

Progress habitat suitability modeling

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Recap previous work



Completed work

- Habitat model for different life events of Ayu fish
- Habitat simulations for 3 separate hydrological years in varying sequences without bed level updates and with water quality for 3 reservoir flushing scenarios
- Results showed that discharge dynamics have larger effects than flushing scenarios

Recommendations

- Long-term hydro-morphodynamics including sediment transport, bed level updates and substrate distribution



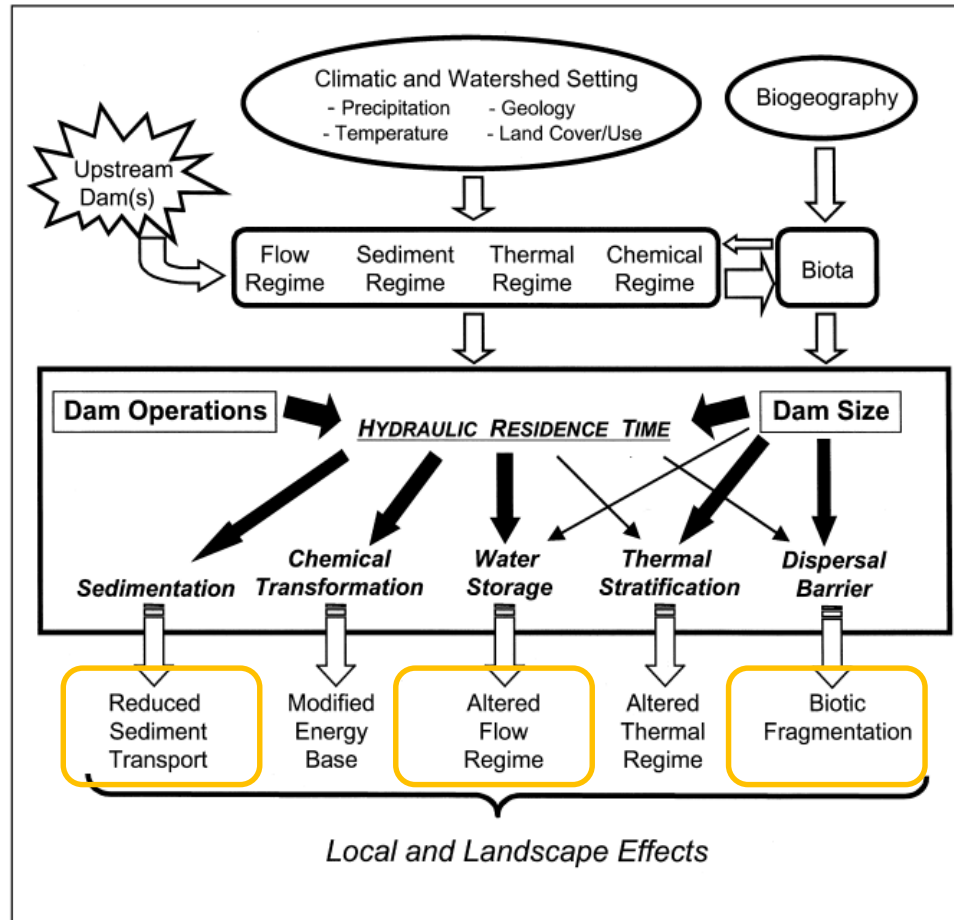
Main project

- Refining habitat model with long-term hydro-morphodynamics, water quality and changes in bed level

TKI project 2018 (extended until March 2019)

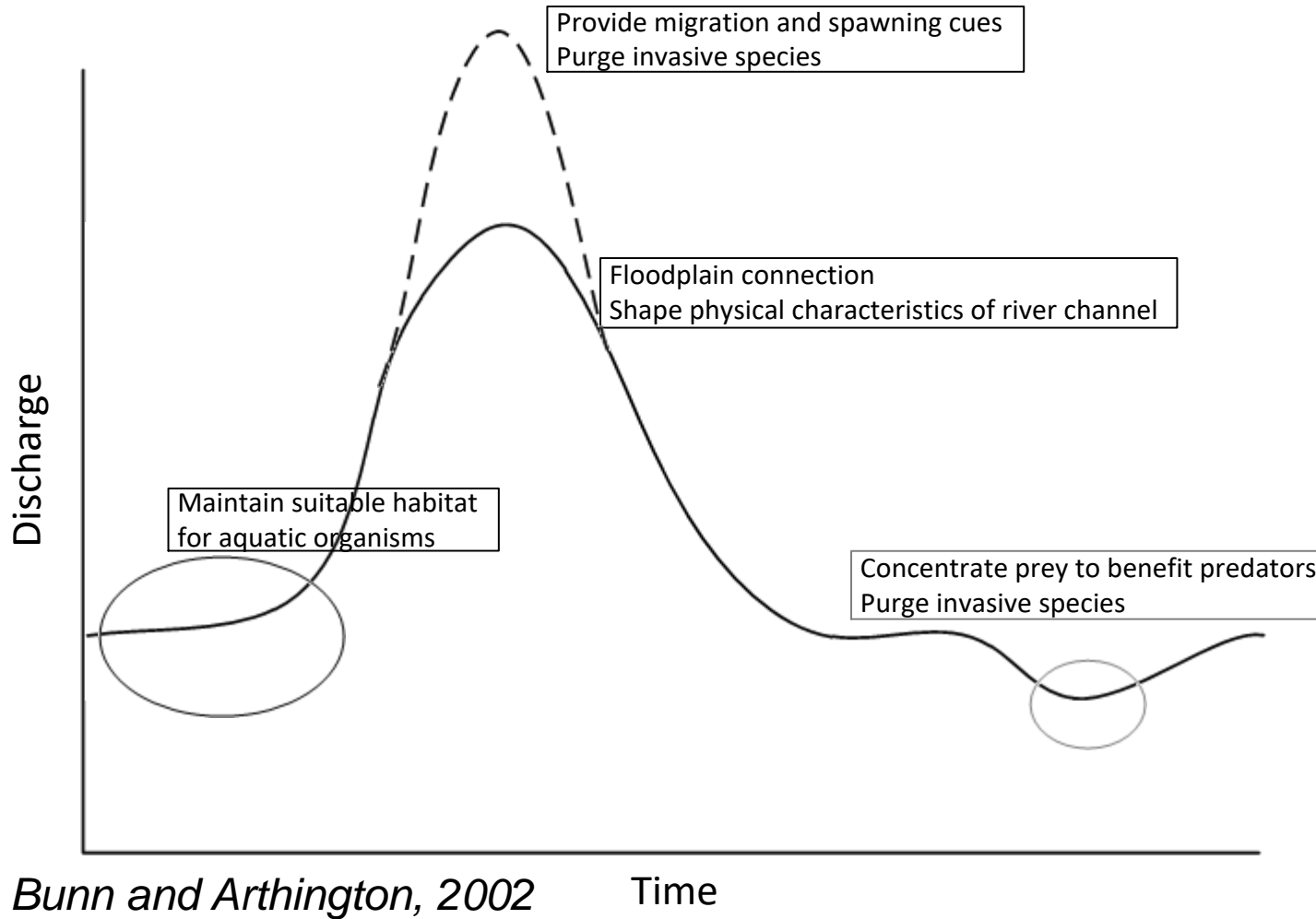
- Literature survey ecological implications of reservoir management
- Improve workflow HABITAT
- Habitat suitability analysis (meta-model) with new developments

Literature survey ecological implications reservoir dams



Poff & Hart 2002

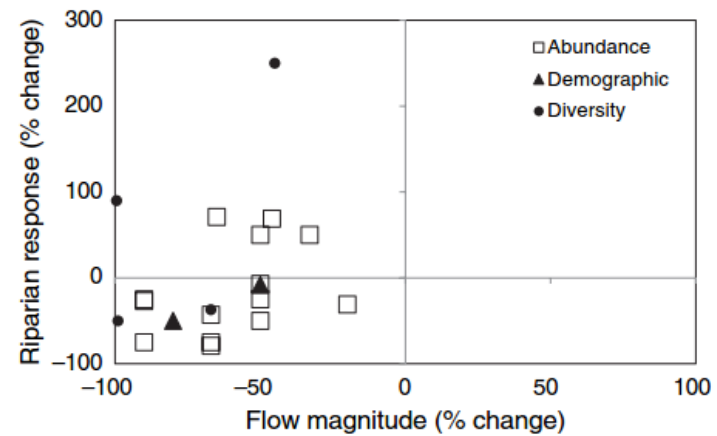
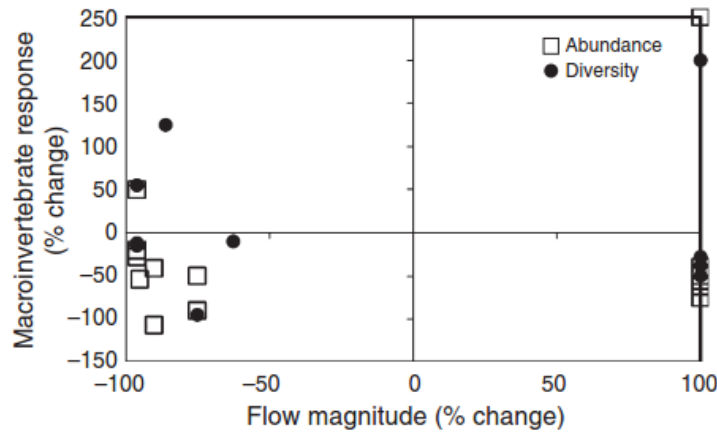
Natural flow regime



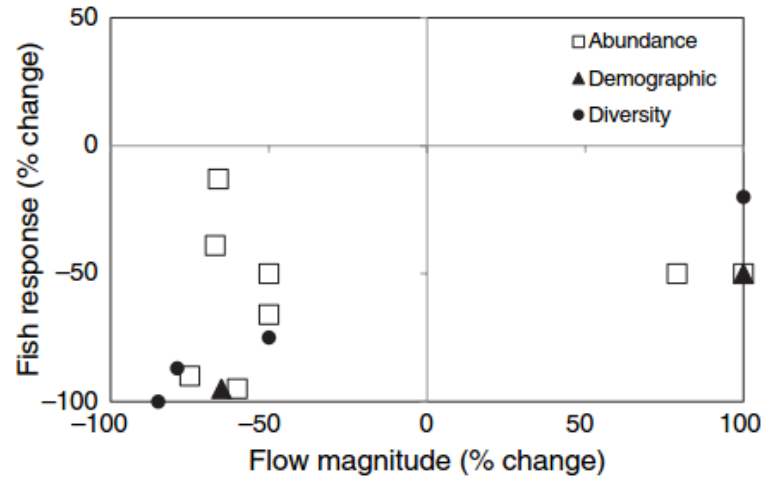
Effects of flow alteration



Any alteration in river flow leads to changes in the river ecosystem



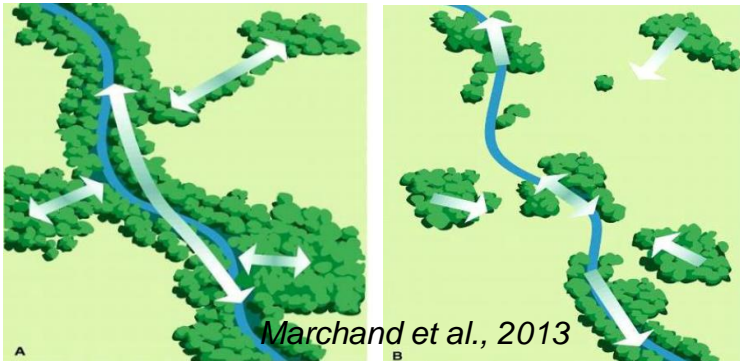
Poff & Zimmerman, 2010



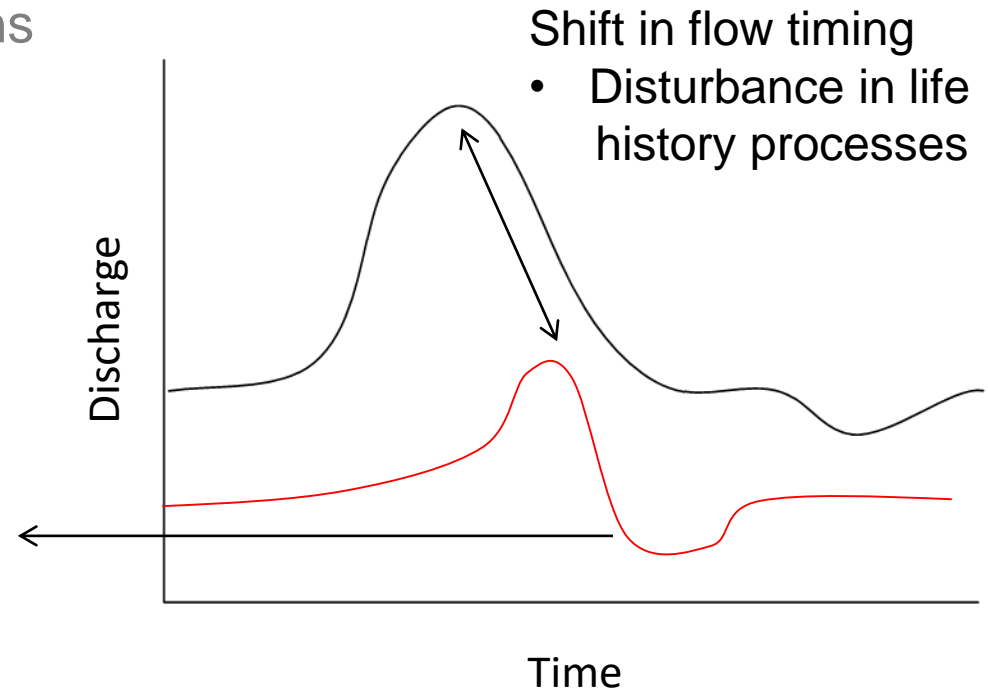
Effects of flow alteration



- Reduced flow
 - Disconnected floodplains



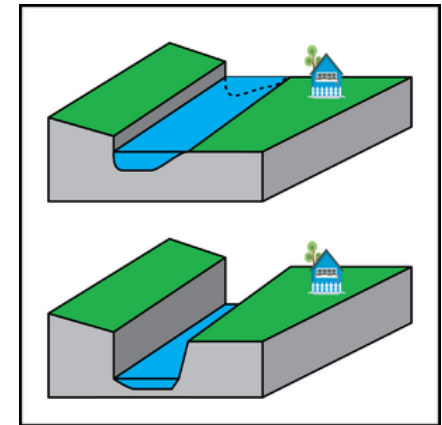
- Dry river bed



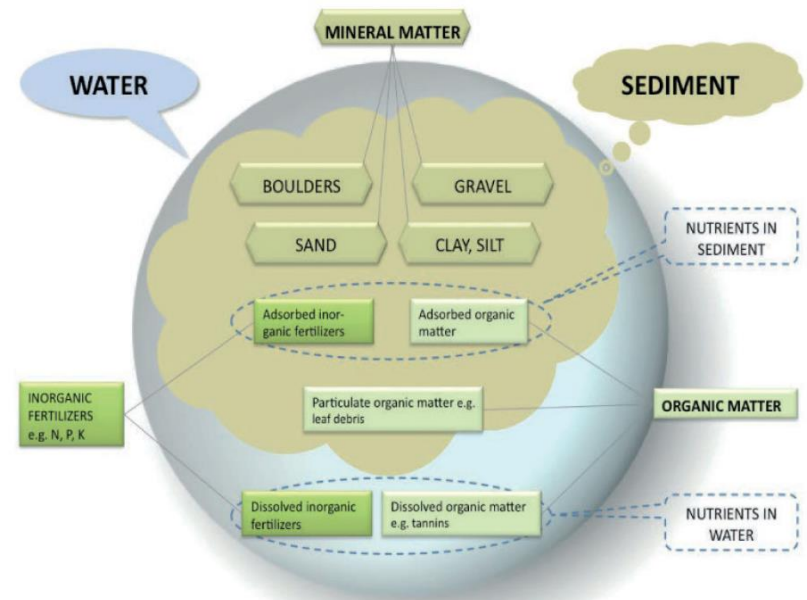
Sediment



- Dams trap sediment
 - River incision
 - Less sediment for habitat building
 - Less nutrients



Baran et al., 2015

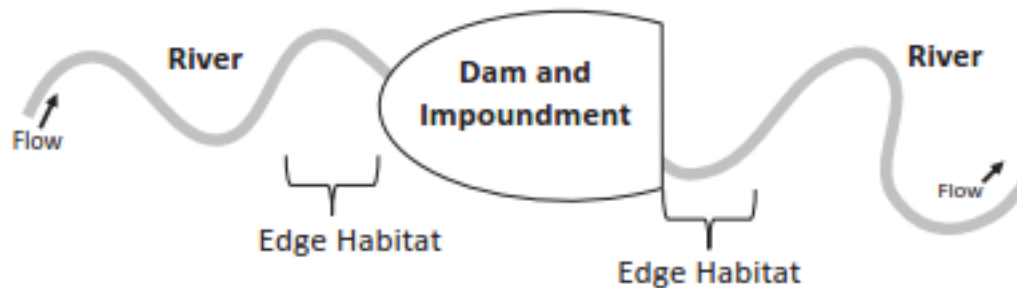


Piman & Shrestha, 2017

Habitat Fragmentation



- Dams block migration routes for fish
 - Physical obstructions
 - Changed habitat conditions



- Especially long distant migrant species (e.g. anadromous or catadromous species) are affected

Reservoir management



- Important concept is: environmental flows (e-flows)

‘Environmental flows describe the quantity, frequency, timing and quality of water and sediment flows necessary to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend on these ecosystems (Worldbank 2018, amended from the Brisbane declaration 2007)’

- How much has the flow regime been altered?
- How does the altered flow- and sediment regime affect downstream ecosystems?
- How are all benefits and impacts distributed among stakeholders?

Reservoir management



- Defining environmental flows can help to create a flow-regime that balances both ecological and socio-economic interests
 - Adapting flushing regimes to minimize ecological effects
 - Regulating discharges during spawning to create more spawning sites for Ayu
- Design of functional fish traps to promote fish migration
- New developments regarding sediment management (e.g. Kondolf et al., 2014)

Environmental flow example



- Advanced E-flow method in Murray-Darling basin, Australia
- Separate authority that determines water limits for diversion and environment
- Based on available water, choices are made to inundate parts of the wetland
- Advanced vegetation monitoring, linked to inundation schemes and climatic conditions continuously improves the water provision



Dyer et al., 2018

Improving workflow HABITAT

- A Python library is created with HABITAT functions

The screenshot displays the HABITAT software interface. The main window is titled "TestModel* - Habitat" and shows a Python script being edited. The script is a test script for setting up an automated HABITAT model structure. The code includes comments and imports for standard and habitat functions, and sets up the main model structure for spawning.

```
1 # Test script for setting up an automated HABITAT model structure
2
3 #region imports for habitat functions
4 from Libraries.StandardFunctions import *
5 from Libraries.HabitatFunctions import *
6
7
8 import os # for reading paths
9 import csv # for reading and writing *.csv files
10
11 # set location of input maps and output
12
13 InputDir = "D:\\oorscot\\Documents\\Projecten\\Sedi
14 ResponseDir = "D:\\oorscot\\Documents\\Projecten\\S
15 OutputDir = "D:\\oorscot\\Documents\\Projecten\\Sec
16 #endregion
17
18 #region Setup main model structure
19 # 1. Create composite model for spawning
```

The interface also shows a project tree on the left with folders like "TestModel", "Script1", "testsript", "RunModels", and "Spawning". The "Spawning" folder is expanded, showing sub-items like "FlowvelocityS", "TemperatureS", "SSS", "DOS", "ResultSpawning", "Egg_Incubation", "Descending", "Ascending", "Feeding", "RunAllModels", "Setting up model structure", "Test script Hidde", and "Test script Hidde 2". The right side of the interface features a "Toolbox" with a "Settings" section containing a list of scripts and functions, including "HabitatModelType", "AddBrokenLinearReclassificationRow", "AddMultiTableReclassificationRow", "ClearAllRows", "CreateEmptyMap", "CreateEquation", "CreateModel", and "ExportToFile".

Improving workflow HABITAT



- This allows:
 - automated setup of the habitat model (i.e. model structure and input data)
 - automated running of several scenarios by updating input maps in a loop
- Advantages are:
 - increased speed in setting up and running the models
 - decreasing typos in defining response curves
 - fast addition of new response curves

Long-term hydro-morphodynamic modeling



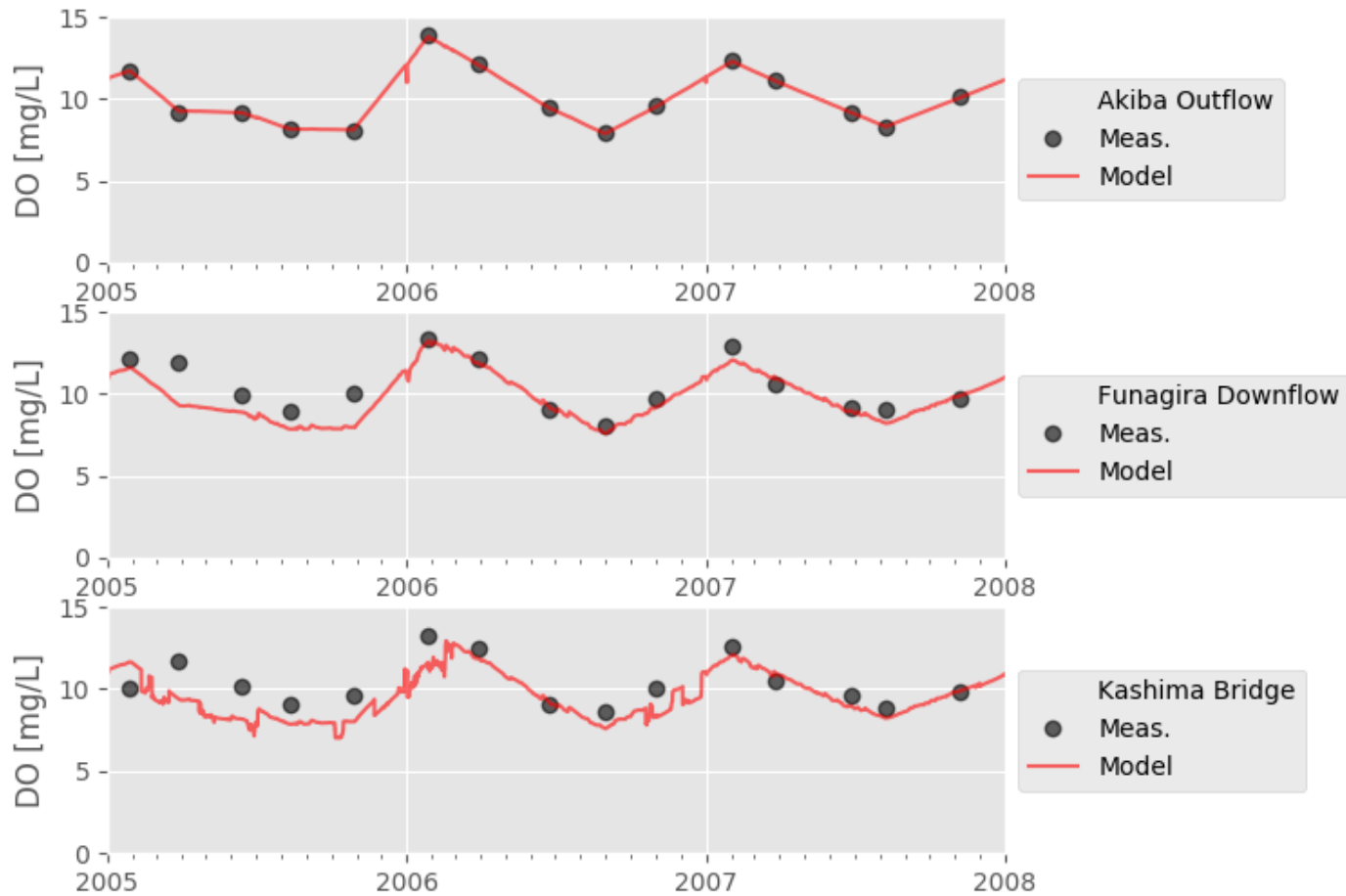
- No stable long-term hymo & WQ model available yet
 - No new habitat modeling results
- Long-term morphological development was not stable at downstream boundary
- Now testing with new settings (Update Amgad)

Water quality model

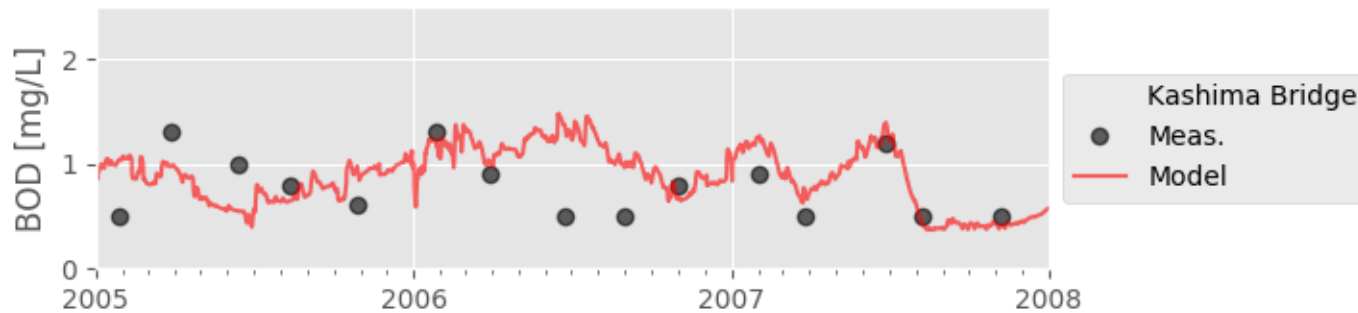
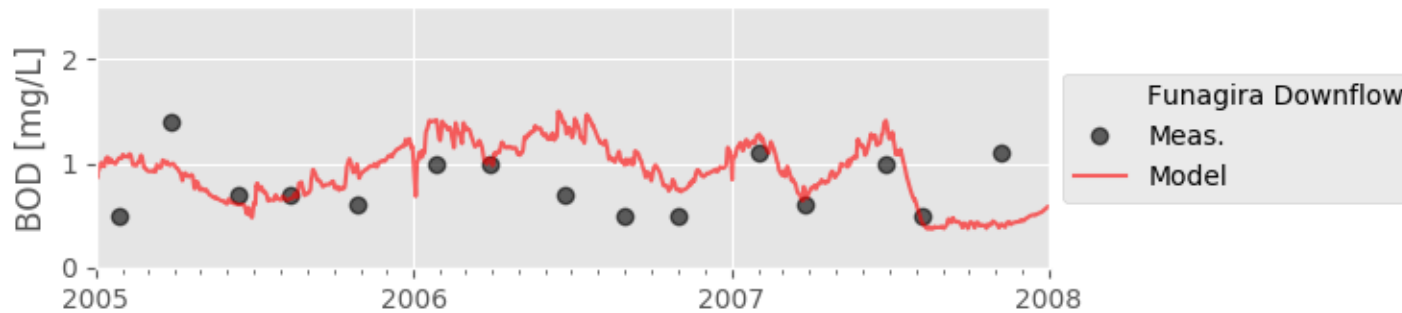
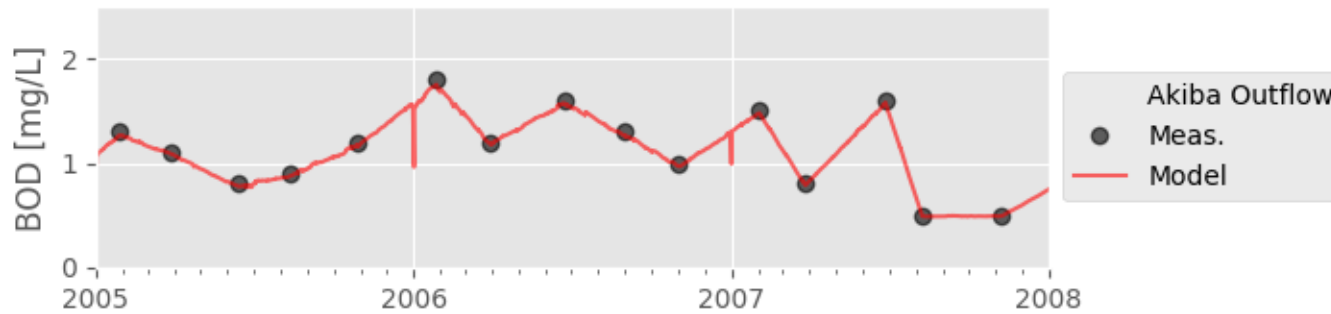


- Challenge in WQ model to deal with higher Morfac due to non-linear WQ processes at different time scales (e.g. re-aeration)

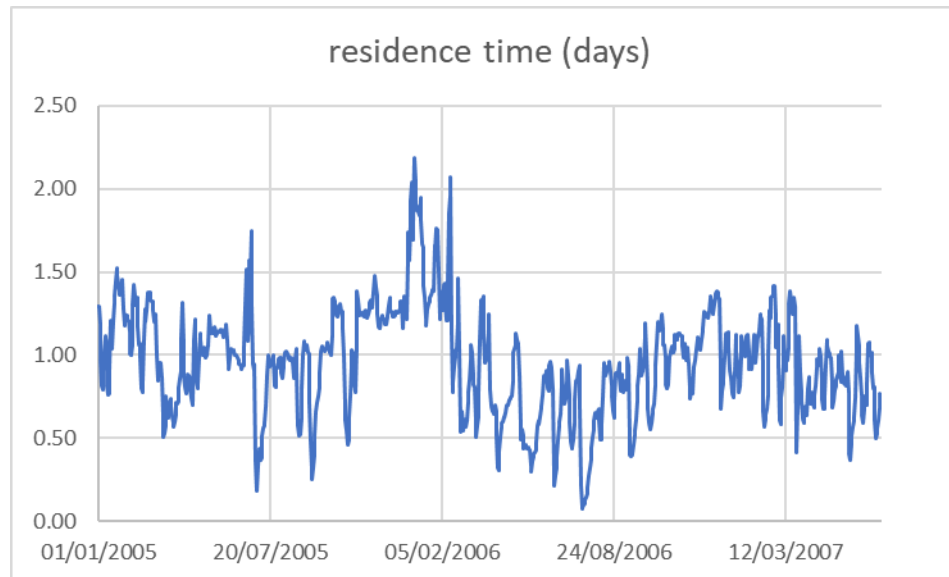
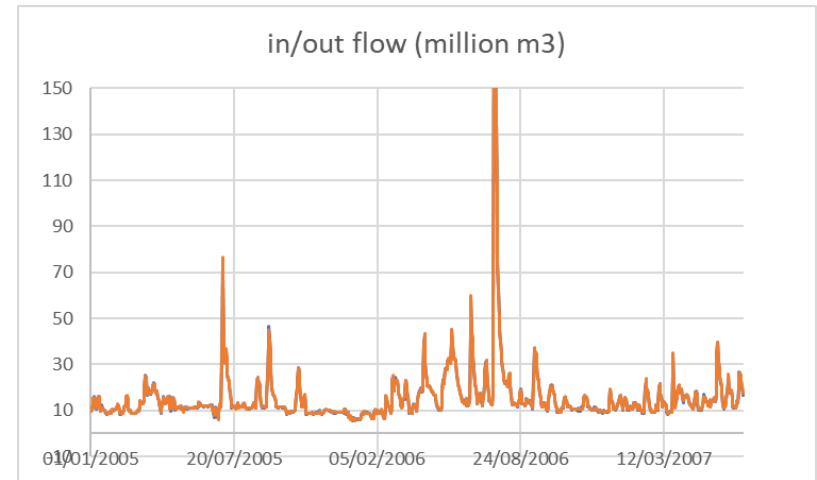
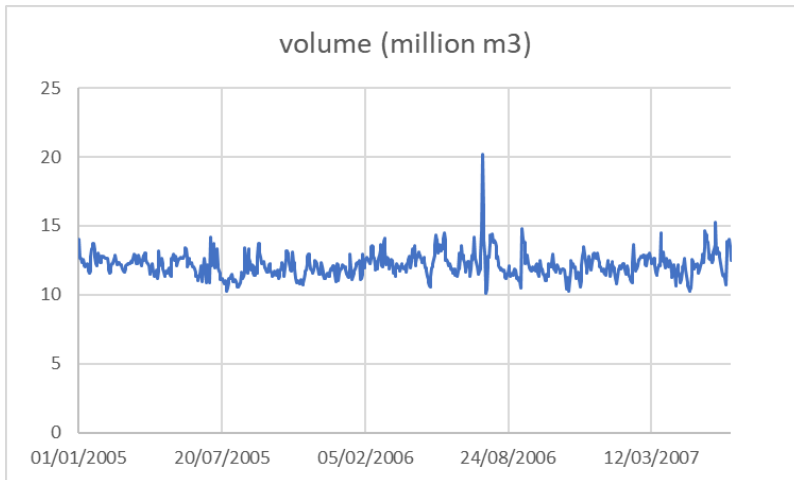
Previous results oxygen



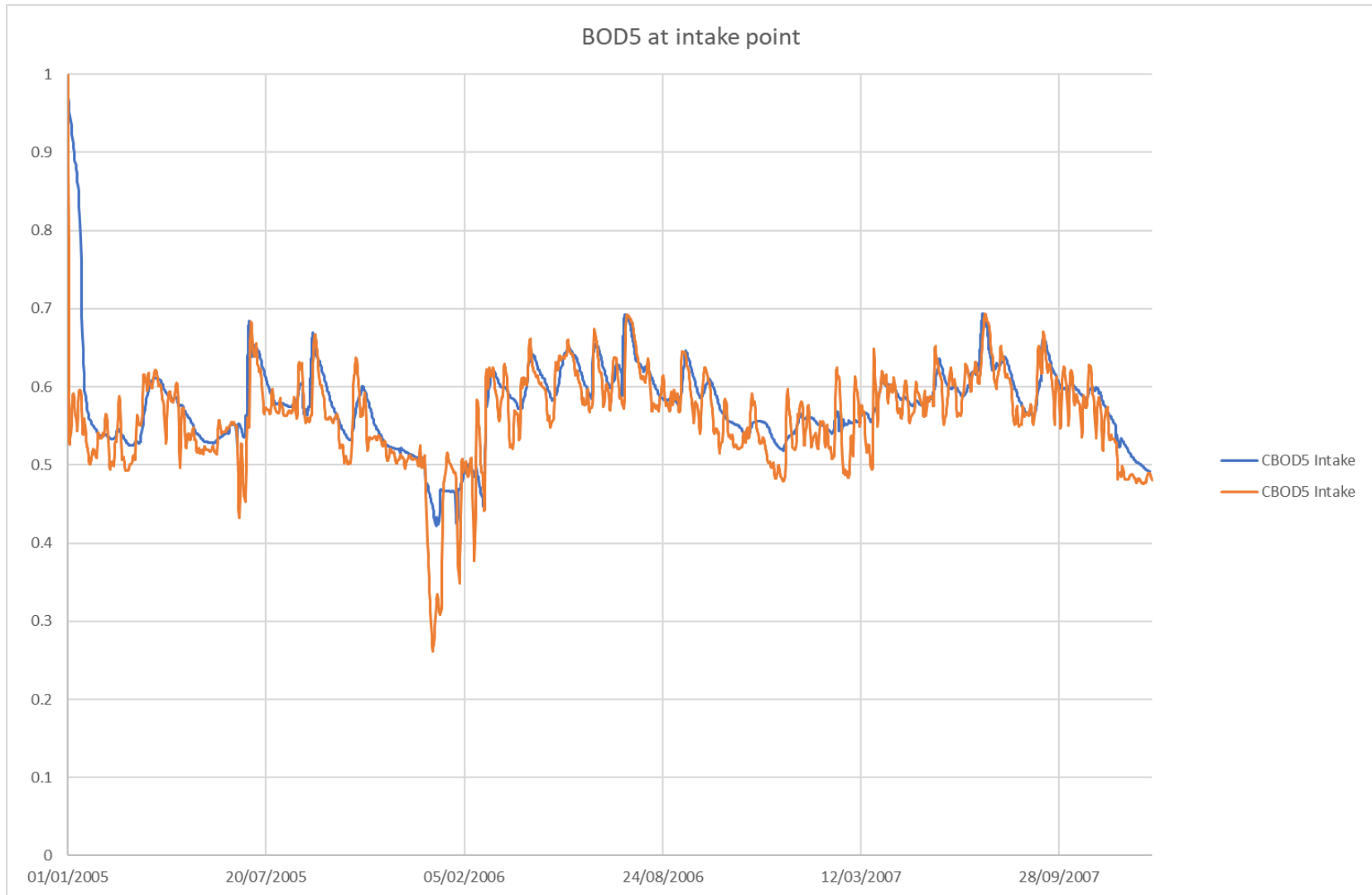
Previous results BOD



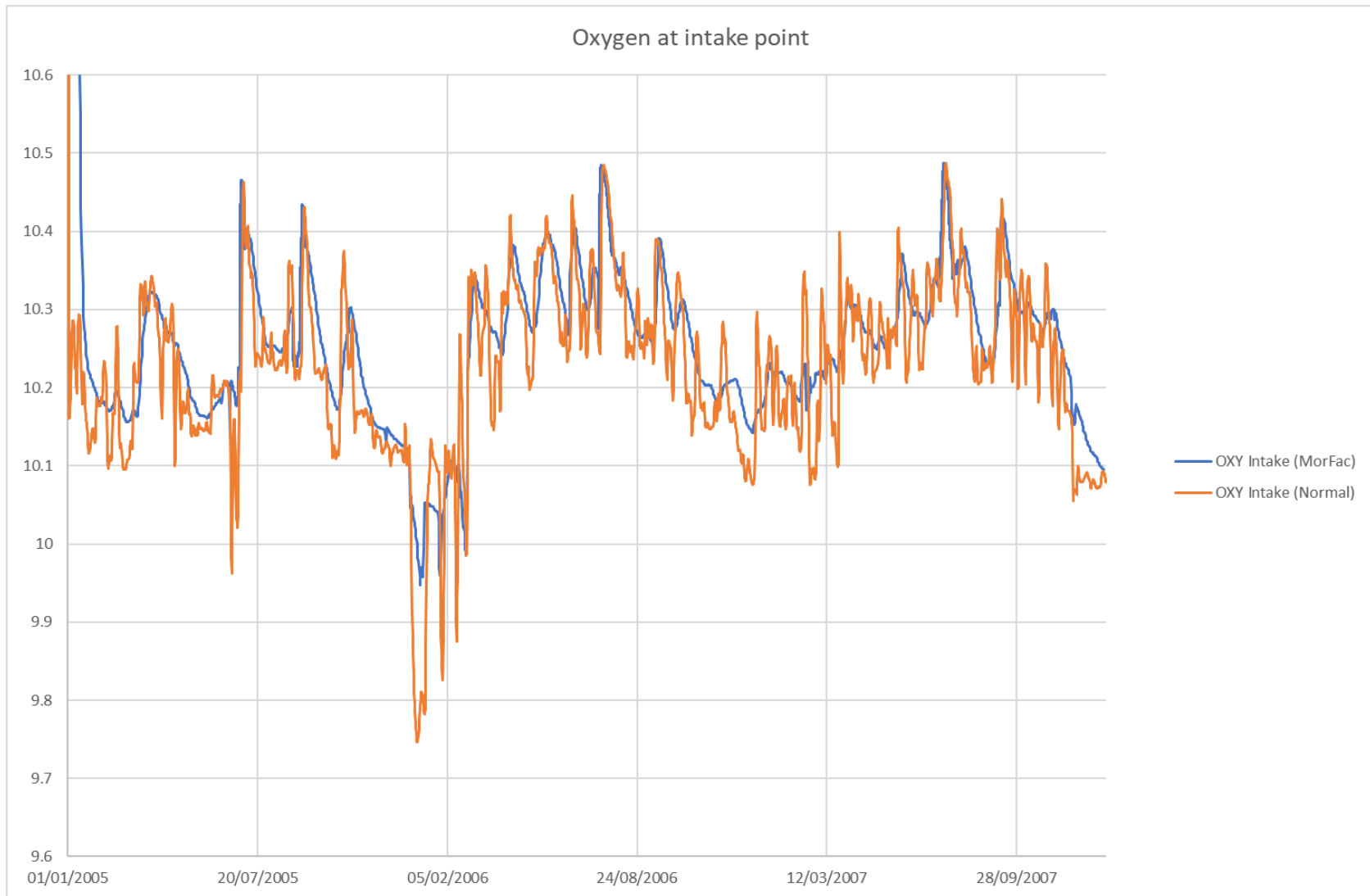
Previous results BOD



Normal run compared to run with MorFac (1/20)



Normal run compared to run with MorFac (1/20)



Future steps



- Investigating method for WQ model to deal with Morfac > 1
- Testing and optimizing morphology calculations
- Combining hymo and WQ
- Habitat suitability analysis
- TKI 2019
 - Integrated D-FM model with morphology, WQ and habitat suitability
 - Routine for grid conversion and statistics calculation for habitat analysis with HABITAT tool