AMB Course Syllabus
-
2020～2021
-
(Updated on April 12th, 2021)

Faculty of Agriculture
Tohoku University
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Important Notice: Information contained on this syllabus may be subject to change at the decision of the course instructor.
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### Graduation Requirements

The minimum number of credits required for graduation is 134.

1. A minimum of 111 credits from obligatory subjects
2. A minimum of 23 credits from elective specialized subjects

### Minimum credits for graduation

(1) General Education Subjects

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</table>

### Cooperative Innovation Program

in Science, Engineering, and Agriculture for Leading Sustainable Industry and Society

Those who enter PGL as government-sponsored students will also belong to this program. In addition to the AMB curriculum, the government-sponsored students will be required to take four subjects below in order to fulfill the program requirements (i.e., requirements for receiving government sponsorship).

1. Introductory Seminar (Interdisciplinary Seminar) [2 credits]
   — General Education Subjects
2. Life and Nature (Study of Nature, Life and Technology) [2 credits]
   — General Education Subjects
3. Science, Technology and Industry in Japan [1 credit]
   — Specialized Subjects
4. Multidisciplinary Internship [1 credit]
   — Specialized Subjects

(2) Specialized Subjects

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Obligatory</th>
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<th>Comments</th>
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<td>* must be acquired from among the 30 elective credits listed in parentheses.</td>
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<tr>
<td>Current Subjects</td>
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<td>(7)</td>
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<td><strong>Total</strong></td>
<td><strong>62</strong></td>
<td><strong>23</strong></td>
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</table>

The credits acquired in each semester (example)

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<tr>
<th>Semester</th>
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<td>4th -5th Semester</td>
<td>Includes Field Practice of Marine Production 21</td>
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<td>6th -7th Semester</td>
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<td>8th-9th Semester</td>
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<td>Related Subjects</td>
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<tr>
<td><strong>Total</strong></td>
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<td><strong>88</strong></td>
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</table>
1. Class subject  
**Biological productivity in aquatic zone and restoration from tsunami disaster**

2. Object and summary of class  
Onagawa Town was one of the most prosperous fishing ports in Japan. However, the 9.0-magnitude Tohoku-Pacific Ocean Earthquake generated a tsunami as high as 15 meters in Onagawa, which caused the town to subside by 1 meter, and completely destroyed its central area. The ria coast of Onagawa and coastal region along the Pacific Ocean had been severely stricken by the tsunami. Various coastal organisms have acclimated to tsunami perturbations and survived in the area. In order to promote reconstruction of tsunami-stricken areas such as Onagawa with respect to aquatic production (fish catching, aquaculture and fishery processing), it might be a promising measure to scientifically focus on the adaptability of coastal ecosystems in the area against tsunami perturbations, and to raise public awareness of the uniqueness of the coastal ecosystems and biodiversity. This subject highlights tsunami damage and the circumstance of reconstruction in Onagawa Town including coastal ecosystems, and brings to understand the importance of constructing new relationship between natural aquatic productivity and human activity. Field lecture will be held on April in Onagawa Town with a two-day trip. Classroom lecture will be held on May or June at Aobayama Campus.

3. Keywords  
marine biodiversity, fisheries, aquaculture, tsunami disaster, reconstruction,

4. Goal of study  
At the end of the semester, students will  
- understand about tsunami disaster.  
- understand the importance of relationship between natural aquatic production and human activity.  
- understand sustainable biological productivity and the application to reconstruction of human society.

5. Contents and progress schedule of class  
- Introduction to studies of marine science, biological productivity and restoration  
- Field lecture about tsunami damage, the restoration of coastal ecosystems, and the circumstance of reconstruction in Onagawa Town (including Onagawa Field Center)  
- Classroom lecture  
- Group discussion

6. Preparation  
For more information, note our announcement in the curriculum guidance during the first week of April.

7. Record end evaluation method  
- Attendance: 40%  
- Activeness: 20%  
- Report: 40%

8. Textbook and references  
Preparing textbook

9. Self study  
None

10. Practical business

11. In addition  
Contact e-mail address:  
- Ikeda: minoru.ikeda.a6@tohoku.ac.jp
### 1. Class subject

**Ecosystems including forest, grassland, farmland, paddy field and biological productivity**

### 2. Object and summary of class

The purpose of the course is to get understanding of agronomical thinking and sustainable biological productivity through 1 day field trip, classroom lectures and discussion time. Field trip will be held in May and the destination is the Integrated Terrestrial Field Station (Kawatabi in Naruko area). Classroom lecture will be held in May and June.

### 3. Keywords

- agronomical science
- integrated terrestrial field
- ecosystem
- environmental issues
- animal waste treatment
- grasslands
- farmlands
- soil science 
- forestry

### 4. Goal of study

At the end of the semester, students will
- experience about fundamental field science
- understand agronomical thinking
- understand sustainable biological productivity

### 5. Contents and progress schedule of class

1. Introduction to Agronomical science (Profs. of Field Science Center)
2. Field lecture about forest ecosystem (Profs. of Forest Ecology)
3. Field lecture about farmlands on hilly and mountainous area (Profs. of Environmental Crop Science)
4. Field lecture about grasslands, farm animals and environmental issues (Profs. of Land Ecology)
5. Field lecture about animal waste treatment, biogas production and recycling system (Profs. of Sustainable Environmental Biology)
6. Field lecture about andosol (volcanic ash soil) and environmental issues on farmland (Profs. of Environmental Crop Science)
7. Field lecture about management of animal feeding and animal welfare (Profs. of Land Ecology)
8. Field observations for integrated terrestrial field (Profs. of Field Science Center)
9. Group discussion (Profs. of Field Science Center)
10. Field room lecture about agriculture and ecosystem (Profs. of Field Science Center)
11. Field room lecture about spatial science and agronomy (Profs. of Field Science and Technology for Society)

### 6. Preparation

Read books related on agronomy, soil science, animal science, forest science and environmental science before the field trip.

### 7. Record end evaluation method

- Attendance and participation for field trip (40%)
- Attendance and participation for classes (30%)
- Report about field trip (30%)

### 8. Textbook and references

URL: [http://www.agri.tohoku.ac.jp/kawatabi/index.html](http://www.agri.tohoku.ac.jp/kawatabi/index.html)

### 9. Self study

Write a report after the field trip. Write down what did you see, what did you feel. We welcome your consideration based on the group discussion.

### 10. Practical business

**In addition**

Field trip will be held in May (Fri.), 8:00 - 18:30. Gathering Spot is Aobayama Campus (Faculty of Agriculture Building).

Please carry rain cape, protection against cold weather, insurance card and lunch to field trip.

E-mail address: chinatsu@tohoku.ac.jp
1. Class subject

**Grasp of problems according to water, foods, energy, biomaterials, environment and health**

2. Object and summary of class

The purpose of the course is to let participants understand and grasp the many agricultural problems such as water, foods, energy, biomaterials, environment and health through the unique lecture with laboratory tours. Students can go to more than 30 laboratories (about 3/4 of all lab. of our faculty) in the course to know and understand the characteristics of each laboratory’s state of education and research. Students will increase knowledge step by step through explanation of stuffs and discussion with each others.

3. Keywords

4. Goal of study

At the end of the semester, students will

- have basic knowledge about the agricultural science including the academic field of plant science, animal science, fishery science, agricultural chemistry, food science at present stage in our faculty.
- have deeper understanding of the strategy for survival of humans in the future by utilizing the agriculture at high levels.

5. Contents and progress schedule of class

The education and research of our Faculty of Agriculture, and the Graduate School of Agricultural Science are operating in the six different fields of plant science, material environmental economy, applied animal science, marine bioscience, biochemistry and bioscience. In the lecture, we will explain the dairy situation in each laboratory including laboratory tours style.

Students will be separated into six groups and will take a lecture by stuffs of the lab. in the rotation system. Each student can visit one to four laboratories in one day.

1. Guidance “Introduction of agricultural sciences”
16. Examination

6. Preparation

7. Record end evaluation method

Students must be attend the laboratory tour more than 60% and take an examination (40%) of the last day.

8. Textbook and references

Textbook and references will be notified at the class.

9. Self study

10. Practical business

11. In addition

Students who have some questions can visit to ask to each laboratory until 18:00 after lecture time.

Contact persons will be notified at the class.

Contact: skata@tohoku.ac.jp
### Subject Information

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<tr>
<th>Subject</th>
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<th>Fri./2nd</th>
<th>Object</th>
<th>AMB</th>
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<tr>
<td>Instructor (Post)</td>
<td>Cheryl L Ames (Assoc. Prof.)</td>
<td>Categories</td>
<td>Specialized Subjects</td>
<td>Preferable Participants</td>
<td>1st-year students</td>
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<td>Position</td>
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<td>Credits: 2</td>
<td>Semester: 2</td>
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<td>Subject Numbering</td>
<td>ABS-APS235E</td>
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1. **Class subject:**
   Introduction to Physiology and Ecology: **a general introduction to marine animal and algal physiology and ecology.**

2. **Object and summary of class:**
   A beginner course in the basics of writing about marine physiology and ecology. Through writing and presentations, students will gain broad basic knowledge of the functional organization of animals (e.g., evolution, nervous and endocrine systems, immunity), algae (e.g., nutrition, growth, immunity) within their respective marine ecosystems.

3. **Keywords:**
   Nervous system, life functions, hormones, biodiversity, photosynthesis, immune systems

4. **Goal of study:**
   Master the basics of physiology and ecology for future application to Applied Marine Biology specialist topics and courses.

5. **Course contents and class schedule**
   (1) Introduction. Basic principles of marine physiology, metabolism and ecology.
   (2) Marine animal Biodiversity: Evolution and bathymetric distribution of marine animals.
   (3) Animal sensory systems: Neurons and hormones
   (5) The nervous system. 2. Neuron structure & function
   (8) Report and examination.
   (9) The endocrine system. 1. Oogenesis, spermatogenesis & fertilization.
   (10) The endocrine system. 2. Reproductive hormones.
   (11) The immune system.
   (13) Algal physiology. 1. Morphogenesis, growth & specialization.
   (15) Report and examination.

6. **Preparation:**
   All students should complete weekly reading and writing assignments prior to each class. By identifying areas of difficulty, each student should aim to improve understanding of the course content.

7. **Record and evaluation method:**
   Attendance and participation during lectures (25%); Reports/quizzes and end-of-term examination (75%)

8. **Textbook and references:**
   Primary reading(s) (students can purchase or borrow a copy from campus library):

9. **Self-study:**
   There is much to learn about these topics. Student are encouraged to review their lecture notes soon after class. Each lecture will start with a discussion and/quiz of the previous lecture to ensure students have a fundamental grasp of the course content, which is required to pass the quizzes/examinations.

10. **Practical business**
    
11. **In addition:** This course covers a broad range of topics. Later courses will explore these topics more deeply. Any questions should be addressed to the lecturer directly during or after lecture, or during office hours.
### 1. Class subject

**Introduction to fundamentals of methods for processing biological sequence data**

### 2. Object and summary of class

The first half deals with the methods for computing the similarity between two or more biological sequences, and the remaining half introduces various methods for other types of sequence processing.

### 3. Keywords

- biological sequence
- string
- similarity
- alignment
- phylogenetic tree
- gene mapping
- short read assembly

### 4. Goal of study

The goal is to understand the theoretical background with respect to validity or limitation of computer processing of biological sequences.

### 5. Contents and progress schedule of class

1. Preliminaries
2. Similarity between sequences
3. Pairwise alignment (global alignment)
4. Pairwise alignment (local alignment and alignment with affine gap penalty)
5. Multiple alignment (star alignment)
6. Multiple alignment (progressive method)
7. Amino acid substitution matrix
8. BLAST
9. PSI-BLAST and HMM
10. Phylogenetic tree (ultra-metric tree and additive tree)
11. Phylogenetic tree (UPGMA and NJ method)
12. Gene mapping
13. Short read assembly (with reference sequence)
14. Short read assembly (de novo)
15. Suggested answers of the term paper

### 6. Preparation

Prepare for the next lesson by conducting a Web search on the topic words related to the lesson.

### 7. Record end evaluation method

- Attendance: 20%
- Term paper: 80%

### 8. Textbook and references

- Recommended book:

### 9. Self study

Review the previous lesson using the handout.

### 10. Practical business

- Office hours: 16:30-18:00 Mon-Wed, and Fri at Room E410
- E-mail address: yoshifumi.sakai.c7@tohoku.ac.jp
1. Class subject

**Reading scientific papers in English**

2. Object and summary of class

The purpose of the course is to let students understand the composition and critical reading of scientific paper.

3. Keywords

Critical reading, discussion

4. Goal of study

Students will
- have practical capability to read scientific paper in marine biology.
- have knowledge of technical terms on studying field of marine biology.

5. Contents and progress schedule of class

The course will be conducted by AMB laboratories.
- Students will take a class in each laboratory three to four times
- Scientific paper to read will be provided from each laboratory
- The format of a class follows an instruction of instructor of each laboratory

6. Preparation

Read the parts to be dealt in each class in advance.

7. Record end evaluation method

The academic achievement will be evaluated by attendance and understanding of class subject of each laboratory.

8. Textbook and references

Scientific paper to read will be provided by each laboratory in advance and students may be recommended to prepare well.

9. Self study

Read the related scientific articles in each field.

10. Practical business

11. In addition

Students may visit the instructor of each class anytime.
<table>
<thead>
<tr>
<th>Subject Numbering</th>
<th>Reading of Scientific Paper II (科学英語講読 II)</th>
<th>5 Semester 1st Quarter Thu/2rd 6 Semester Thu/3rd</th>
<th>Day/Period</th>
<th>5 &amp; 6 Semester</th>
<th>Object</th>
<th>AMB</th>
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<td>Professors from all the fields of AMB (Prof. &amp; Assoc. Prof.)</td>
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1. Class subject

**Reading scientific papers in English**

2. Object and summary of class

The purpose of the course is to let students understand the composition and critical reading of scientific paper.

3. Keywords

Critical reading, discussion

4. Goal of study

Students will
- have practical capability to read scientific paper in marine biology.
- have knowledge of technical terms on studying field of marine biology.

5. Contents and progress schedule of class

The course will be conducted by AMB laboratories.
- Students will take a class in each laboratory three to four times
- Scientific paper to read will be provided from each laboratory
- The format of a class follows an instruction of instructor of each laboratory

6. Preparation

Read the parts to be dealt in each class in advance.

7. Record end evaluation method

The academic achievement will be evaluated by attendance and understanding of class subject of each laboratory.

8. Textbook and references

Scientific paper to read will be provided by each laboratory in advance and students may be recommended to prepare well.

9. Self study

Read the related scientific articles in each field.

10. Practical business


11. In addition

Students may visit the instructor of each class anytime.
1. **Class subject**

   **Observation of marine biodiversity and understanding the importance for sustainable productions.**

2. **Object and summary of class**

   To understand importance of marine biodiversity.

   (1) Field trip to the rocky intertidal area and observation of the biodiversity.

   (2) Observation of early development of marine invertebrates

3. **Keywords**

   marine ecosystem, biodiversity, production, aquaculture

4. **Goal of study**

   Students will be able to understand the importance for marine biodiversity through the observation of species diversity and development of marine organisms.

5. **Contents and progress schedule of class**

   **Four days in 2nd semester (August)**
   - Days 1-2: Field trip to the rocky intertidal area and survey the biodiversity.
   - Days 3-4: Observation of early development of marine invertebrates.

6. **Preparation**

   For more information, note our announcement on June or July.

7. **Record end evaluation method**

   - Attendance: 40%
   - Activeness: 20%
   - Report: 40%

8. **Textbook and references**

   Preparing textbook

9. **Self study**

   None

10. **Practical business**

    Contact e-mail address:

    - Ikeda: minoru.ikeda.a6@tohoku.ac.jp
<table>
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<tr>
<th>Subject</th>
<th>Physiology of Biological Resources (資源生物生理学)</th>
<th>Day/Period</th>
<th>Object</th>
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<td>Categories Specialized Subjects</td>
<td>Preferable Participants</td>
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1. **Class subject:** Physiology of Biological Resources

2. **Object and summary of class:** This course provides a fundamental overview of the physiological requirements permitting marine animals to exist and reproduce within a host of environments often differing from their internal states.

3. **Keywords:** Neuroendocrinology, reproduction, osmoregulation, immunology.

4. **Goal of study:** Develop an understanding of the varied ways and means by which cells in a multicellular organism communicate to maintain the organism's integrity and ensure the production of a new generation. Develop a solid grasp of the concept of homeostasis and its application in neuroendocrine regulation, osmoregulation and immunology.

5. **Course contents and class schedule**

   (1-4) Neurophysiology.
   Definition of Neurophysiology and classification of chemical transmitters. Reception by target cells. Process of receptor cell receipt and information transmission.

   (5-7) Neuroendocrinology.
   Hormones (e.g., thyroid hormone, growth hormone, and insulin), the organs and glands that secrete them, and their actions on different organ systems in the body.

   (8) Report and examination.

   (9-11) Endocrinology of reproduction

   (12) Osmoregulation.
   Significance of the control of osmotic pressure and the function of the regulatory cells. Mechanisms of the hormonal control of osmoregulation.

   (13-14) Immunology.
   Natural immunity and the recognition and removal of foreign material from the body. Vertebrate and invertebrate immune systems.

   (15) Report/examination.

6. **Preparation:** All students should complete weekly reading and writing assignments prior to each class. By identifying areas of difficulty, each student should aim to improve understanding of the course content.

7. **Record and evaluation method:** Attendance and participation during lectures (25%); Reports/quizzes and end-of-term examination (75%)

8. **Textbook and references:** Primary reading(s) (students must purchase or borrow a copy from campus library):

9. **Self-study:** There is much to learn about these topics. Student are encouraged to review their lecture notes soon after class. Each lecture will start with a discussion and/quiz of the previous lecture to ensure students have a fundamental grasp of the course content, which is required to pass the quizzes/examinations.

10. **Practical business**

11. **In addition:** This course covers a broad range of topics. Later courses will explore these topics more deeply. Any questions should be addressed to the lecturer directly during or after lecture, or during office hours.
1. Class subject

**Relationships among organisms and those between organisms and their environment as fundamental factors supporting biological production in nature.**

2. Object and summary of class

More than 1500 thousand of organisms are recognized to live on the earth now. These numerous organisms maintain various interrelationships with surrounding organisms and its environmental factors, which may support biological production in nature.

The present subject addresses fundamental concepts of ecology necessary to understand mechanisms of nature in each category of population, community, and ecosystem.

3. Keywords

biological production, population, biological community, marine ecosystem, environment, interspecific relations

4. Goal of study

Students can understand the structure and function of biological nature, and find an outline of the relationships between organisms and its environment.

5. Contents and progress schedule of class

1. Species (binomial nomenclature, reproductive isolating, crossbreed)
2. Classification (five kingdoms, three domains) Biological production in each ecological category: producer, consumer, decomposer.
3. Divergent evolution, natural selection
4. Adaptation, Speciation, & Diversity
5. Niche, fitness
6. Interspecific relationships (competition, predation etc.), Gause's Law
7. Population: definition, mode of life, population growth models, r-K strategy
8. Category of interspecific relationships (competition, predation etc.), Gause's Law
9. Concept of ecological niche, relationship between niche and competition
10. Community theory, ecological succession, climax
11. Structure and function of ecosystem,
14. Biological and physical cycle in nature
15. Ecosystem service

6. Preparation

Many books are published on ecosystem, environment, and bio-diversity, from which it is required to obtain various information about contemporary ecological problems.

7. Record end evaluation method

Evaluation will depend on achievement of final examination. Furthermore, submissions of short term papers are required several times in the course.

8. Textbook and references


9. Self study

Students should have concern over topics on nature and organisms shown in various media and consider their biological and ecological meanings.

10. Practical business

11. In addition

Office hour for inquiry about the course should be offered any time at the Laboratory of Fisheries Biology and Ecology.
E-mail: skata@tohoku.ac.jp
### Subject Information

<table>
<thead>
<tr>
<th>Subject</th>
<th>Fish Genetics and Breeding science (水産遺伝育種学)</th>
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<th>3rd Quarter Mon./3rd, 4th</th>
<th>Object</th>
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<td>M. Nakajima (Associate Prof.)</td>
<td>Categories</td>
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<td>2nd-year students</td>
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<td>Credits</td>
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<td>Language Used in Course</td>
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</table>

### Class Subject

1. Understand the basic theory of inheritance and the application methods for the genetic improvement in aquatic organisms.

2. **Object and summary of class**
   - In the aquatic organisms, not only genetics in individual level but also population level is important. Because, the position of conservation in genetic resources has very important in this subject. In this class, the basic theory of inheritance in individual level, population level, the basic theory of genetic improvement and the conservation of genetic resources will be explained and discussed.

### Keywords

- Genetic improvement, Genetic variation, Linkage, Genetic marker, Quantitative trait, Heritability, Breeding value, Heterosis, Recombinant DNA

### Goal of study

1. Understand the basic theory of genetics in both of individual and population level
2. Understand the theory of the application methods of genetics for the genetic improvement
3. Understand the basic theory of genetics for the conservation of genetic resources.

### Contents and progress schedule of class

#### Basic theory of inheritance

1) Basic theory and various mode of inheritance
2) Genetic variations
3) Linkage and recombination
4) Basic theory of genetics in population
5) Genetic drift and inbreeding
6) Natural selection
7) Population structure and genetic diversity of population
8) Genetic markers for the analysis of populations and quantitative traits

#### Basic theory of genetic improvement

9) Basic theory of inheritance in quantitative traits
10) Heritability and breeding value
11) Basic theory of selection
12) Heterosis and hybrid vigor
13) Genetic improvement by recombinant DNA

### Preparation

Please read a book about conservation and genetic improvement.

### Record and evaluation method

Total results are evaluated by the final examination, reports and the results of the problems set at a lecture at each time.

### Textbook and references

- Genetics for fish hatchery managers, D. Tave, An AVI Books, New York, 1992

### Self study

Ask me the things which are not understood. Please do preparations for lecture and a review used text book shown to the above.

### Practical business

The office will be opened from 10:00 AM to 05:00 PM to receive the question. The question is also received by e-mail, masamichi.nakajima.b6@tohoku.ac.jp
<table>
<thead>
<tr>
<th>Subject</th>
<th>Field Practice of Marine Production I・II (生産フィールド実習 I・II)</th>
<th>Day/Period</th>
<th>Intensive Course</th>
<th>Object</th>
<th>AMB</th>
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<tr>
<td>Instructor (Post)</td>
<td>Ikeda M. (Prof.)</td>
<td></td>
<td>Specialized Subjects</td>
<td>Preferable Participants</td>
<td>2nd &amp; 3rd-year students</td>
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<tr>
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1. **Class subject**

**Practical field and experimental training for marine biodiversity.**

2. **Object and summary of class**

To understand importance of marine biodiversity.

(1) Observation and analysis of marine biodiversity.

(2) Analysis of genetic diversity in marine organisms.

(3) Comparative observation of early development and morphogenesis of marine invertebrates.

3. **Keywords**

marine ecosystem, biodiversity, genetic diversity, early development, morphogenesis

4. **Goal of study**

Students will be able to understand the importance for biodiversity in marine ecosystems through the observation of species/genetic diversity and development of marine organisms.

5. **Contents and progress schedule of class**

**Five days in 4th semester (August)**

- Days 1-2: Quantitative and qualitative of marine biodiversity.
- Days 3-4: Observation of early development of marine invertebrates.
- Day 5: Presentation

**Five days in 6th semester (August)**

- Days 3-4: Observation of morphogenesis of marine invertebrates.
- Days 5: Presentation

6. **Preparation**

For more information, note our announcement on June or July.

7. **Record end evaluation method**

- Attendance: 40%
- Activeness: 20%
- Report: 40%

8. **Textbook and references**

Preparing textbook

9. **Self study**

None

10. **Practical business**

11. **In addition**

Contact e-mail address:

- Ikeda: minoru.ikeda.a6@tohoku.ac.jp
Subject: Fishery Science Practice I・II (学生実験Ⅰ・Ⅱ)

Day/Period: Semester 5: Mon.-Fri. /3rd & 4th, Semester 6: Mon.-Fri. /3rd & 4th, Mon/3rd & 4th, Tue.-Fri./1st-4th

Object: AMB

Instructor (Post): Professors from all the fields of AMB (Prof. & Assoc. Prof.)

Categories: Specialized Subjects

Specialized Subjects: Preferable Participants

Preferable Participants: 2nd & 3rd-year students

Position: Faculty of Agriculture (Graduate School of Agricultural Science)

Subject Numbering: AAL-APS308J/AAL-APS309J

Language Used in Course: Japanese

1. Class subject
   Morphology, function and components of aquatic organisms, analysis of substances in environment

2. Object and summary of class
   The purpose of the course is to let participants understand the taxonomy, constitution of body, function of aquatic organisms, the way to use analytical instruments and analysis of experimental data.

3. Keywords
   Experiments, anatomy, microscopy, chemical analysis, statistics

4. Goal of study
   Students will
   - have basic knowledge for anatomical structure and components of aquatic organisms and analysis of environment.
   - have deeper understanding of aquatic organisms and marine environment.

5. Contents and progress schedule of class
   The course will be conducted by AMB laboratories.
   - Anatomy of invertebrate and teleost
   - Molecular biology and genetics
   - Taxonomy of aquatic organisms
   - Histology
   - Physiology
   - Analytical chemistry of environment and organisms
   - Microbiology
   - Ecology
   - Statistic analysis

6. Preparation
   Understand the materials and methods to be used in each class in advance.

7. Record end evaluation method
   Students should attend every experiments and absence is not acceptable for any reason. Students should submit report of each by the deadline suggested in each experiment. The academic achievement will be evaluated by attendance and submitted report through entire period.

8. Textbook and references
   Text for the course will be provided and students may be recommended to prepare well.

9. Self study
   Refer to related books in the library for writing reports.

10. Practical business

11. In addition
   Students may visit the instructor of each experiment anytime.
<table>
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<tr>
<th>Subject</th>
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<th>Day/Period</th>
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<td>Specialized Subjects</td>
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<td>AAL-APS310J</td>
<td>Language Used in Course</td>
<td>Japanese</td>
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</table>

1. Class subject

**Components of aquatic organisms, analysis of substances in environment**

2. Object and summary of class
The purpose of the course is for students to understand the body components of organisms and the procedures to extract and analyze chemical components in the environment.

3. Keywords
Experiments, analysis, biogenic substances, chemical components

4. Goal of study
Students will
- have basic knowledge of biogenic substances from aquatic organisms and analysis of the environment.
- have knowledge of experimental procedures.

5. Contents and progress schedule of class
The course will be conducted by AMB laboratories
- Anatomy of fin fish
- Extraction and analysis of genetic material
- Analysis of components of seawater
- Evaluation of taste components
- Extraction and analysis of body components
- 

6. Preparation
Understand the materials and methods to be used in each class in advance.

7. Record and evaluation method
Students should attend every experiment and absence is not acceptable for any reason. Students should submit a report on each theme by the required deadline. Academic achievement will be evaluated by attendance and grading of all reports submitted.

8. Textbook and references
Texts for the course will be provided.

9. Self study
Refer to related books in the library for writing reports. Prepare well before attending each practical.

10. Practical business

11. In addition
Students may visit the instructor of each experiment any time.
Subject | Basic Biology, Practice (基礎生物学実験) | Day/Period | Mon.-Fri./3rd & 4th, 1st-4th | Object | AMB
--- | --- | --- | --- | --- | ---
Instructor (Post) | Professors from all the fields of AMB (Prof., Assoc. Prof., Assistant Prof.) | Categories | Specialized Subjects | Preferable Participants | 2nd & 3rd-year students
Position | Faculty of Agriculture (Graduate School of Agricultural Science) | Credits | | 1 | 
Subject Numbering | AAL-APS311J | Semester | | 5&6 | 

1. Class subject

**Body plan and function of aquatic organisms**

2. Object and summary of class
   The purpose of the course is to let students understand body plan and function of aquatic organisms studying on morphology, genetics, cell biology, physiology and statistic analysis.

3. Keywords
   Morphology, Genetics, Taxonomy, Cellular tissue

4. Goal of study
   Students will
   - have knowledge of basic biology
   - have knowledge of experimental procedure

5. Contents and progress schedule of class
   The course will be conducted by AMB laboratories.
   - Anatomy of fin fish
   - Genetics and analysis of polymorphism
   - Cell biology of aquatic plant
   - Histology of marine animals

6. Preparation
   Read textbook before the class and understand an outline of experimental procedure in advance.

7. Record end evaluation method
   Students should attend every experiments and absence is not acceptable for any reason. Students should submit report of each by the deadline suggested in each experiment. The academic achievement will be evaluated by attendance and submitted report through entire period.

8. Textbook and references
   Text for the course will be provided and students may be recommended to prepare well.

9. Self study
   Review the results of the experiment and summarize it in the report.

10. Practical business

11. In addition
   Students may visit the instructor of each experiment anytime.
<table>
<thead>
<tr>
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<td>Object</td>
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<tr>
<td>Instructor (Post)</td>
<td>M. Osada (Prof.)</td>
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<td>Semester</td>
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</table>

1. **Class subject**

**Underlying concept of aquaculture and overview of projects of representative aquaculture**

2. **Object and summary of class**

   Restoration of natural fishery resources and growth of fish products is an urgent issue to be resolved in aquaculture. The purpose of this class is to let students understand the concept of aquaculture and specific aquaculture projects.

3. **Keywords**

   - Teleost
   - Crustacea
   - Bivalve
   - Natural seed
   - Artificial seed

4. **Goal of study**

   Students will
   - cognize the importance of aquaculture for restoration and growth of fishery product.
   - have knowledge of specific issues on aquaculture.

5. **Contents and progress schedule of class**

   - Concept of aquaculture 1
   - Concept of aquaculture 2
   - Salmon 1 (life cycle)
   - Salmon 2 (artificial seed production and release)
   - Yellowtail 1 (life cycle)
   - Yellowtail 2 (natural seed collection and farming)
   - Flounder 1 (life cycle)
   - Flounder 2 (artificial seed production and release)
   - Kuruma Prawn 1 (life cycle)
   - Kuruma Prawn 2 (artificial seed production and farming)
   - Scallop 1 (life cycle)
   - Scallop 2 (natural seed collection and farming)
   - Oyster (natural seed collection and farming)
   - Others (Pearl oyster and Bluefin tuna cultivation)
   - Chromosome manipulation and sex manipulation

6. **Preparation**

   Read textbook before the class and understand an outline of life cycle and aquaculture process of each animal in advance.

7. **Record end evaluation method**

   The academic achievement will be evaluated by report assigned in each lecture.

8. **Textbook and references**


9. **Self study**

   Read again textbook based on the information learned at the class and review the knowledge of aquaculture.

10. **Practical business**

11. **In addition**

   Students may visit the office or contact via Email (makoto.osada.a8@tohoku.ac.jp) anytime.

   URL of the lab “Aquacultural Biology”; http://www.agri.tohoku.ac.jp/zoshoku/english.html
1. Class subject
Life history of marine resources, biology, population dynamics and methodology of population analysis.

2. Object and summary of class
Characteristics of marine organisms are tempo-spacio fluctuations and reproduction. Especially marine resources are affected by not only environmental condition but also fishing pressure. In this lecture, after short review of world and Japanese fisheries production, life history traits and fluctuating patterns of populations are explained. Methodology of stock assessment and population are also mentioned for the fisheries management.

3. Keywords
Fish biology, life history strategy, Fisheries, Population analysis

4. Goal of study
To understand the biological characteristics of marine resources and to learn theoretical and technical methods for marine biology, stock assessment and fisheries management.

5. Contents and progress schedule of class
1. Status of world and Japanese fisheries production
2. Stock identification and population structure
3-4. Ichthyology (External and internal morphology)
5-8. Life history (Age and growth, life cycle, migration, maturing and spawning, early life history, mortality and survival)
9. Patterns of population dynamics
10-11. Data analysis and stock assessment
12-13. Surplus yield model and yield per recruit model
14. Cohort analysis
15. Fisheries management

6. Preparation
There are no particular prerequisites for this course. Basic biology capabilities will ease the learning.

7. Record end evaluation method
Score of an end-of-term exam and attendance

8. Textbook and references
Marine Fisheries Ecology, Jennings et al., 2001 Wiley-Blackwell
Fishes: An Introduction to Ichthyology, Moyle and Cech, 2004 Pearson Prentice Hall
Fisheries Biology, Assessment and Management, M. King, 2007 Wiley-Blackwell

9. Self study
Please do not lose teaching documents and your class note for the final exam.

10. Practical business

11. In addition
Contact: skata@tohoku.ac.jp
1. Class subject

**The ecology of giant kelp forests**

2. Object and summary of class

This course provides the basic knowledge about the community ecology of marine kelps through the readings of some chapters related to the ecological topics in the book ‘The biology and ecology of giant kelp forests’ by Schiel & Foster (2015).

3. Keywords

Kelp forest, Sea urchin, Barren, Grazing, Population dynamics, Production, Rocky subtidal ecosystem, Phase shift, Global warming.

4. Goal of study

The goal is to understand the structure and function of marine kelp communities through the study of the ecology of giant kelp forests.

5. Contents and progress schedule of class

1. Introduction
2. The abiotic environment-1: Substratum and sedimentation
3. The abiotic environment-2: Temperature, light and nutrient
4. The abiotic environment-3: Water motion
5. Dispersal and connectivity of populations-1: Demography and metapopulations
6. Dispersal and connectivity of populations-2: Reproductive output and source of propagules
7. Dispersal and connectivity of populations-3: Spore dispersal and recruitment windows
8. Session review-1
9. Grazing in kelp communities-1: Kelp-sea urchin interactions
10. Grazing in kelp communities-2: Reversion of barrens to kelp habitat
11. Grazing in kelp communities-3: Other grazers in giant kelp communities
12. Predation and trophic cascades-1: Fish predation on grazers
13. Predation and trophic cascades-2: Lobster predation on grazers
14. Predation and trophic cascades-3: Sea otter predation on grazers
15. Session review-2

6. Preparation

Read the relevant chapters in the textbook in advance.

7. Record end evaluation method

Examination, report and attendance.

8. Textbook and references

Reference texts:

9. Self study

Review is required.

10. Practical business

11. In addition

Office phone number: 022-757-4152
Mail address: masakazu.aoki.e6@tohoku.ac.jp
1. Class subject

**Biochemical characterization of aquatic organisms and seafood**

2. Object and summary of class

The organisms inhabiting in water have unique components to adapt to and survive in the environment. To understand their ways of life, it is essential to understand the chemical components of fish and other marine organisms. While marine organisms show beneficial effects on human health, some of them possess toxic substances and some microorganisms and parasites are responsible for food poisoning. The class deals with the biochemical, nutritional and functional properties of the components in the organisms and the mechanisms of development as well as adaptation to habitat environment. The other related topics will also be introduced.

3. Keywords

Aquatic organisms, chemical components, catabolic pathways, regulatory systems

4. Goal of study

To get the sufficient knowledge about the characteristics of marine organisms from a biochemical viewpoint. To understand the mechanisms to survive in water

5. Contents and progress schedule of class

1: Biochemical characteristics of marine organisms
2: Metabolism
3: Proteins
4: Lipids
5: Carbohydrates
6: Vitamins
7: Minerals
8: Enzymes
9: Active components
10: Physical aspects of life
11: Functional substances
12: Natural toxins and food poisoning
13: Thermoregulation
14: Osmoregulation
15: Report writing

6. Preparation

Collect the related information in the library and through the web

7. Record end evaluation method

Based on the final report (50%), homework (20%) and class attendance (30%).

8. Textbook and references


9. Self study

Read related papers published in recent years.

10. Practical business

11. In addition

Handouts will be provided for each class.
1. Class subject
   Review marine environment and adaptive ecology of pelagic organisms that evolved in the oceans.

2. Object and summary of class
   Deepen understanding of the production of plankton that live in vast and deep ocean environment based on physical and chemical characteristics of the ocean.

3. Keywords
   physics, chemistry, biology, ecology, productivity, global warming

4. Goal of study
   Understand pelagic environment of the oceans and adaptation of its inhabitants, regional differences, and biological oceanographic basis that support fish production

5. Contents and progress schedule of class
   1, 2: History of Biological Oceanography
   3-5: Physical environment
   6-8: Chemical environment
   9: Primary production in the oceans
   10: Secondary production in the oceans
   11: Relationship between phytoplankton and zooplankton
   12-14: Marine plankton and global environment
   15: Current topics on Biological Oceanography

6. Preparation
   Acquire basic knowledge on oceans and organisms living in them.

7. Record end evaluation method
   short tests and term-end test

8. Textbook and references

9. Self study
   Understand cause and effect of phenomena taught in class.

10. Practical business

11. In addition
    mail address: wsokoshi@tohoku.ac.jp
<table>
<thead>
<tr>
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<th>Applied Genetics in Aquatic Organisms</th>
<th>Day/Period</th>
<th>4th Quarter Fri./1st-2nd</th>
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<td>Minoru IKEDA (Prof.)</td>
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1. Class subject

Conservation and sustainable yield of marine bio-resources

2. Object and summary of class

A variety of marine bio-resources have inhabited in the coastal areas. These are important food resources and also reproductive resources. Considering a conservation and sustainable yield of them, though ecological and physiological studies are important, genetic studies should be quite important for future.

In the present lecture, I will explain the importance of applied genetics for future managements of marine bio-resources by using actual scientific research in my laboratory.

3. Keywords

marine organisms, genetics and breeding science, population structure, conservation, aquaculture

4. Goal of study

Understanding the present condition of marine production in coastal area of Japan. Also, through the lecture, ability of consideration and problem solving are required.

5. Contents and progress schedule of class

1. Introduction
2. Extinction
3. Quantification of Genetic Diversity (I)
4. Quantification of Genetic Diversity (II)
5. Quantification of Genetic Diversity (III)
6. Quantification of Genetic Diversity (IV)
7. Inbreeding & Outbreeding Depressions (I)
8. Inbreeding & Outbreeding Depressions (II)
9. Molecular Identification (VI)
10. Conservation Units (I)
11. Conservation Units (II)
12. Conservation Units (III)
13. Genetic Rescue
14. Translocations
15. Captive Breeding Program

6. Preparation

No need but you should survey the technical terms in the lecture and write on your note book.

7. Record end evaluation method

Examination and Reports

8. Textbook and references

Directing on the lecture

9. Self study


10. Practical business


11. In addition

When you have a question, please contact me by e-mail.
e-mail address: minoru.ikeda.a6@tohoku.ac.jp
1. Class subject
On the invertebrate animals distributed in aquatic environments, basic physiology, especially immunology and feeding behavior, digestive and circulatory systems and life history will be outlined.

2. Object and summary of class
To learn the innate immune systems in marine invertebrates involved in basic innate immune systems, molecular and cellular host defense and apoptosis of immune cells.
To learn trained immunity of aquatic invertebrates based on host-parasite coevolution.
To understand structures of digestive organs, and feeding and digestive mechanisms of bivalve mollusks.
To understand structures of heart and vessels, and circulatory system of bivalve mollusks.

3. Keywords
Aquatic invertebrates, Innate immunity, Host defense, Apoptosis, Digestive organs, Circulatory systems

4. Goal of study
Understanding the basic sciences in relation to immunology, feeding behavior and life history of aquatic invertebrates.

5. Contents and progress schedule of class
1st: Guidance and overview of aquatic invertebrates
2nd: Innate Immunity in Invertebrates 1: general theory of innate immunity
3rd: Innate Immunity in Invertebrates 2: general theory of innate immunity 2
4th: Innate Immunity in Invertebrates 3: cellular defense mechanisms: morphology and functions
5th: Innate Immunity in Invertebrates 4: humoral defense mechanisms: molecule types and their functions
6th: Innate Immunity in Invertebrates 5: pathogen recognition receptors (PRRs) and PAMPs
7th: Innate Immunity in Invertebrates 6: trained immunity of invertebrates: model for host-parasite coevolution
8th: A thorough review and first examination (Exam 1) of the class in the first half
9th: Feeding mechanisms of bivalve mollusks 1
10th: Feeding mechanisms of bivalve mollusks 2
11th: Feeding mechanisms of bivalve mollusks 3
12th: Digestion and nutrition in bivalve mollusks 1
13th: Digestion and nutrition in bivalve mollusks 2
14th: Circulatory system of bivalve mollusks 1
15th: Circulatory system of bivalve mollusks 2
16th: A thorough review and second examination (Exam 2) of the class in the second half

6. Preparation
You should study basic biology, especially immunology and molluscan biology, prior to class studying.

7. Record end evaluation method
Attendance point: 300 points (20 points per one lecture time; 15 times)
Examination point: 200 points (100 points per one exam)
AA=90-100%; A=80-89%; B=70-79%; C=60-69%; D=below 60%

8. Textbook and references

9. Self study
You can study yourself to use textbooks (shown as above) getting for general knowledge of this class. These textbooks are owned by the library of Tohoku University. You can use these one.

10. Practical business

11. In addition
E-mail: waradica@tohoku.ac.jp
Office hour: 13:00-15:00 of Tuesday and Wednesday.
1. Class subject

**Concepts and methods for the study of marine plant life**

2. Object and summary of class

Marine algae are the major primary producers at the marine coastal areas, but most of us know little about them. Object of the class is to understand the concepts and methods for the study of marine plants such as algae and seagrasses. In this series of lectures, firstly, we will try to understand the basic characteristics of marine plants. Second, the patterns in the geographical and vertical distributions of marine algae will be discussed. Next, we will overview the studies on the population and community aspects of marine plants. Analytical methods of population dynamics and the details of plant-animal interactions will also be discussed. In addition, some topics in seaweed mariculture and marine pollution will be shown. Finally, monitoring methods of marine plant communities and the actual application of them will be introduced.

3. Keywords

seaweed, kelp, *Sargassum*, plant-animal interactions, grazers, herbivores

4. Goal of study

For students to be able to understand the basic ideas and methods for the study of marine plants.

5. Contents and progress schedule of class

(1) At the beginning: all about WAKAME: *Undaria pinnatifida*
(2) Geographical distribution of marine algae
(3) Vertical distribution of marine algae: intertidal zone
(4) Vertical distribution of marine algae: subtidal zone
(5) Primary production of coastal marine plants
(6) Population analysis of marine plants
(7) Monitoring survey of marine plant communities
(8) Dispersal ability of marine plants
(9) Plant-animal interactions in benthic algae communities
(10) Epiphytic animals and tsunami impacts
(11) Grazing snails
(12) Field experiments
(13) Mariculture
(14) Pollution
(15) Session review

6. Preparation

7. Record and evaluation method

Attendance rates and test scores will be recorded and evaluated.

8. Textbook and references

Handouts will be available at the beginning of each lecture.

9. Self study

Review is required.

10. Practical business

11. In addition

Office phone number: 022-757-4152
Mail address: masakazu.aoki.e6@tohoku.ac.jp
1. Class subject

The biochemical characteristics and effective utilization of marine bioresources

2. Object and summary of class

The biochemical characteristics of marine organisms as foodstuffs will be explained. The attendees are supposed to understand the principle of seafood production and the processing methods. Accurate knowledge of the hygienic control of fish and shellfish will also be dealt to understand the roles of marine organisms as resources for food. The functions of seafood for human health and the characteristics of seafood for medicinal and industrial materials will be also discussed.

3. Keywords

Food preservation, Freezing and thawing techniques, Postmortem changes of fish and shellfish

4. Goal of study

To be able to understand the principals and methods of food processing, preservation and the control of seafood qualities and to get the knowledge for the effective utilization of marine resources.

5. Contents and progress schedule of class

1 Marine resources for food
2 Characteristics and variation of seafood
3 Nutritional aspects of seafood
4 Processing principals of typical seafood
5 Food poisonings related to seafood
6 Seafood allergy
7 Health-promoting functions of the substances from aquatic organisms
8 Biochemical substances from marine organisms for medicinal and industrial materials
9 Control of muscle protein quality
10 Report writing
11 Term-end exam

6. Preparation

Review the contents of the lectures on Marine Biochemistry

7. Record end evaluation method

The final grade will be calculated based on the mid-term reports (40%) and term-end examination (60%).

8. Textbook and references

Handbook of Marine Natural Products vol.1, vol.2 (Fattorusso, E. et al., ed.) Springer (2012)

9. Self study

Refer to the websites related to the topics and also to the related papers.

10. Practical business

11. In addition
Class subject: **Seafood Management.**

Object and summary of class: This dynamic course, the contents of which keep changing with fluctuating fisheries resources, instructs on the features of seafood quality and its management with regards to maintaining the safety of seafood.

Keywords: Hygiene, HACCP, diseases, food safety, pandemic, disasters, aquaculture, legal and international issues.

Goal of study:
- Develop a solid understanding of methods for quality and hygiene management of seafood at each step, from harvest to the consumer's table.
- Describe the features of seafood quality.
- State the methods of maintaining quality in terms of safety.
- State relevant regulations and public laws for maintaining seafood quality and safety.
- Describe the essential points of quality management under the HACCP system, and necessity of the FERAT system.

Course contents and class schedule:
1. Introduction. Seafood and seafood processing.
3. Chemistry: Components of seafood affecting color, taste and smell.
4. Harmful chemical (e.g., histamine, etc.) and physical substances (foreign objects) affecting food safety.
5. Harmful biological substances (1) Parasites. Bacterial & fungal infections, listeriosis, etc.
7. Ecology of Wild-caught and Aquaculture Fisheries
8. Students produce an outline of his/her selected target seafood species for final project
10. Basic seafood handling: visit to Ishinomaki Fish Landing and Market* or Sendai City Fish Market. *
12. Seafood management (3): The HACCP system. Visit to food processing company. *
13. Class debate on sustainable options to replace vital but unsustainable fisheries
14. Final Presentations.
*In person or virtual.

Preparation: All students should complete weekly reading and writing assignments prior to each class. By identifying areas of difficulty, each student should aim to improve understanding of the course content.

Record end evaluation method: Attendance and participation during lectures (25%); Reports/quizzes and end-of-term examination (75%)

Textbook and references:
- Primary reading(s) (students can access all main material online):

Self-study: Weekly reports must be written by students in their own words. Reports will be assessed for their completeness, accuracy and unique writing style. Students will write in the context of demonstrating clearly what they have learned during lectures and readings assignments.

Practical business

In addition: Any questions should be addressed to the lecturer directly during or after lectures, or during office hours. *The class will participate in one off-campus practical excursion as time and schedules permit.
1. Class subject  
**Systematics and biology of marine plankton**

2. Object and summary of class  
An introduction to systematics, physiology, and ecology of marine plankton

3. Keywords  
Diatom, flagellate, ciliate, jelly fish, copepod, krill, food chain, microbial food web, vertical migration

4. Goal of study  
Understanding structure and role of plankton community in marine ecosystem

5. Contents and progress schedule of class  
   - Definition of plankton (1)  
   - Historical development of planktology (1)  
   - Marine environmental characteristics (2)  
   - Systematics and biology of marine phytoplankton (3)  
   - Systematics and biology of marine zooplankton (4)  
   - Characteristics of primary production in the ocean (1)  
   - Characteristics of secondary production in the ocean (1)  
   - Vertical migration in zooplankton and its ecological role (1)  
   - Current topics in marine plankton (1)

6. Preparation  
Basic knowledge of biology and ecology, basic understanding of marine ecosystem

7. Record and evaluation method  
Presence/absence evaluation & examination

8. Textbook and references  
Biological Oceanography: An Introduction, second edition  
Lalli and Parsons, 1997, ELSEVIER Butterworth-Heinemann

9. Self study  
Fisheries Science

10. Practical business

11. In addition  
Contact email address: ni5@tohoku.ac.jp
<table>
<thead>
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<th>Subject Numbering</th>
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1. Class subject

**Elementary knowledge for diversity of aquatic organisms based on genetics, evolutionary biology, ecology.**

2. Object and summary of class

This course is intended to provide a framework for the study of aquatic organisms, the foundation upon which all other courses in AMB will build. Using evolution as central organizing principle, we will examine the material and processes of inheritance, the forces that drive biological diversification, and the patterns and phenomena that result from these processes.

3. Keywords

- genetics, evolution, ecology, marine biodiversity, diversification, conservation

4. Goal of study

Students will be able to gain the synthetic concept for conservation and utilization of aquatic organisms based on genetics, evolutionary biology, ecology.

5. Contents and progress schedule of class

1. Introduction
2. Molecular Genetic Markers (I)
3. Molecular Genetic Markers (II)
4. Molecular Genetic Markers (III)
5. Molecular Genetic Markers (VI)
6. Molecular Identification (I)
7. Molecular Identification (II)
8. Molecular Identification (III)
9. Molecular Identification (VI)
10. DNA Barcoding (I)
11. DNA Barcoding (II)
12. DNA Barcoding (III)
13. DNA Barcoding (IV)
14. Guidance of Molecular Ecological Softwares (I)
15. Guidance of Molecular Ecological Softwares (II)

6. Preparation

None

7. Record end evaluation method

- Attendance: 10%
- Activeness: 10%
- Final Exam: 80%

8. Textbook and references

Preparing textbook

9. Self study

None

10. Practical business

11. In addition

Contact e-mail address:
Ikeda: minoru.ikeda.a6@tohoku.ac.jp
1. Class subject

**Introduction to Fisheries Science**

2. Object and summary of class

This course provides an overview of the fishery science. Students will learn the fishery science on the basis of marine biology in a broad sense from molecules to ecosystems.

3. Keywords

Fisheries science, basics & outlines

4. Goal of study

The goal is to understand the fishery science basically from ecology, physiology, genetics, molecular biology and evolution, and to appreciate the fishery science as the applied marine biology.

5. Contents and progress schedule of class

**Topics on marine ecology and oceanography**

**Lab Marine Plant Ecology**
- Oct. 2 — “The ecology of herbivorous crustaceans” (M. Aoki)
- Oct. 9 — “The ecology of floating seaweeds” (M. Aoki)

**Lab Fisheries Biology & Ecology**
- Oct. 23 — “How to know the fish age” (S. Katayama)
- Oct. 30 — “How to know the fish migration” (S. Katayama)

**Lab Biological Oceanography**
- Oct. 16 — “Plankton in the ocean” (G. Nishitani)
- Nov. 6 — “Benthos adapted to marine environment” (W. Sato-Osako)

**Lab International Integrative Research & Instruction**
- Nov. 13 — “Environmental DNA: Sources, Tools & Applications” (C. Ames)

**Topics on biology and biochemistry of aquatic organisms**

**Lab Aquacultural Biology**
- Nov. 20 — “Immunity in marine invertebrates” (K. Takahashi)
- Nov. 27 — “Manipulation of reproduction in bivalve mollusks” (M. Osada)

**Lab Marine Biochemistry**
- Dec. 4 — “Food chemistry of fish and shellfish” (Y. Ochiai)
- Dec. 11 — “Probiotics and bioactive substances in fish” (T. Nakano)

**Topics on fish genetics and biotechnology**

**Lab Marine Life Science & Genetics**
- Dec. 18 — “Genetic conservation and sustainable use of resources in aquatic organisms” (M. Nakajima)
- Dec. 25 — “Biological sequence comparison methods” (Y. Sakai)

**Lab Integrative Aquatic Biology**
- Jan. 8 — “Coastal ecosystem dynamics and fishery resources” (T. Fujii)
- Jan. 15 — “Evolution and fisheries resources” (M. Ikeda)

6. Preparation

Refer to the recent topics in each field.

7. Record end evaluation method

Attendance and report. The report should be directly submitted to the instructor of each lecture by the next lecture.

8. Textbook and references

No textbook. Reference books will be introduced.

9. Self study

Summarize the content of each class promptly.

10. Practical business

11. In addition

Questions, comments, and requests accepted.

Send them to the representative instructor, Prof. Osada: makoto.osada.a8@tohoku.ac.jp
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<thead>
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1. **Class subject**

   **Practical training at the points of fishery production and research**

2. **Object and summary of class**

   This course provides the tours at the point of fishery production and research. Students will learn fisheries science practically.

3. **Keywords**

   Field trip, investigative tour

4. **Goal of study**

   The goal is to increase awareness of students to learn fisheries science.

5. **Contents and progress schedule of class**

   This course provides the practical tours as below:

   1. Research institute of fishery
   2. Seafood company
   3. Fish market
   4. Aquarium etc.

6. **Preparation**

   Collect information before starting each tour.

7. **Record and evaluation method**

   Attendance and report. The report should be submitted by the designated deadlines.

8. **Textbook and references**

   No textbook. Reference books will be introduced by each professor.

9. **Self study**

   Refer to related books in the library after each tour.

10. **Practical business**

11. **In addition**

    Questions, comments, and requests are welcome. Send them to the representative instructor, Prof. Sato-Okoshi: wsokoshi@tohoku.ac.jp

2. Object and summary of class: Survey the different types of organisms in the sea in order to develop a fundamental understanding of marine biodiversity. Assess the effects of natural and anthropogenic disturbances on marine ecosystems and their inhabitants.

3. Keywords: Marine Biodiversity, Plankton, Ecdysozoa, Lophotrochozoa, Phylogenetics, Systematics, Ecology

4. Goal of study: Develop an understanding of the main categories of marine animals (Metazoa), become familiar with the basic body plans and distinguishing features against the background of evolution, ecology and systematics.

5. Contents and progress schedule of class
Each lecture will provide an overview of the fundamentals of different groups of marine organisms. Students will gain an understanding of the systematics and phylogenetics. Practical components will be incorporated through “virtual” class excursions to public museums and aquariums.

(1). Introduction. Marine organisms and the food web; producers, consumers, detritivores; the major groups & their spatial and bathymetric distributions; solar-dependent and solar-independent (hydrothermal) systems.

(2). Systematics and phylogenetics

(3) Plants. Phytoplankton: major groups & their characteristics. Macrophytic seaweeds.


(5). Crustacea (1) Major groups. Zooplanktonic forms.


(8). Report and exam.

(9). Echinodermata.

(10). Chaetognatha, Hemichordata, Urochordata, Cephalochordata.


(13). Marine mammals. Comparison with closest terrestrial relatives.

(15). Report and exam.

6. Preparation: All students should complete weekly reading and writing assignments prior to each class. By identifying areas of difficulty, each student should aim to improve understanding of the course content.

7. Record and evaluation method: Attendance and participation during lectures (25%); Reports/quizzes and end-of-term examination (75%)

8. Textbook and references: Primary reading(s) (students can purchase or borrow a copy from campus library):

9. Self-study: There is much to learn about these topics. Student are encouraged to review their lecture notes soon after class. Each lecture will start with a discussion and/quiz of the previous lecture to ensure students have a fundamental grasp of the course content, which is required to pass the quizzes/examinations.

10. Practical business

11. In addition: Any questions should be addressed to the lecturer directly during or after lectures, or during office
*Groups not covered during this course will be dealt in the courses Life & Nature, Planktonology and in Basic Seminars.
1. Class subject

**Resource and Environmental Economics**

2. Object and summary of class

This class object is to study the concepts of Resource and Environmental Economics. Ten Professors, Associate Professors and Assistant Professors will give the lectures weekly.

3. Keywords

agricultural economics, remote sensing, food business, environmental conservation, agricultural ethics

4. Goal of study

The goal of this class is to obtain the background knowledge concerning Resource and Environmental Economics as well as the basic principles of Agricultural Economics, Farm Management Science, Remote Sensing and Life Cycle Assessment of Goods.

5. Contents and progress schedule of class

① Guidance (Head of department)

② Readings an annual report of food, agriculture and rural village in Japan (Head of department)

An annual report of Japanese MAFF shows the outline of food, agriculture and rural village in Japan.

③ Food & Agriculture for Human Society (Prof. Katsuhito FUYUKI)

Poverty and socio-political unrest have deteriorated human security in developing countries. In this class, I will raise human security issues, especially food security and rural development for poverty alleviation.

④ Agricultural policy and environmental issues (Assoc. Prof. Keiichi ISHI)

This lecture will examine trends of agricultural policy integrating environmental problems.

⑤ Recent Situation of Japanese Agriculture and Global Food Production (Head of department)

World food supply and demand has changed dramatically in 21th Century. We explain its causes like emerging economies’ economic growth and expanding use of agricultural products for biofuels, and its implication. And also we study agricultural structural problems of Japan like too small farming.

⑥ Trends of Japanese food consumption and consumer’s behavior (Prof. Fusao ITO)

In this class, recent characteristics of change in Japanese food consumption will be showed. Students will be able to learn some problems of Japanese future food market.

⑦ Environment and Development (Assoc. Prof. Nina TAKASHINO)

In the lecture, key concepts of environmental economics such as externality, the tragedy of commons, public goods, Prisoners’ Dilemma will be introduced in the context of economic development.

⑧ Recent Situation of Japanese Agriculture and Agribusiness (Prof. Katsuhito FUYUKI)

Farmer’s income comprises not only agricultural income. Japan's government should support promoting agriculture production-related businesses, such as the processing of farm products by farmers themselves. In this lecture, statistical data and other information of such businesses will be introduced.

⑨ Spatial science in agriculture (Assoc. Prof. Chinatsu YONEZAWA)

Introduction of remote sensing and geographical information science (GIS) for agricultural application. Spatial thinking is an important and powerful agricultural problem solving tool.

⑩ Slash and Burn Agriculture: Environmental Degradation in Meghalaya, India (Assistant Prof. Minakshi Keeni)

This lecture will cover the introduction and evolution of slash and burn agriculture through time across the world. This will be followed by special emphasis on the Meghalaya case in India.
### Community farming in Japan (Prof. Tsuyoshi SUMITA)
Recently, community farming has been established in Japan. In this class, the characteristics and functions of community farming will be explained.

### Compatibility between conservation of nature and tourism (Assoc. Prof. Tomoko IMOTO)
With nature tourism, an appropriate balance between conservation and development can lead to economic growth. We explore possible ways to reduce the impact of tourism on nature using land-use classification and economic evaluation of nature.

### Creation of the report I (Head of department, et al.)

### Creation of the report II (Head of department, et al.)

### Creation of the report III (Head of department, et al.)

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<table>
<thead>
<tr>
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<tr>
<td>6. Preparation</td>
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</tr>
<tr>
<td>7. Record end evaluation method</td>
<td>Attendance to the lectures 50%, reports 50%</td>
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<tr>
<td>8. Textbook and references</td>
<td>Textbook and references will be introduced by each professor.</td>
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<td>9. Self study</td>
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<tr>
<td>11. In addition</td>
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</table>
1. Class subject:

**Life science for agricultural and industrial applications**

2. Object and summary of class:

   This class object is to study fundamentals and recent progress in the research fields of molecular biology, cell biology, and physiology with plants, animals, and microbes as well as chemistry of biologically active natural products. More than ten Professors and Associate Professors will give lectures weekly to introduce their specific research fields.

3. Keywords: Biochemistry, Molecular Biology, Chemistry

4. Goal of study

   The goal of this class is to obtain the background knowledge concerning life science for agricultural and industrial applications as well as the basic principles of biochemistry and biotechnology.

5. Contents and progress schedule of class

   1) **Mineral nutrients of higher plants**
   Students will learn about essential nutrients for higher plants and their physiological roles.

   2) **Genome and epigenetics**
   This lecture deals with characteristics and functions of genome and epigenetics in eukaryotic cells, including molecular mechanisms of gene regulation and effects of food ingredients on epigenetics.

   3) **Enzymes in pathophysiology and toxicology**
   This lecture will be presented to understand role of enzymes in health and disease, especially focusing on pathophysiology of Alzheimer’s disease and therapeutic application of natural toxins.

   4) **Applied microbiology and fermentation technology**
   Microorganisms possess a wide variety of metabolism and thus are applied to bio-conversion in fermentation industry. This lecture will address both transport processes (substrate-uptake and product-efflux) catalyzed by solute transporters at cell membranes and intracellular metabolic pathways from the view points of bioenergetics in microorganisms. We will also lecture on the principles of protein production technology by bacteria.

   5) **Synthesis and application of bioactive natural products**
   This lecture will be presented to build basic understanding of synthetic organic chemistry in the filed of natural products chemistry and its roles in agricultural production, medicinal chemistry, and so on.

   6) **Molecular basis of nitrogen metabolism in rice**
   In this lecture, molecular mechanisms underlying the primary ammonium assimilation and the related processes in rice will be introduced.

   7) **Molecular eukaryotic microbiology**
   Eukaryotic microorganisms such as yeasts and filamentous fungi have been playing a pivotal role in academic science as well as in industrial production of valuable substances. This lecture will give an overview of molecular analysis of the important characteristics of yeast and koji-mold, which each has been used in sake fermentation for over a thousand years in Japan.

6. Preparation: Textbooks and references will be introduced by each instructor.

7. Record end evaluation method : Attendance to the lectures 50%, reports 50%

8. Textbook and references: Textbooks and references will be introduced by each instructor.

9. Self study: Textbooks and references will be introduced by each professor.

10. Practical business

11. In addition

   Instructors: Profs. Tomohisa OGAWA, Masahiko HARATA, Keietsu ABE, Shigefumi KUWAHARA, Mitsue MIYAO, Takahiro SHINTANI;
   Associate Profs. Hiroyuki ISHIDA, Eugene FUTAI, Jun KANEKO, Masaru ENOMOTO, Toshihiko HAYAKAWA
1. Class subject

Recent research topics in aquatic animal physiology

2. Object and summary of class

Studies on aquatic animal physiology have contributed to not only aquaculture production, but also fundamental biology. In this course, some recent findings in aquatic animal physiology (mainly germ cell biology and neuroendocrinology) will be introduced.

3. Keywords

Germ cells, Reproduction, Neuropeptides, Fish, Shellfish

4. Goal of study

Learning recent findings, scientific interests with science impact, and further application.

5. Contents and progress schedule of class

1. Guidance & Introduction
2. Germ cell biology in aquatic animals 1 (germ cell classification)
3. Germ cell biology in aquatic animals 2 (germ cell classification)
4. Germ cell biology in aquatic animals 1 (germ cell transplantation)
5. Germ cell biology in aquatic animals 2 (germ cell transplantation)
6. Neuroendocrinology in aquatic animals
7. Examination

*Contents of the class may be changed without prior notification.

6. Preparation

No need.

7. Record end evaluation method

Evaluation is based on class attendance and the final examination.

8. Textbook and references

Handouts are used.

9. Self study

Review the handouts.

10. Practical business

11. In addition

Students may visit the office or contact by Emailing (kazue.magasawa.d6@tohoku.ac.jp) anytime.
| Subject | Current topics of Fish Ecology  
(先端海洋生物生態学) | Day/Period | Wed./3rd | Object | AMB |
|---------|---------------------------------|------------|---------|--------|-----|
| Instructor (Post) | Kyoko Kinoshita  
(Assistant Prof.) | Categories | Specialized Subjects | Preferable Participants | 3rd-year students |
| Position | Faculty of Agriculture (Graduate School of Agricultural Science) | Credits | 1 |
| Subject Numbering | ABS-APS364E | Language Used in Course | English |

1. Class subject

**Current topics of Fish Ecology**

2. Object and summary of class
   This course covers the functions of benthic invertebrates in the marine ecosystem and their contribution to fishery resources.

3. Keywords
   Benthos, Climate change, Invasive species, Marine ecosystem, Stable Isotopes

4. Goal of study
   Through the course, students will be able to understand environmental conditions surrounding marine biological resources.

5. Contents and progress schedule of class
   1. Overview of the marine environment
   2. Benthic life habits
   3. Coastal environments
   4. Stable isotope ecology
   5. Mariculture
   6. Biological invasion and climate change
   7. Examination

6. Preparation
   No need.

7. Record end evaluation method
   Attendance and participation during lectures (12%), assignments (28%) and final examination (60%).

8. Textbook and references
   Oxford University Press, New York.  
   Handouts are given within class.

9. Self study
   Thinking about current topics on Marine Ecology through the textbook, handouts and recent papers.

10. Practical business

11. In addition
   If you have any questions, contact me by email.  
   My email address is as follows: kyoko.kinoshita.c7@tohoku.ac.jp
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1. **Class subject**
   Marine Biochemistry and Seafood Science

2. **Object and summary of class**
   This course will provide students with an understanding of the importance of biochemistry, physiology and food science in the field of fisheries sciences.

3. **Keywords**
   Lipid; Protein; Washoku; Bioactive Substance; Freshness; Quality Assessment; Stress; Growth; Transgenic Fish

4. **Goal of study**
   To understand biochemical and physiological phenomena in fish and functional substances for our health from marine natural products and seafood.

5. **Contents and progress schedule of class**
   1. Introduction “Current research topics in our lab at a glance”
   2. Washoku and seafood
   3. Functional substances from marine products
   4. Quality of seafood
   5. Stress in fish
   6. Growth and nutrition in fish
   7. Examination

6. **Preparation**
   TBA (Preparation will be notified at the class)

7. **Record end evaluation method**
   Class attendance, presentation, and examination

8. **Textbook and references**
   References will be notified at the class.
   (tentative) Dietary Supplements for the Health and Quality of Cultured Fish by Nakagawa, Sato and Gatlin, CABI, 2007.

9. **Self-study**
   TBA (Self-study will be notified at the class)

10. **Practical business**

11. **In addition**
    Questions, comments, and requests will be accepted during office hours.
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1. **Class subject**

   **Recent studies of genetics in aquatic organisms.**

2. **Object and summary of class**

   Learning recent topics of genetics in relation to larval evolutionary ecology to discuss the future area of active research.

3. **Keywords**

   Larvae, Development, Evolutionary ecology, Climate change

4. **Goal of study**

   Touching the current topics in the genetics of aquatic organisms with a focus on evolutionary ecology of marine invertebrate larvae.

5. **Contents and progress schedule of class**

   - General introduction of this class
   - Evolutionary origins and transitions in developmental mode
   - Functional morphology and ecology of larval forms
   - Larval transport, settlement, and metamorphosis
   - Larval ecology at the extremes
   - Larval ecology in the face of changing climate
   - An -omics perspective on marine invertebrate larvae; summary

6. **Preparation**

   No need.

7. **Record and evaluation method**

   Class attendance, presentation, and reports

8. **Textbook and references**


9. **Self study**

   Search recent topics on what learned in previous class

10. **Practical business**

11. **In addition**
1. Class subject

Ecology of marine temperate reef communities.

2. Object and summary of class

Some current topics in ecology of marine temperate reef communities will be introduced.

3. Keywords

seaweed, kelp bed, herbivore, grazer, sea urchin, gastropod, plant-animal interactions, benthos, parasite, symbiosis,

4. Goal of study

To learn the factors affecting the complex networks in marine temperate reef communities.

5. Contents and progress schedule of class

1) Plant-animal interactions in marine benthos
2) Biology and ecology of sea urchins
3) Phase shift in rocky subtidal ecosystem
4) Biology and ecology of marine crustaceans
5) Parasitic and symbiotic relationships
6) Marine mesograzers
7) Examination

6. Preparation

7. Record and evaluation method

Attendance and examination

8. Textbook and references

Recent papers are given within class.

9. Self study

10. Practical business

11. In addition

E-mail: eri.inomata.b6@tohoku.ac.jp
1. Class subject

**Fish Molecular Biology -- Fish as a Model System**

2. Object and summary of class

   In recent decades, fish became more and more used as excellent model system to investigate fundamental questions not only in aquaculture, but also in basic biology, medicine, and environmental science. This class will discuss why they are favored and how the model system developed, by showing examples of fish and other animals used as experimental model system.

3. Keywords

   Experimental model animal, genetics, developmental biology, non-conventional model animal

4. Goal of study

   Students will understand the potential of fish and the reason why fish are used as an excellent experimental model in various fields. Some of learned strategies would be helpful for students to design their own research projects in any fields.

5. Contents and progress schedule of class

   1. Introduction: Molecular biology as a tool for the research in biology and medicine
   2. Advantage of nematode and fly as model system: development, genetics and mutagenesis
   3. Advantage of fish as a model system: developmental genetics, genomics and mutagenesis
   4. Advantage of frog and chicken as model system: development and micro-surgery
   5. Advantage of mouse as a model system: development and stem cell technology
   6. Advantage of using multiple model system: comparative approach and evolutionary biology
   7. Experimental model system: past, present and future
   8. Summary and final exam

6. Preparation

   Review the previous classes. Please feel free to ask during the class, if you have any ambiguous points.

7. Record end evaluation method

   Attendance, participation, quiz and final exam.

8. Textbook and references

   Developmental biology (Scott F Gilbert)
   Others will be introduced in the class.

9. Self study

   Have a look at the Nature or Science magazine to see how model organisms are used in the latest biological research, and read some articles if you find them interesting.

10. Practical business

    Office hours, 10:00 to 18:00, Monday to Friday, please make an appointment beforehand.
    Contact, hayokoi@tohoku.ac.jp
### Subject

**Current topics of Plankton Biology**  
(先端プランクトン学)

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<thead>
<tr>
<th>Day/Period</th>
<th>Fri./3rd</th>
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<tr>
<th>Object</th>
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<tr>
<th>Instructor (Post)</th>
<th>G. Nishitani (Associate Prof.)</th>
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<tr>
<th>Categories</th>
<th>Specialized Subjects</th>
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<th>Preferable Participants</th>
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<tr>
<th>Position</th>
<th>Faculty of Agriculture (Graduate School of Agricultural Science)</th>
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<th>Credits</th>
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<th>Language Used in Course</th>
<th>English</th>
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<tr>
<th>Subject Numbering</th>
<th>ABS-APS369E</th>
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### 1. Class subject

**Molecular Ecology and utilization of plankton**

### 2. Object and summary of class

Plankton is a very small organism and its morphology cannot be observed without using a microscope. However, plankton is one of the most important components and significantly contributes to the marine ecosystem. In this class, several researches on utilization of plankton and its ecology using the latest molecular techniques will be introduced.

### 3. Keywords

Plankton, Harmful and useful species, Molecular ecology

### 4. Goal of study

Students will learn that molecular methods are effective and are important tools for plankton research. Moreover, students will also understand the utilization of plankton for industry and human health.

### 5. Contents and progress schedule of class

1. Classification and biology of useful plankton
2. Applications of useful plankton for human health
3. Molecular Ecology of useful plankton
4. Classification and biology of harmful and toxic plankton
5. Molecular Ecology of harmful and toxic plankton
6. Food analysis in the gut contents of invertebrate larvae
7. Examination

### 6. Preparation

Understand an outline of each topic in advance

### 7. Record end evaluation method

Attendance and examination

### 8. Textbook and references

All handouts will be given within class

### 9. Self study

Read handouts again and review the molecular topics in plankton. If you are interested in some plankton species, learn more in details from the literature and using Internet, etc.

### 10. Practical business

### 11. In addition

E-mail: ni5@tohoku.ac.jp
1. Class subject

The past, present, and future of industry, science, technology and their relationships and integration in Japan.

2. Object and summary of class

This specialized subject course (one credit) is a multidisciplinary course that has been organized by the faculties of science, engineering, and agriculture since 2016. Except for the first class, each class will feature a lecture by a specialist in his field. The topic of each lecture will be related to the science, technology, and industry, and their relationships in Japan and the globe”. The topics also include issues and efforts in specific fields of industry to implement the 17 SDGs (Sustainable Development Goals) announced by the United Nations in 2016.

Students will learn how science, technology, and industry in different fields were integrated and developed, and how they contributed, contribute, and will contribute to our society with different cultures, and in diverse circumstances.

Registered students are expected to apply what they learn from this course in another course titled "Multidisciplinary Internship" which will be given in summer 2021.

3. Keywords

4. Goal of study

The goal of this course is to give students a multidisciplinary perspective and open-minded attitude in a diverse group of people with different cultural and academic backgrounds.

5. Contents and progress schedule of class

#1 Guidance will be given by Y. Watanabe at GLC on October 6.
#2-8 Lectures by guest speakers will be given on the 7 dates listed in the table below. Please note that this schedule is a tentative one and the final schedule will be announced in a timely manner.

<table>
<thead>
<tr>
<th>Date</th>
<th>Guest Speaker</th>
<th>Company/Institution</th>
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<tbody>
<tr>
<td>Oct. 6</td>
<td>渡邉由美子 (Yumiko WATANABE)</td>
<td>東北大学・GLC</td>
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<tr>
<td>Oct. 13</td>
<td>井出 秀一氏 (Hidekazu IDE)</td>
<td>原子燃料工業 (株) (Nuclear Fuel Industries)</td>
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<tr>
<td>Oct. 20</td>
<td>山口 喬氏 (Takashi YAMAGUCHI)</td>
<td>(株)住友重機械工業 (Sumitomo Heavy Industries)</td>
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<tr>
<td>Oct. 27</td>
<td>蜂名 武雄氏 (Takeo EBINA)</td>
<td>(国研)情報通信研究機構 (NICT: Info. &amp; Comm. Tech.)</td>
</tr>
<tr>
<td>Nov. 10</td>
<td>佐藤 陽一氏 (Yoichi SATO)</td>
<td>(国研)産業技術総合研究所 (AIST: Advanced Industrial Science &amp; Tech.)</td>
</tr>
<tr>
<td>Nov. 17</td>
<td>富田二三彦氏 (Fumihiko TOMITA)</td>
<td>(株)理研食品 (Riken Food)</td>
</tr>
<tr>
<td>Nov. 24</td>
<td>仁平 貴康氏 (Takayasu NIHIRA)</td>
<td>(国研)情報通信研究機構</td>
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</table>
6. Preparation

7. Record end evaluation method

- Attendance, active participation, including the submission of a short essay on each lecture (50%)

The length of the short essay is expected to be approximately one A4 page using 12 point ‘Times New Roman’ font. You may want to write what you learn from the lectures, and also the situation of a specific area of your home country.

Please save your file with a name including your student ID and the date of the class in “docx” or “pdf” format. This rule applies to the final report as well.

B9SBxxxxDATE (e.g., 1013 for DATE of October 13)
B9TBxxxxDATE
B9ABxxxxDATE

The deadline for submitting an essay to the classroom is 9 am of every next Monday after the class.

- A proposal (1,200~1,500 words) on your idea to contribute to the growth and/or innovation of an industry in your country while maintaining sustainable development in that country or elsewhere in the globe.
  You are expected to apply your specialty and integrated knowledge beyond the conventional academic field that you learned about from this course (50%)

The deadline of this report is 9 am on Monday, January 5, 2021 (negotiable).

Note: Late submission of an essay and a report may result in a lower score on your work. A long delay (more than 1 week) will be considered to be a failure of the submission, and no scores will be given.

8. Textbook and references

9. Self study

10. In addition

If you cannot attend a class for any reason, please email the coordinator of this course (yumiko.watanabe.a5@tohoku.ac.jp) as soon as you know you will be absent.
1. Class subject  
Introduction of Japanese fisheries and aquaculture productions and seafood processing

2. Object and summary of class  
Japan is well-known for fisheries and aquaculture production. The objective of the class is for international students to gain an understanding of fisheries production systems. Students taking this course will take interests in the traditional and recent art and technologies of fisheries, aquaculture, distributing, processing and eating fish and shellfish in Japan.

3. Keywords

4. Goal of study  
Students will  
- know the unique and active coastal fisheries in Japan.  
- learn about the distribution system for raw marine organisms landed at the fish market.  
- understand operations of the seafood processing industry.  
- discover Japanese excellent techniques of fish aquaculture and its seedling production.

5. Contents and progress schedule of class  
All subjects are provided as online lectures.  
Please visit Google Classroom “mgbpb2c”

We have set 7 subjects in “授業”.  
1 Coastal fisheries: Ocean Fishing  
2 Seafood processing: 2-1 Tsukiji Fish Market, 2-2 MAGURO, 2-3 Cook Around Japan " Kesennuma "  
2-4 Hand-made Delicious Kamaboko, 2-5 The Bounty of the Deep  
3 Aquaculture: Changing Asian Kitchens with Aquaculture

For each item, first listen to the introduction (power-up with narration) by the teacher, and then watch the on-demand videos provided by NHK (Japan Broadcasting Corporation).

Online lecture will be open during June 15st to Aug. 12th.  
- Please select the two topics that you are most interested in and submit your impressions as a report by Aug. 12th.

6. Preparation

7. Record end evaluation method  
Attendance and reports

8. Textbook and references

9. Self study

10. In addition  
    skata@tohoku.ac.jp (Prof. Satoshi KATAYAMA)