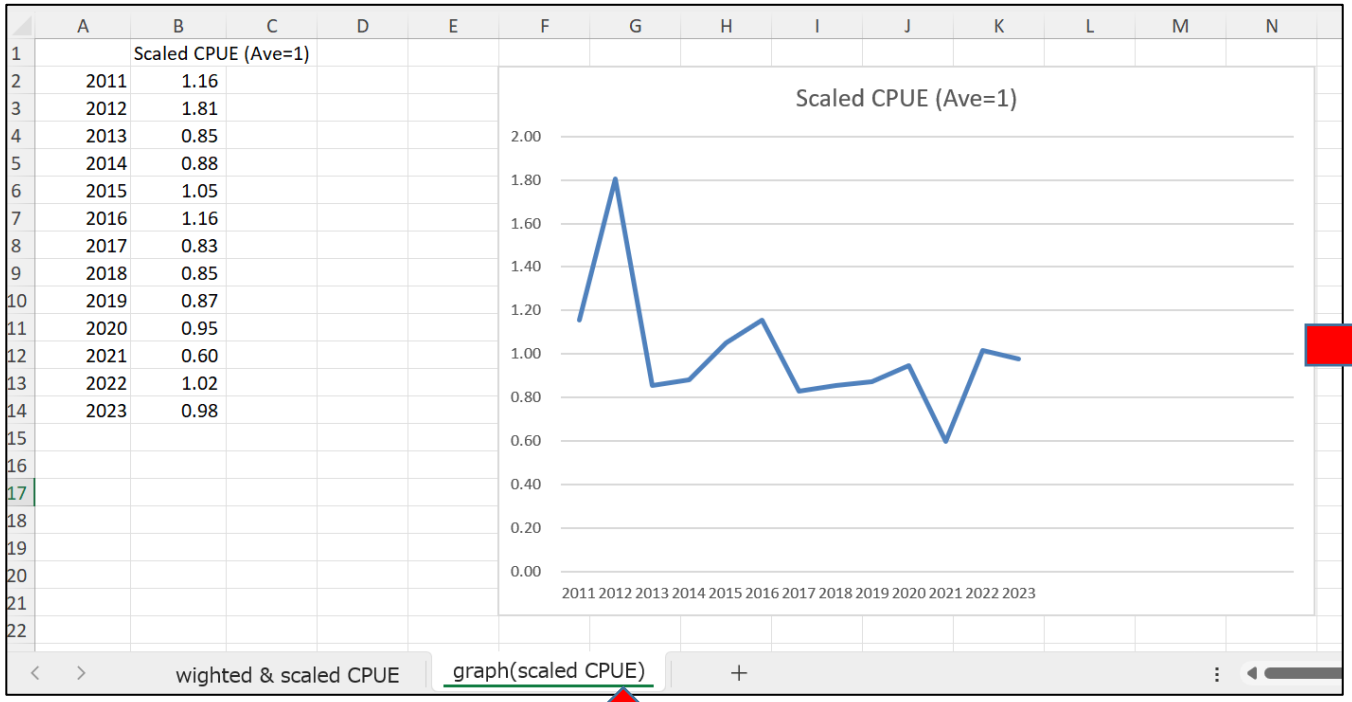
Original data

Result 1

wighted & scaled CPUE | graph(scaled CPUE)

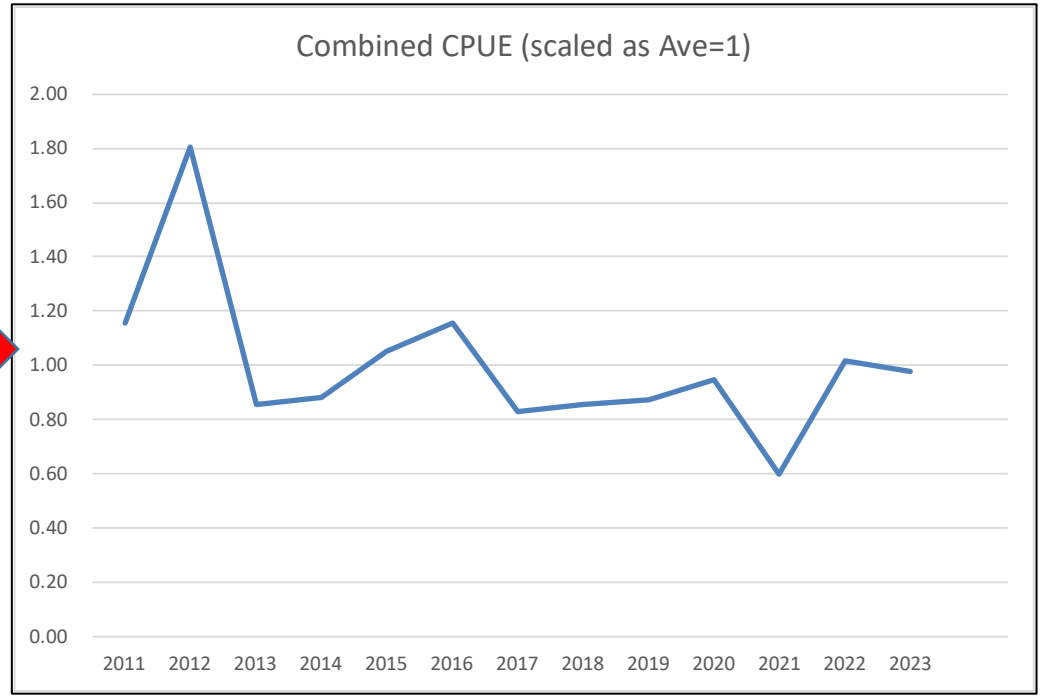
6. [3rd menu] Creating one common standardized CPUE

Results (2nd sheet) Graph for scaled average CPUE (weighted average by catch)



	A	B
1		Scaled CPUE (Ave=1)
2	2011	1.16
3	2012	1.81
4	2013	0.85
5	2014	0.88
6	2015	1.05
7	2016	1.16
8	2017	0.83
9	2018	0.85
10	2019	0.87
11	2020	0.95
12	2021	0.60
13	2022	1.02
14	2023	0.98

2nd sheet
(Default graph)



Users need to edit the default graph to finalize

Appendix A: History of development

Type	Version	Contents	Month, Year
Menu-driven CPUE standardization (specific) software	1.0	Original development (GLM based CPUE standardization)	April, 2016
	1.1	Minor improvements of the output (graphics and tables)	June, 2016
	1.2		February, 2018
	2.0	Additional function (Log-normal GLM & 0 inflated Delta 2 steps log-normal GLM)	May 2019
	2.1	Improvements of the output (graphics and tables)	April, 2021
New CPUE_Manager (3 menus)	1.0.0	Original development	August, 2023
	1.1.0	Minor improvement	September, 2023
	1.2.0	Upgraded New manual (PowerPoint)	January, 2024


Stock assessments for ALL
STOCK ASSESSMENT
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60%
7%
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