First application of Habitat Evaluation Procedure to EIA in Japan: How to quantify loss and gain of habitats?

Akira Tanaka – tanaka@yc.musashi-tech.ac.jp

Background and objective of the study

Recently, many countries, including Japan, have developed similar policies/guidelines on mitigation sequencing such as “avoid – minimize - compensate (i.e. offset)” in relation to Ecological Impact Assessment. (“EcIA” is a part of EIA which deals with ecology/biology issues.) Formation of effective ecological mitigation measures should be core process in EcIAs. However, it is not easy to evaluate proposed mitigation measures practically. Compensatory mitigation (=biodiversity offset) in particular has been controversial because some sort of quantitative analyses would be required. Ecological net gain and net loss must be compared to secure “no net loss”. Japan’s “EIA Law of 1999” (published in 1997 and executed in 1999) requires project proponents to do holistic “ecosystem assessment” in addition to traditional inventory surveys of flora & fauna. “Law for the Promotion of Nature Restoration of 2002” has promoted ecological restoration projects nationwide. Proponents of ecological restoration projects have been required to demonstrate the success, or otherwise, of such restoration.

The author considered that the Habitat Evaluation Procedure (HEP), developed in the United States in 1970s and often used in EIA in the U.S., could become a beneficial tool for Japan if the procedure could be adjustedto the fragmented land-use in Japan. The author has been attempting to promote the widespread use of HEP in EIAs and ecological restoration projects through the publication of a reference book on the application of HEP in Japan（tanaka 2006） and by setting up a website for Habitat Suitability Index models on Japan’s wildlife in the Web of Japan Society for Impact Assessment (http://www.yc.musashi-tech.ac.jp/~tanaka-semi/HSIHP/index.html) in 2006.

The EIA case introduced in this presentation is the first case of HEP application to an EIA in Japan, and the author participated in the HEP process ranging from planning to analysis as a coordinator of the HEP team. This study is made for the purposes of discussing the effectiveness of HEP application on EIAs in Japan and of verifying the potentiality of HEP by analyzing the experience of the first HEP application to Japan’s EIAs.

Why was Habitat Evaluation Procedure introduced into Japan?

Japan’s traditional EcIA consisted of preparing an inventory of flora and fauna and there were not habitat/ecosystem analyses. 1997 EIA law requires project proponent to do holistic “ecosystem assessment” so as to integrate traditional inventory making into it. HEP is an ecosystem assessment tool of habitat approach which can integrate each wildlife species and environmental conditions as its habitat.

For applying HEP in an EIA, it is necessary to prepare a plan of mitigation measures with particular information as to when, where and how they are implemented. Although alternative analyses have not been required and have therefore not been carried out, it is essential to introduce alternative analyses in Japan’s EIAs. HEP is not a technique for absolute evaluation, but a technique for comparatively evaluating alternatives. If HEP is introduced to Japan’s EIAs properly, alternatives analyses must also be introduced.

Most of ecosystem assessment so far in Japan has been subjectively qualitative but not objectively quantitative. Impacts on intricate ecosystem are evaluated quantitatively from the viewpoint of habitat suitability for certain wildlife species in HEP. Further, the space of the habitat is expressed by a particular value in ha, acre, etc. Furthermore, the period during which the habitat exists is expressed by years. The Cumulative Habitat Unit as the final unit of HEP is expressed as a value obtained by multiplying these three values of "quality", "space" and "time".

There has been little information on species-habitat relationship that is available for EcIAs in Japan. For each wildlife species to be evaluated by HEP, an expert of the species decides particular and quantitative index values, i.e. Habitat Suitability Index (HSI), that can range from 0 (not suitable at all) to 1 (most suitable) for expressing quality of the habitat of each alternative. HSI models are developed in HEP and are open to public comment. Past experience of HSI models will be modified and utilized in future HEP.

Japan's EIA/EcIA studies are conducted by consultants who are hired by project proponents and there is little formal chance to discuss with other stakeholders, including other environmental specialists/NGOs, until the draft EIA report is completed and released to the public. Consequently it is difficult to have fair assessment results without bias in draft EIA report. In contrast, the HEP is performed by a team consisting of ecological experts representing conservationists and ecological experts representing the developer.

Essential conditions for HEP

This project is a 33.6ha residential and commercial development in Yokohama City, the second largest city of Japan, adjacent to Tokyo. The project site is located at an edge of traditionally human used natural area called "Satoyama," which consists of "Yato" (a stream, wetlands and paddy fields) and the surrounding hilly secondary deciduous forests. Many citizens visit this region considered as an urban nature observation place. If the proposed development project is implemented, this natural ecosystem will be partially lost. For conserving "Satoyama," four wildlife species with the "Yato" ecosystem and the hilly secondary forests as habitats were selected as the species to be evaluated (evaluation species) (Fig.1). To eliminate the bias in the evaluation by the project proponent and any particular organization in the execution of HEP, an HEP team consisting of the HEP expert, experts of the wildlife species to be evaluated (see below), the project proponent, two nature conservation organizations and a consultant was established.

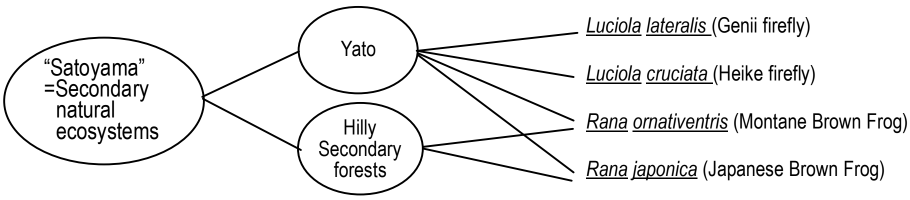


Fig.1 Ecosystems to be protected and evaluation species

Alternative land use plans to be evaluated by HEP

The evaluation covered the following four scenarios.

(1) Present situation: Present situation of the project region before the project is implemented.

(2) Future A: A scenario where the project is implemented together with the mitigation measures proposed in the HEP process discussed by the HEP team. (="With the development project" scenario)

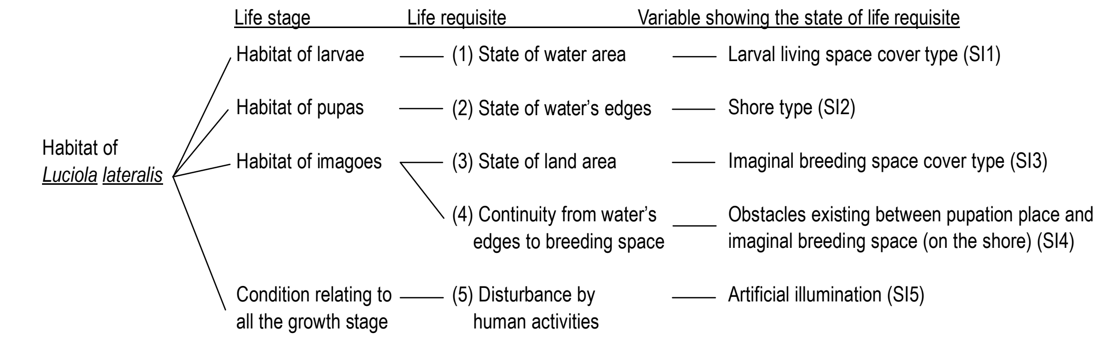
(3) Future B: A scenario where the project is implemented with general mitigation measures (without implementing the mitigation measures proposed in the HEP process discussed by the HEP team).

(4) Future C: A scenario where the project is not implemented, since the project proponent gives up the development and sells the lands or returns the lands to individual rightful persons. (="Without the development project" scenario = baseline).

Habitat Suitability Index Models (HSI Models)

Fig.2 shows the relationship between the life requisites of *Luciola lateralis* and the variables showing the states of respective life requisites (habitat variables) respectively set for preparing the HSI model of the species. Meanwhile, the HSI model of the species for calculating the Habitat Suitability Index (HSI) as a comprehensive index showing the habitat suitability for the species is shown in the equation below. Each Suitability Index (SI) is read from respective SI models. SI models can be both graphs and tables such as of Fig.2.

<Life requisite and SI values>



<a SI model for SI values>

Larval liveing space of water	Value of SI1
Water (flowing)	1.0
Water (not flowing)	0.5
Land	0.0

<Relationship between HSI and SIs>

$$HSI = \left\{ \frac{SI1 + SI2 + \left(SI3 \times SI4\right)^{1/2}}{3} \right\} \times SI5$$

Fig. 2 HSI Model of *Luciola lateralis*,

Calculation of Total Habitat Units (THU)

Fig. 3 presents a proposed modification to the original HEP for fragmented land use peculiar to Japan. In the original HEP, the same subregions are used to identify different SIs. The THU calculation procedure is shown below.

(1) Read the SI values of respective evaluation subregions according to the SI models of each evaluation species, instead of using same subregions which is the way of original HEP.

(2) Calculate HSI for the respective evaluation subregions divided according to the conditions of all the SI models (called “evaluation subregions of the minimum unit”).

(3) Multiply the HSI value calculated for each of the evaluation subregions of the minimum unit by the corresponding area, to calculate Habitat Units.

HU＝HSI×Area of the evaluation subregion of the minimum unit.

(4) Add up the HU values calculated for the respective evaluation regions of the minimum unit, to calculate THU.

THU＝ Value obtained by adding together the HU values of the entire evaluation region.

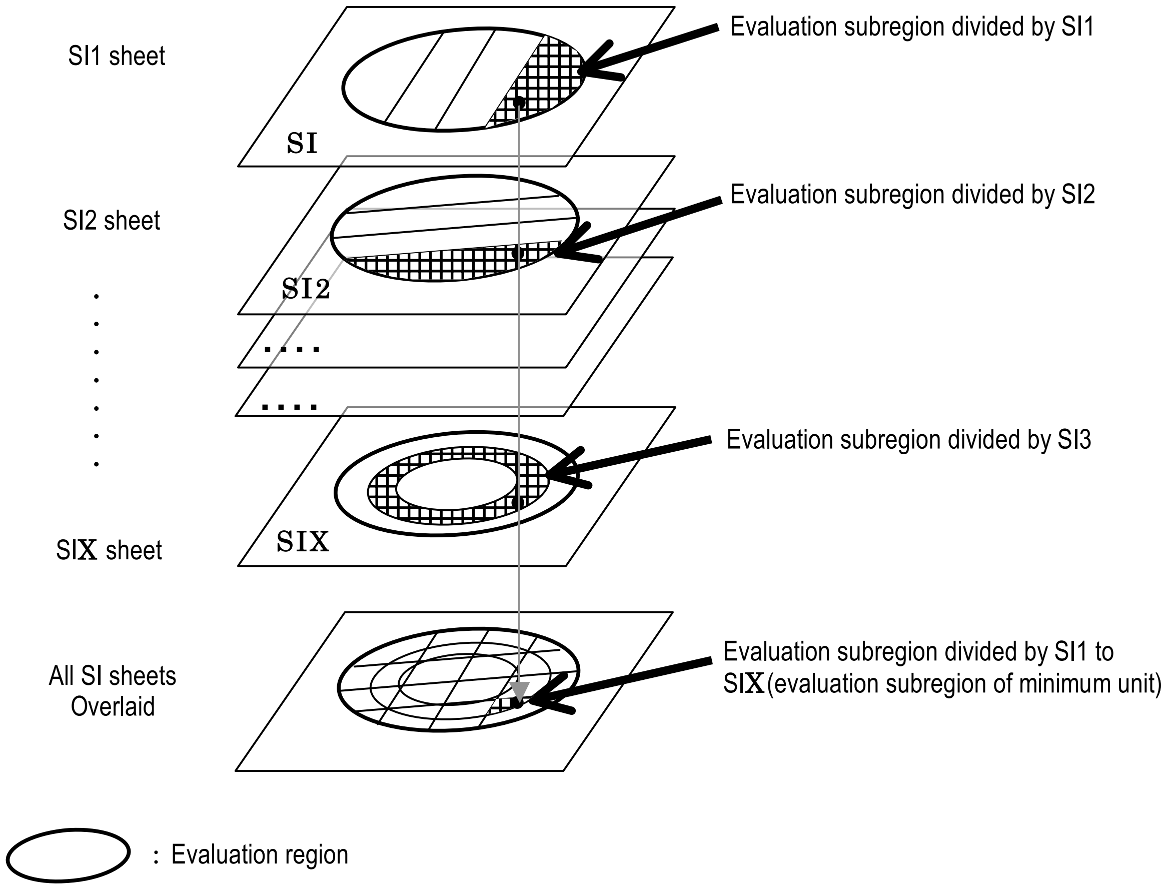


Fig. 3 Idea of evaluation subregions of the minimum unit for fragmented habitats

Results of HEP

In this HEP, the “Present situation” of the project region and “Future A,” “Future B” and “Future C” set as future situations of the project region were comparatively evaluated. With regard to the changes of THU of *Luciola lateralis*, *Luciola cruciata*, *Rana ornativentris* and *Rana japonica* in the respective evaluation scenarios, the THU levels of “Future A,” “Future B” and “Future C” with the THU values of “Present situation” as 100% are shown in Fig. 4. Comparatively speaking, “Future A” scenario is better than both “Future B” and “Future C” scenarios from the view point of the four species’ habitat suitability. The reason why THU of *Rana ornativentris* increased by 3%

in “Further A” is that the project proponent planned to create ponds suitable as habitat for the species for example.

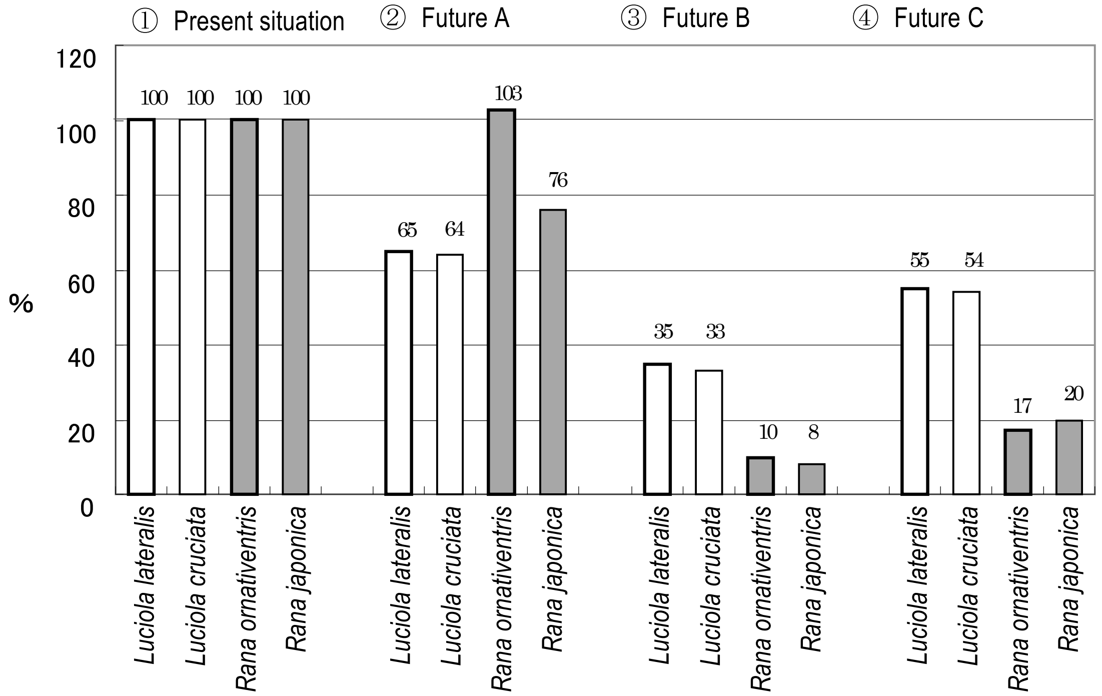


Fig. 4 THU levels of respective evaluation species in the respective evaluation scenarios

(With the THU values of the present situation as 100%)

Discussion

The application of HEP has allowed the comparative evaluation of alternatives using clear numerical values such as THUs. This HEP analysis became the first case of alternatives assessment in an EIA in Japan. The HEP team contributed to integrated substantial mitigation ideas through advice from species experts. Numerical values are easily understood even by general citizens who are not experts, enabling the citizens to present ideas for further mitigation of impacts. HSI models which describe habitat suitability of a wildlife species were available to the public, while the HEP process provides indispensable information for EcIAs by publishing HSI models. Consequently, this case study proved that HEP would play a great roll to resolve traditional EIA problems in Japan.

On the other hand, although the project proponent donates existing forested area of 12.3ha to Yokohama City as a sort of compensatory mitigation, all scenarios shows obviously lower THU values compared to present situation. We have not legal obligation in Japan for “no net loss” of natural habitats, yet. The mitigation sequence of “avoid – minimize – compensate (offset)” was included in EIA Law of 1999, but there have not been any standardized definition of “compensation.” Application of HEP to EIAs expose what/when/how much we will lose and what/when/how much we will gain in terms of habitats in EIA process. Therefore HEP-like quantitative ecological assessment methods accelerate to establish “no net loss” policy of natural habitat.

A variety of activities relating to carbon offsets has been getting active, although “no net loss” policy of natural habitat has not been discussed in Japan. There is a tight relationship between biodiversity offsets (compensatory mitigation) and carbon offsets, and so sooner or later the two offset activities should be combined. Futhermore, new types of mitigation banking (conservation banking, biodiversity pool) systems should be developed to compensate loss of habitats to achieve “no net loss” of habitats on earth.

References

Tanaka, Akira (2001). Changing Ecological Assessment and Mitigation in Japan. Built Environment 27(1), 35-41

Tanaka, Akira (2006). Theory and Practices for Habitat Evaluation Procedure in Japan (Japanese language). Asakura. Tokyo. 266pages.

U.S. Fish and Wildlife Service (1980). Habitat Evaluation Procedures (HEP). U.S. Dept. of Interior, Fish and Wildlife Service. Ecological Service manual 101, 102 and 103, 368pages.