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Habitat Equivalence Assessment methodology to determine compensation for restoration costs: an overview

Policy brief

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Essential damage to the environment resulting from rf's atrocities in Ukraine call for the development of a methodology to estimate the compensation for the expenditures related to the environmental remediation and restoration. This kind of methodology must enable the estimation of the amount which would objectively cover the compensation costs for the environment regeneration in Ukraine. The challenging nature and importance of such a methodology make us resort to the experience of other countries in this sphere.

Among the methodologies which are actively exploited in the USA is Habitat Equivalency Assessment. Below is a closer look at HEA.

The US Department of Commerce National Oceanic and Atmospheric Administration Damage Assessment, Remediation and Restoration Program outlines this methodology in the following way. Claims for the damage to natural resources have three basic components:

1) the cost of restoring the injured resources to baseline, or "primary restoration";
2) compensation for the interim loss of resources from the time of injury until the resources recover to baseline;
3) the reasonable costs of performing the damage assessment

Following US statutory requirements, all recovered damages are used to restore, replace, rehabilitate or acquire the equivalent of the injured resources (or to cover the costs of assessments). Consequently, recoveries for interim losses are spent on "compensatory restoration" actions providing resources and services equivalent to those lost.

To ensure full compensation for interim losses, the trustees determine the scale of the proposed compensatory restoration actions for which the gains provided by the actions equal the losses due to the injury.

The damage claim then is the cost of implementing the selected primary and compensatory restoration actions (plus the costs of the assessment) or alternatively, the responsible parties may be allowed to implement the projects themselves, subject to performance criteria established by the trustees.

To develop the restoration plan, trustees must determine and quantify injury, develop restoration alternatives that consist of primary and compensatory actions, scale restoration alternatives, and select a preferred restoration alternative.

The scale of compensatory restoration actions is conditional upon the choice of primary restoration actions. Consequently, for each restoration alternative under consideration, the type and scale of the primary restoration actions are to be identified first. Then the compensatory components of restoration alternatives can be scaled.

The process of scaling a project involves adjusting the size of a restoration action to ensure that the present discounted value of project gains equals the present discounted value of interim losses.

There are two major scaling approaches:

1) the valuation approach;
2) the simplified service-to-service approach, which applies under certain conditions (see below).

Habitat Equivalency Assessment (HEA) is an example of the second approach. The implicit assumption of HEA is that the public is willing to accept a one-to-one trade-off between a unit of lost habitat services and a unit of restoration project.

HEA does not necessarily assume a one-to-one tradeoff in resources, but instead in the services they provided prior to being injured and upon implementation of restoration efforts. Consider a marsh as the resource and primary productivity a resource service. Suppose the replacement project provides only 50 percent of the productivity per acre of marsh as the injured site would have provided, but for the injury. In order to restore the equivalent of lost productivity per year, then, the replacement project requires twice as many acres of marsh.

The assumption of comparable services between the lost and restored habitats may be met when, in the judgment of the trustees, the proposed restoration action provides services of the same type and quality, and of comparable value as those lost due to injury. Therefore, the scaling analysis simplifies to determining the scale of a restoration action that provides a quantity of discounted replacement services equal to the quantity of discounted services lost due to the injury. In Ukraine, the relevant ministry may adopt the appropriate decision upon consultations with the public and scientists.

In cases where services at the compensatory restoration site are not of the same type and quality or of comparable value to those injured, then the assumption of a one-to-one trade-off between the resources at the injury site and the compensatory restoration site may be inappropriate. In these cases, NOAA recommends that trustees evaluate whether the conditions for HEA are met and consider using the valuation approach as an alternative to determining the trade-off between injuries and compensatory restoration actions.

Necessary conditions for the applicability of HEA include that (1) a common metric (or indicator) can be defined for natural resource services that captures the level of services provided by the habitats and captures any significant differences in the quantities and qualities of services provided by injury and replacement habitats, and (2) the changes in resources and services (due to the injury and the replacement project) are sufficiently small that the value per unit of service is independent of the changes in service levels.

When choosing a metric to evaluate the quantity and quality of services provided per unit of habitat, the trustees should examine the capacity, opportunity and the payoff (i.e. benefits) of the services being provided as well as equity issues involved with the potential compensation projects. On-site biophysical characteristics (e.g., soil, vegetative cover, and hydrology) affect the capacity of an ecosystem to provide services. Landscape context affects whether the ecosystem will have the opportunity to supply many of the services and strongly influences whether humans will value the opportunities for services and hence, their value.

The choice of a metric to characterize services is key to determining whether HEA is applicable in a given context. On-site ecological attributes, such as stem density, canopy structure (density times height), or fish density, are sometimes used as a proxy for services; however, they are primarily indicators of capacity.

All in all, HAE takes place in seven steps. The spatial extent of injury is assessed with further determination of the core service to be restored. It should be noted that even though only service is included in basic calculations, thorough choice of the relevant unit of measurement to represent this service may result in effective coverage of a few services. For example, the dominant plant stem dominance in wetlands may be used to represent primary restoration and it will also represent a potential for being used by local fauna and other ecological functions.

Basic steps of using this methodology:

1. Determine the spatial extent of injured habitatat.
2. Choose the service to be restored and indicator to represent the service
3. Carry out an assessment of exploitation losses in the injured habitat
4. Determine the restoration curve (i.e. restoration rate)

5. Estimate the losses related to restoration and remediation
6. Estimate the overall losses
7. Estimate the necessary size of the restored habitat to compensate for total losses

In real life, the actual calculations are based on mathematical operations. In order to simplify the calculations, a special program was developed. Free HEA program is available on the Internet and accessible at *http://www.nova.edu/ocean/visual_hea/index.html,* *https://hcas.nova.edu/tools-and-resources/visual_hea/index.html*

Below is the equation to determine the amount of necessary compensatory restoration:

$$P = J * \frac{V_j}{V_p} * \frac{\sum_{t=0}^{N+1}\left[(1+r)^{C-t} * \frac{b^j - 0.5\left(x_{t-1}^j + x_t^j\right)}{b^j}\right] + \left[\left(\frac{b^j - x_{t=N+1}^j}{b^j}\right) * \frac{1}{r} * (1+r)^{C-(N+1)}\right]}{\sum_{t=I}^{M+1}\left[(1+r)^{C-t} * \frac{0.5\left(x_{t-1}^p + x_t^p\right) - b^p}{b^j}\right] + \left[\left(\frac{x_{t=M+1}^p - b^p}{b^j}\right) * \frac{1}{r} * (1+r)^{C-(M+1)}\right]}$$

where t = 0 – the time when the injury occurred,

C – discount basis[1], or time when the discount factor is 1.0 (hereinafter measured in years)

B – time when the injured habitat recovers to baseline

N – time when the injured resource services reach the maximum

I – time when the habitat project begins to provide services

M – time when the habitat replacement project reaches full maturity

L – time when the habitat replacement project stops yielding services

V_j – value per hectar-year of services provided by injured habitat prior to the injury

V_p – value per hectar-year of services provided by replacement habitat

X_t^j – level of services per hectar provided by injured habitat at end of of year t

b^j – baseline services (uninjured) per hectar of injured habitat

X_t^p – level of services per hectar provided by replacement project at end of year t

b^p – initial level of services per hectar of replacement projects

r – discount rate over the time period

J – number of injured hectars

P – size of replacement project

For general understanding, the calculation mechanism may be utmostly simplified to the following:

If 10,000 seagrass stems grow over 1 hectar of the sea bottom, 1 seagrass stem grows on 1 m^2.

According to the seagrass growth data, the time required for 1 seagrass stem to grow to the baseline level is 1 year.

It has been estimated that the area of 0.5 ha was injured, which makes up for 50% of the site.

Correspondingly, only 50% of the site can carry on providing services of a habitat for seagrass growth.

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[1] Discounting is the only financial methodology comparing the value of different objects in time

50% of 10,000 seagrass stems is 5,000 stems which we lose all in all because of the injury.

Therefore, our goal is to facilitate restoration of at least 5,000 seagrass stems.

Let’s assume that the restoration plan involves the conditions for growing 1,000 seagrass stems per year.

Under such conditions, the lost stem number will equal the restored stem number in 5 years.

In order to achieve the project goal in 1 year we need 5 times larger area for growing seagrass.

Hence, 0.5 multiplied by 5 is 2.5 ha of the sea bottom requisite to reach the restoration goal in 1 year.

The purpose of these calculations is to balance the total injury and acquisition indicators over the time period of running the restoration project.

This example is a very simplified version of thorough calculations carried out using this methodology. In particular, in 2000 the experts of Fonseca law firm employed HEA to scale the seagrass restoration in order to restore the habitat injured by treasure hunting activities in Florida Keys. All in all, 0.66 ha (1.63 acres) of seagrass (Thalassia testudinum) was destroyed while using the treasure hunting technique to reveal the buried objects in the vicinity of Grassy Key in the Florida Keys National Marine Sanctuary. Using seagrass stem density as an indicator and seagrass growth model, the experts estimated it would take at least 17 years to restore in a natural way. In view of this restoration estimate, HEA calculations demonstrated that the lost service restorations require extra 0.63 ha (1.55 acres) of seagrass. Eventually, the federal court obligated the company involved in treasure hunting and retrieval to pay the $ 589,311 worth of fine for destroying the seagrass while treasure hunting in the Florida Keys National Marine Sanctuary without a permit. The company was ordered to submit the historical artefacts retrieved during the treasure hunting, including the anchor, silver coins, canon balls and silver plates. The decision completed the case opened in 1992 (see “US vs Mel Fisher”, November/December 1992). The $ 589,311 worth of fine is the amount the prosecutors claimed as compensation for the NOAA damage assessment and seagrass restoration. The most significant outcome of the case is that the court sustained the NOAA right to protect the Sanctuary’s resources from unauthorized treasure hunting.

Furthermore, advantages and limitations or disadvantages of this methodology should be identified.

Advantages. The method has a general nature and is not inextricably connected to one specific habitat or type of service, therefore, it is widely applicable. This method has been successfully applied in relation to habitats to assess it restoration to the natural form. It may be employed both for landscapes and populations.

Limitations. The injured and restored habitats will eventually provide the same quantity and quality of service (not better); the ratio of ecosystem services and the habitat values is constant and the actual service value remains unchanged over time. This method disregards the fact that habitats provide multiple services, a lot of which are essential for evaluating the habitat quality.

The most innovative habitat evaluation methods, such as HGM and Index of Biological Integrity (IBI) are aimed at eliminating the latter limitation and include a number of indicators representing the variety or services of the habitat.

Another problem is that such restoration may be unreasonable or limited (service for service, restoration is only possible to baseline). It may frequently be more desirable to implement non-natural restoration to solve broader problems of ecosystem restoration, for example, plan its increased productivity and improved efficiency.

Conclusions

To sum up, it should be noted that given methodology is quite complicated to comprehend and employ. It may not always be possible to carry out such calculations, for example, to outline the provisional area of 2.5 ha of the sea bottom to grow seagrass. Moreover, this methodology can only be applied under the conditions indicated above. However, the goal of this methodology appears far-reaching inasmuch it calls for restoration of the same amount to services as were injured. Therefore, the use of HEA as a supplementary methodology in certain cases may be quite functional and efficient in assessing the amount of compensation for the damage to the habitat.

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