
**Data files**

**tracer_matrix.Rdata**

An R binary data, including the tracer model matrix named as \( A \) (which is denoted as \( A \) in the article). This matrix has a dimension \( 20484 \times 20484 \), and its \( i \)-th row \( j \)-th column element indicates the contribution of unit individual density (per liter) in cell \( j \) to eDNA concentration (copies per liter) in cell \( i \).

**cell_attributes.csv**

A data table of attributes of each grid cell of the tracer model, with the following columns:

- **no**: Unique ID of the grid cell.
- **lon**: Longitude of the grid cell.
- **lat**: Latitude of the grid cell.
- **dep**: Water depth (m) of the grid cell.
- **dep_level**: Vertical layer of the grid cell.
- **vol**: Water volume (m\(^3\)) of the grid cell.

**eDNA_measurements.csv**

A data table of the eDNA survey, with the following columns:

- **st**: Unique ID of the sampling station.
- **dep**: The level of depth where the sample was collected. With three levels: \( B \) (bottom), \( M \) (medium), and \( S \) (surface).
- **conc**: Concentration of eDNA (copies/L).
- **cell**: The ID of the grid cell of the tracer model which corresponds to the water sampling location.

**acoustic_measurements.csv**

A data table of the acoustic survey, with the following columns:

- **Sv**: Extracted volume backscattering strength value \( (S_V) \) to determine individual density per 1 m\(^3\) water cube.
- **cell**: The ID of the grid cell of the tracer model which corresponds to the \( S_V \) measurements.

**coarser_cells.csv**

A data table of integers that indicate IDs of coarser grid blocks for each grid cell.
200m Used for 200 m grid blocks.
300m Used for 300 m grid blocks.
400m Used for 400 m grid blocks.

R scripts

01_fit_model_eDNA.R
Fit the tracer model to the eDNA survey dataset.

02_fit_model_echosounder.R
Fit a linear mixed model to the acoustic survey dataset.

03_reproduce_main_results.R
Post-process the model fit objects to obtain the results shown in the main text.

04_fit_coarser_models.R
Fit the tracer model to the eDNA survey dataset in which fish density is estimated in coarser grid blocks.

05_reproduce_supplementary_results.R
Post-process the model fit objects to obtain the results shown in the supplementary file.

functions.R
Define the following auxiliary functions:
aggregate_abundance() Calculate vertically aggregated abundance.
aggregate_density() Calculate vertically aggregated density.
draw_map() Plot a map of fish density in Maizuru Bay.

Stan scripts

model_eDNA.stan
A Stan model code for the eDNA survey dataset.

model_eDNA_coarser.stan
A Stan model code for the eDNA survey dataset. Fish density is estimated in coarser grid blocks.

model_echosounder.stan
A Stan model code for the acoustic survey dataset.