Introdution

● Several theoretical researches say that it is difficult to maintain species coexistence.

Dynamics of the system, which the producers are competing over two or more resources, is decided by the resources supply ratio to the system, and each producer's resources use ratio. (Tilman 1982, Andersen 1997)。

Andersen (1997) predicted that coexistence of phytoplankton became very difficult under existence of zooplankton from the result of a simulation.

● However, is species coexistence so difficult?

In the actual lake, many examples in which species coexistence is maintained are known.

● The above prediction lacks actuality, because it is not taking into consideration about the spatial heterogeneity of organisms.

Spatial structure has big influence on population dynamics of a system. (Tilman & Kareiva 1997, Hanski 1998)

However, the relation between the spatial heterogeneity of a resources supply ratio and producers' resources use ratio was seldom considered by the conventional research.

● Then, I consider the spatial structure of a system about population dynamics of a lake.

(1) By considering spatial structure in a lake, the above-mentioned coexistence conditions may extend from prediction of Andersen (1997).

(2) It is thought that a motion of water has big influence on population dynamics in a lake. Then, what influence is brought about?

研究

● I pay my attention to the relation between the spatial heterogeneity of a resources supply ratio, and producers' resources use ratio.

In a lake, it is thought that the ratios of the resources that producers avail differ spatially because the way of nitrogen supply and that of phosphorus supply should differ (*) and because of a motion of water. If it takes into consideration that a resources use ratio influences plankton growth (stioichiometory) (**), it will be thought that the spatial heterogeneity of resources supply influences population dynamics greatly.

A lake with inflow/outflow river is assumed. And the simulation about population dynamics of plankton will be performed paying attention to the following.

(1) The ratio as which phytoplankton (zooplankton) requires nitrogen and phosphorus (N/P)

(2) The internal amount of supply and the ratio of nutrients of a lake

(3) The inflow amount (concentration and speed) and ratio of nutrients to a lake

(4) Influence on population dynamics by the physical structure (area, a form, depth, etc) of a lake

(*) Generally, nitrogen takes the water-soluble high form of nitric acid etc. , and is mainly supplied by the inflow from the outside of a lake.

To it, usually, phosphorus takes the form of the phosphoric acid which soil is easy to adsorb, and is mainly supplied by the reduction from the soil and detritus of the bottom of a lake.

(**) For example, in the case of nitrogen and phosphorus, if there is little amount of supply of phosphorus even if much nitrogen is supplied, producers cannot use nitrogen for growth. Therefore, the producer has the optimal resources use ratio required for growth, and can say that the species that can use the resources in environment more efficiently is advantageous to competition.

Composition of a calculation program (proposal)

1. prerequisite

This time, I do not take into consideration change of the production speed by the amount of insolation. (I want to correct this, when finding the good data about change of a daylong production speed of phytoplankton.)

It considers that the whole lake is one calculation region, and treats as a 2-dimensional plane of a bird's-eye view. It is assumed that a calculation region is surrounded with a perpendicular wall in the circumference, and depth of water is uniform, and has an inflow river and an outflow river. (Refer to the following figure)

A spatial mesh of the region and a calculation time interval presuppose that it is uniform all by the whole system.

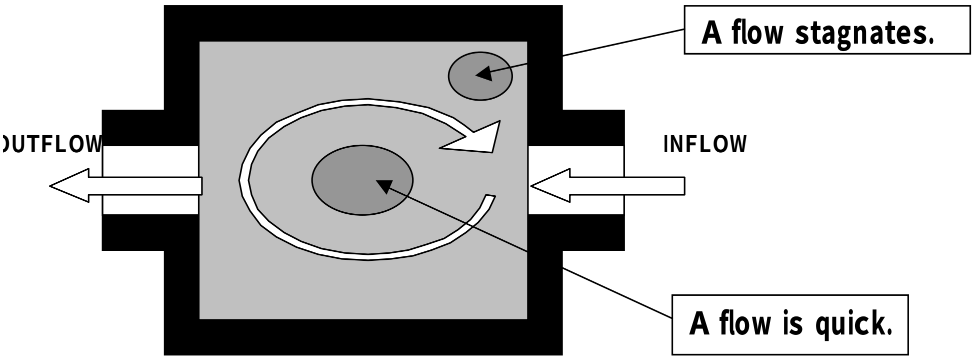

IMAGE of my Model

2. The procedure of calculation

(1) Setting values and initial values

1. The parameters about initial amount of and traits of zooplankton and phytoplankton are set up.
2. Initial values are set up about a flow, nutrition concentration, etc.

(2) In main loop, followings are performed at each step.

1. Calculation about growth of plankton (calculation of the biomass of the following step)
2. Calculation about active displacement zooplankton
3. Calculation of the spatial heterogeneity of nutrient concentration
4. Calculation of the water and flux calculation
5. Calculation of inflow and outflow
6. The output of data, and exchange of data

The present progress

I am under work about the part of 2, 3, and 5 of the above (2) now.

Now, I am going to complete the work of the calculation part of a flow, to unify with the calculation program of plankton growth, and to begin simulations.

Experiment plan

(1) When the amount of inflow to a lake changes, how do the coexistence conditions of phytoplankton change?

Combinations of one zooplankton and two species of phytoplankton are prepared for the simulation. They differ in a resources use ratio. The use ratios of each plankton are set up based on the past example of researches. Then I am going to examine the difference in the dynamics of the system in conditions without a flow, and conditions with a flow.

(2) How is population dynamics influenced by the difference in the structure of a lake?

I heard that there was a collection of data about the structure, the water quality, and living things of domestic lakes. And I think that it seems to be interesting to reproduce and predict those lakes using the model.