Priority Subjects — **Further Improvement of Facility Operations and Maintenance Technologies**

Development of Efficient Impact Assessment Methods for Ecosystems

Background and Objective

According to the amendment of the Environmental Impact Assessment Law in 2011, the assessment of biodiversity must be included in the Environmental Impact Statement at the planning stage of construction of new power plants and expansion of existing plants, and the results of environmental conservation measures must be published. In addition, wind-power generation was added as a new target project regulated by the said law. Government-level discussions regarding the necessity of biodiversity offsets*1 and the assessment of environmental impact of power plants on marine ecosystems have begun, increasing the necessity for technological developments related to the introduction of new regulations and systems.

The target of this research is the development of technologies related to biodiversity assessment and conservation, which enable the smooth construction, renewal, and operation of power plants.

Main results

1 Development of a three-dimensional coordinate system for flying birds

In the environmental impact assessment of the construction of wind power plants, the frequency of birds flying at the height corresponding to wind turbines should be clarified to predict the collision frequency of birds with wind turbines. Conventionally, flying birds were visually observed; however, this requires considerable effort and the error is large. To efficiently obtain data on the flight heights of flying birds, the research team developed a three-dimensional coordinate system for obtaining the three-dimensional positions of flying birds using images simultaneously recorded by two cameras. The precise determination of the frequency of birds flying at the height corresponding to the swept area of wind turbines was confirmed to be possible from the results of long-term observation of flying birds using the system and the three-dimensional coordinates of flying birds (Fig. 1). Future goals are to develop a transportable system and to carry out verification in various environments, with the aim of developing a versatile method that can be applied to environmental impact assessment.

2 Development of a method for predicting impact to population of principal plant species*2 in order to determine the necessity of conservation transplantation

In environmental impact assessment, the necessity of conservation transplantation of principal plant species depends on the degree of impact and mitigation measures to focal populations such as relocation and/or minimization of construction areas. The research team developed a method of efficiently and quantitatively predicting the degree of impact mitigation to the plant population using minimal parameters (e.g., survival rate and reproductive rate estimated from the distribution of the plant) and alternative draft layouts of construction areas (Fig. 2). The method will be verified and further improved using data on actual sites, so as to be employed in actual environmental impact assessments for the reduction of uncertainty and the cost associated with conservation transplantation.

3 Development of a technology for predicting standing biomass of seagrass bed during the growing season

Among marine ecosystems, the seaweed and seagrass bed ecosystem plays an important role as a location of high biological production and a habitat of various living organisms. To estimate standing seaweed and seagrass biomass during the growing season, which is necessary in environmental impact assessment, a submersible survey involving considerable time and cost is required. The research team developed a simple numerical model for predicting the standing biomass using publicly available data (e.g. solar irradiance, sea temperature, and transparency) released by public institutions [1]. In FY2014, the research team developed a model for seagrass beds formed on a sandy sea bottom in Japan and validated the model with observed data (Fig. 3). The model enables estimation of the standing biomass of seagrass in various regions of Japan, and contributes to rapid and low-cost assessment.

*1 When the impact to ecosystems in developed areas cannot be mitigated on site, such residual impact to the ecosystems can be mitigated by creating and/or maintaining similar ecosystems at other sites.
*2 Principal species refer to the species listed in national and municipal laws and regulations as being critically endangered or easily affected by changes in the environment.

[1] M. Honda, *Algae*, 62:143-151, 2014.

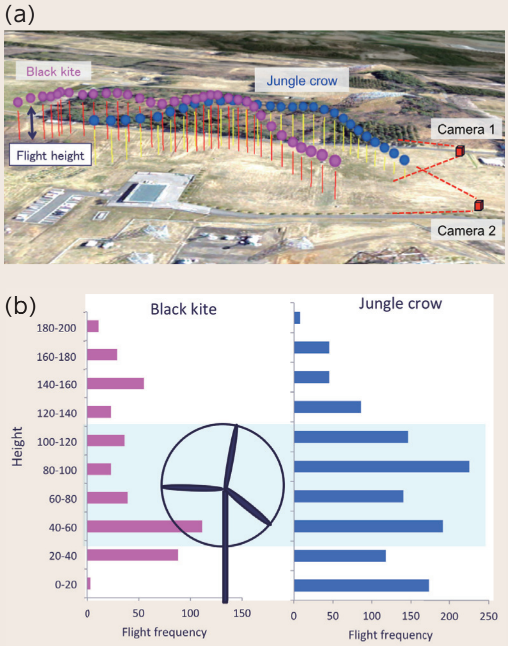

Fig. 1: Quantification of the flight heights of flying birds using a three-dimensional coordinate system

Examples of positions of flying birds represented three-dimensionally using images simultaneously recorded by two cameras (pink and blue circles represent the positions of a black kite and a jungle crow, respectively) (a). Distribution of flight height of black kite and jungle crow quantified using images recorded over 50 h (b). Both the black kite and the jungle crow fly at heights corresponding to those of the rotary plane of wind turbines with a frequency of ≥40%. The system enables us to efficiently obtain precise flying data required to estimate the collision frequency of these bird species with wind turbines.

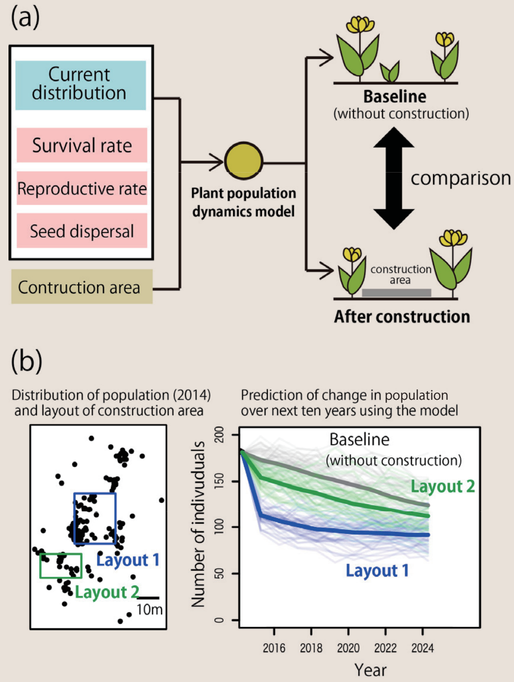

Fig. 2: Prediction of change in population using a plant population dynamic model

The change in the population of principal plant species is predicted using parameters (e.g., survival rate, reproductive rate, and seed dispersal distance), the current distribution of the plant, and draft layouts of construction areas (a). The impacts of two alternative draft layouts on the population of the golden orchid (a principal species) were compared with that of the baseline (without construction). The results indicate that the impact of draft layout 2 on the golden orchid is smaller than that of draft layout 1 (b).

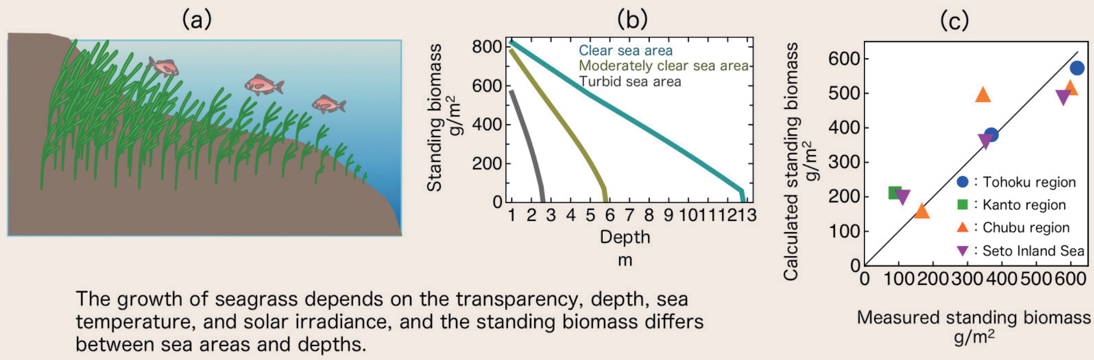

Fig. 3: Numerical model for predicting the growth of seaweed

In the model, the standing biomass of seagrass during the growing season at different depths of water is predicted using environmental data, such as solar irradiance, sea temperature, and the transparency of each sea area (a, b). For the seagrass beds in the Tohoku, Kanto, Chubu regions, and Seto Inland Sea, where detailed ecological examinations have been carried out by universities and fisheries research institutes, estimated values of the standing biomass from the numerical model with the environmental dataset were consistent with reported values. The results confirmed that the numerical model can accurately predict the standing biomass (c).