Cross-Disciplinary Collaboration and Technological Progress

- A case with ecology -

Japan Society of Civil Engineers
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Development of Engineering

- Any field which takes the perspective of different disciplines improves its own knowledge and technology quickly/
  - discovery of semiconductor ⇒ development of electronics
  - Progress of molecular biology ⇒ development of biotechnology
- The engineering will not progress without the collaboration with science.
- Biology is one of the fields which civil engineering should introduce into.
- Introduction of collaborative research with biology

Civil Engineering up to Now

- Progress based on non-biological science
  - Physics like structural mechanics, fluid mechanics, etc., as main base
  - Securement of the breaking strength and the safety of facilities
  - Stable functioning of facilities (flood-control to prevent river overflow, smooth vehicular traffic)
- Lack of knowledge about the ecosystem

Comparison between Engineering and Science

- Purpose of science (ecology): Seeking truth
  - The primary target is to clarify exceptions
  - Microscopic observation
- Purpose of engineering (civil engineering): Practical use
  - Systematization with the truth solved by science and the experiential knowledge
  - Systematization with the experiential knowledge only (in some cases)
  - Macroscopic observation

Introduction of Ecosystem into Civil Engineering

- With our recognition of these exceptions, what kind of ecosystems can we consider?
  - Engineering hypothesis on ecosystem
- How should we research the ecosystem with our recognition of the exception?
  - Establishment of an engineering research method on the ecosystem
- How can we recover the ecosystem with our recognition of the exception?
  - Assessment of compensation measures for the ecosystem alteration

Ecosystem

A term to describe a discrete unit that consists of living and non-living parts, interacting to form a stable system. Fundamental concepts include the flow of energy via food-chains and food-webs, and the cycling of nutrients biogeochemically. Ecosystem principles can be applied at all scales. Principles that apply to an ephemeral pond, for example, apply equally to a lake, an ocean, or the whole planet.

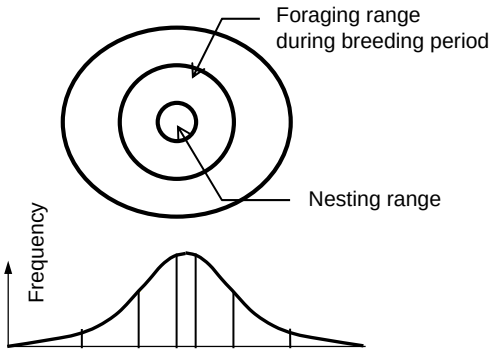
Oxford "A Dictionary of Ecology"

Ecosystem Research in Ecology & Civil Engineering

- Investigation method of the ecosystem
  - To assume index species
  - To assume food-chains contain index species
  - To investigate the ecological community which contains index species
  - To examine the assumption
- Assessment method of ecosystem
  - To keep environment that index species can breed
- Methods of reducing human impact on the ecosystem
  - To reserve nests & rest areas of index species, and to reserve areas that index species can hunt & gather living things as food during the breeding seasons

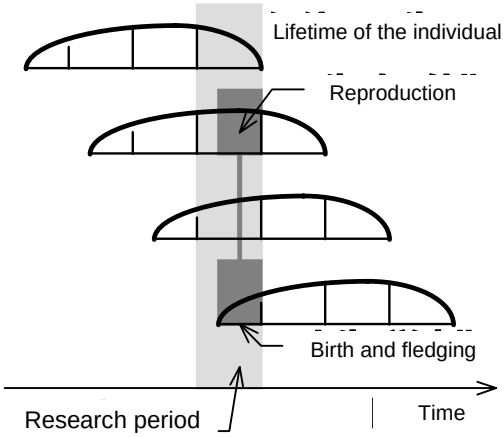
Spatial Approach to Ecosystem

- Focusing on the highly frequented living areas
- Focusing on the nesting range and the foraging range during breeding period
- Degree of substitutability
- Not considering the less frequently used areas

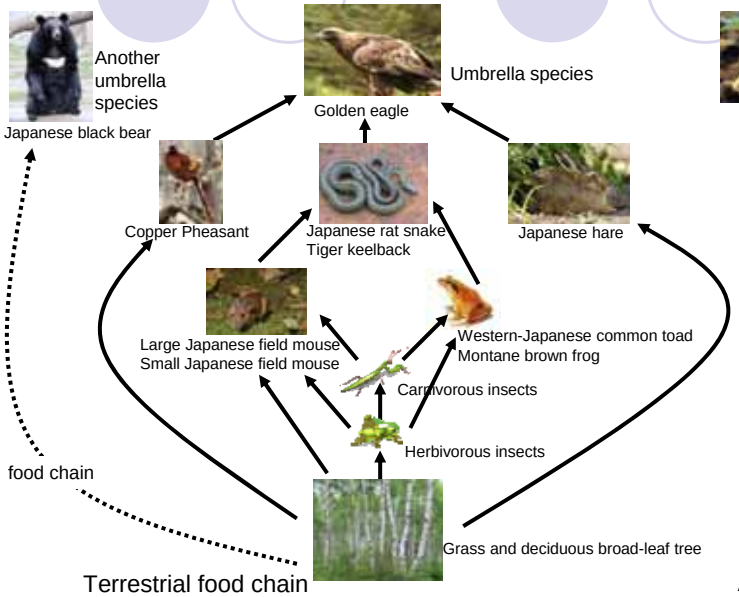


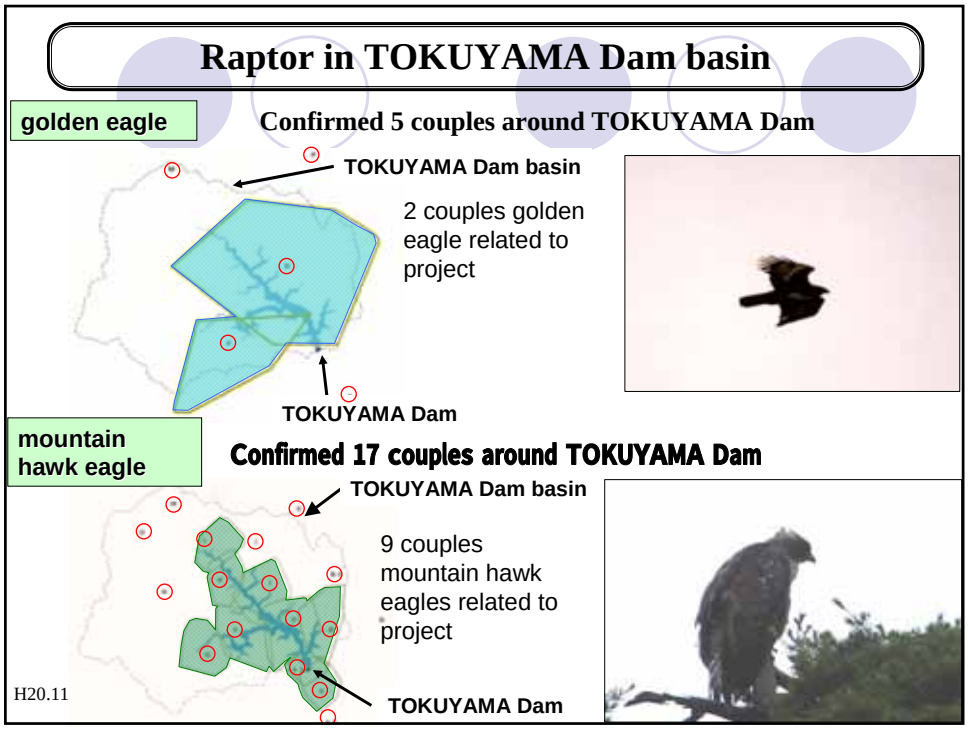
Periodical-Axis Approach to Ecosystem

- Focusing on breeding, birth of next generation, and growth
- Not considering the non-breeding period
- Not observing the entire life span of an individual
- Not considering the evolutionary changes of species



Food – Chain and Index Species





Different values between ecology and civil engineering

- Civil engineering side･･･There is no relation between technical theory and sense of value.
- Biology side･･･It is cruel for those who have been targeting the biology in their life
- Civil engineering side recognizes the biology side having the sense of value on ecosystem. Do not broach that disaster prevention and life are important
- We should recognize that the sense of value is different between each other

Future Civil Engineering

- Does civil engineering aim for changes in the land?
  - New engineering based on ecology
- Establishment of the management technique for the land
  - Harmony of development and land conservation

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Thank you for your listening

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