Economic Valuation of Habitats – the case of Mediterranean Grove

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Abstract

Increasingly, development stresses stemming from land-use changes, such as urbanisation, or transportation networks impact natural habitats and species biodiversity resources embodied in them.

To endorse sustainable development the value of the economic undeveloped natural resource should be compared to the value of this same resource after development has taken place. For such a comparison there is a need to evaluate the undeveloped resource and its components, which is the focus of this work.

In this paper the characteristics of economic valuation of Mediterranean forest are considered. First the ecological characteristics of this habitat are identified and analyzed. Subsequently existing data and expert knowledge are utilized to evaluate the portfolio of the various ecological characteristics at the Mount Carmel National Park. Adding the values of the various characteristics then derives the total economic value of the park.

Keywords: biodiversity portfolio, economic valuation, ecological characteristic, habitat, Mediterranean grove.

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1. Introduction

Biodiversity can be defined as the ‘variety of life’. It encompasses all of the species that currently exist on earth, including their genetic make-up and the communities they form. The loss of the world’s biodiversity, and its economic and ecological consequences, is nowadays widely recognised as matter of urgent global concern and has attracted the attention of scholars and practitioners in both social and natural sciences.

Despite their many benefits, biological assets, such as genes, species and ecosystems, have values that are difficult or impossible to measure in market prices (see Gowdy, 1997). However, if individual consumers and policymakers have to make trade-offs between economic development and biodiversity protection, it is fundamentally important to know what is being traded-off against what. Therefore, in order to make comparisons involving environmental goods and services, it is required to have an idea of the economic value of these environmental assets. Since the 1970s, a considerable amount of research attention has been paid to the valuation of environmental goods and services (Bateman and Turner, 1993; Garrod and Willis, 1999; Louviere *et al.*, 2000). Careful studies by, for example, Hagen and Welle (1991), Rubin *et al.* (1991), Shechter *et al.* (1998), Janssen and Padilla (1999), Bulte and van Kooten (1999), Jakobson and Dragun (2001), and Desaigues and Ami (2001) exemplify the contribution of valuation studies to the ecological-economic literature. However, the number of valuation studies of Mediterranean forests, even though this habitat is highly sensitive to climatic changes, is – to our knowledge – very small.

Mediterranean groves suffer from three main disturbances: overgrazing, fires and intense logging. The overgrazing is derived from the appearance of the Black Goat. There is evidence that the diet of the goats is based on two main considerations. The first one is to minimize the consumption of minor ingredients of the plants in the goat’s stomach, and the second is to provide the goat with the best quality of food available. As a result of food shortage, the goats need to collect each grazing day as much as it can, an action that puts a stress on the forest when the number of goats increase beyond the sustainable size. On the other hand, grazing helps the Mediterranean grove to decrease fire events and thus can be served as a tool to improve the management of the habitat. The main plant species, which are preferred by the goats include: *Quercus Calliprinus*, *Phillyrea Latifolia* and *Pistacia Palaestina.* The overgrazing might cause a growth deficiency in these species so that they reach only the size of a small bush. To fully recover, the goats should be away from the habitat for at least 15 years. Some adaptations of Mediterranean groves to the disturbances are already detected. They include, fast revival and growing abilities to bring back the flora landscape and, developing deterrence mechanism (especially for grazing).

This paper discusses the evaluation of the unique characteristics of Mediterranean forest by treating each plant or group of plants in the habitat as a portfolio of various ecological characteristics. Evaluating each characteristic separately and use the waited sum to present the total value of the plant.
A case study – of the Mount Carmel National Park in Israel illustrates. We make use of existing data and expert knowledge in order to determine the value of the resource.

The paper consists of six sections. Section 2 focuses on the economic valuation framework of this research. In section 3, we define the specific characteristics to Mediterranean grove. In section 4, we provide a short background about Mediterranean grove and introduction to the Mount Carmel National Park. Next, Section 5 presents and analyses the numerical results of the economic valuation study and section 6 concludes.

2. Valuation framework

The valuation framework consists of four main steps and follows a bottom-up approach; Starting at the level of individual species and scaling up to the habitat level. First the representative plant species of the different sub habitat types, which comprise Mediterranean grove are identify. Second, for the selected species, relevant characteristics that relate to the various uses and values of each plant s are determined. Then, economic theory is used to evaluate each characteristic. The third step is to value the each plant by evaluating via expert opinion the importance of the various characteristics for this particular plant. This provides waits for adding the Dollar values of each characteristic. Ultimately, in the fourth step, the values of the natural habitats are calculated.

The total value of habitat h (h=1…H), TV_h, is the sum of the values of species i=1...m, TV_i times the relative abundance a_{ih} of the species in that habitat:

$$TV_h = \sum_{i=1}^{m} a_{ih} TV_i \qquad (1)$$

the economic valuation of each plant species is in turn the weighted sum of its characteristics values, where the weights reflect the ecological importance of each characteristic to this particular plant. So that:

$$TV_i = \sum_{j=1}^{n} w_{ij} q_j \qquad (2)$$

w_{ij} - the weight of the ecological characteristic’s importance. The value of ecological characteristic q_j when j=1...n.

The characteristics of the typical habitat we choose to research are characteristics of Mediterranean grove. The next section shows how we assess the value of the characteristics.

3. Identification of plant species and determination of relevant characteristics to the Mediterranean grove

Economic valuation of ecological characteristics is unique to the characteristics of every habitat. Although some characteristics may be common to many species, some may be particular to certain species. This work focuss on the Mediterranean Grove and thus, we concentrate on characteristics that are relevant to this habitat. Also it should be noted that we study only the flora of the habitat. Although the omission of the fauna provide an under estimate of the habitat value, one should notice that vegetation types determined to a large extent the available food stock for the animals in the habitat. Therefore, the vegetation cover provides habitat availability of a particular animal species.

The selection of representative plant species, and the determination of the various characteristics is primarily based on existing ecological knowledge about Mediterranean groves (Dafni A.1999. The characteristics cover a broad spectrum and relate to the following aspects: forestation, pasture, medical uses, agricultural genes reservoir, landscape values, pharmaceutical products, endemism and rarity. Note that the last two, endemism and rarity, are especially associated with non-use values, whereas the other s are primarily related to use values. Note that the total value of species incorporates use and non-use value. Use value for our purpose contains direct and indirect use whereas rarity is part of the non-use value characteristic. In the following, the valuation of each of the relevant characteristics is discussed.

3.1. Forestation

The lexicographic definition of forest is “a large area covered with trees and undergrowth”. This definition is rather general and quite banal and does not consider the ecological and economic importance of forests. For example, forests play a role in recycling the earth’s water, carbon, and oxygen, as well as producing of other important substances. They also provide habitats for animal and plant species and contribute to the resilience and stability of ecosystems (Fuhrer, 2000; Bengtsson *et al.*, 2000). The economic importance of forests comes from the consumption of logged wood, for example as fuel and as wood for construction and the manufacture of paper. Moreover, forest can be used for a wide range of recreational purposes, including walking, camping and bike riding (see Perman, 1999; Plantinga *et al.*, 1999).

Thus, the value of forests consists of two main elements. The first element relates to the commercial value of the logged timbers, while the second element contains amenity values that are associated with the standing forest. Defined as the natural and physical qualities of an area that contribute to people's appreciation of its pleasantness, aesthetic coherence, and cultural and recreational attributes, the amenity value include, environmental and recreational values (Quinn, 1992; Tyrväinen, 1996). The total value of forests, q_1, is the sum of the net present value of the timber, $NPV(V_t)$,and the amenities values, V_f. Thus,

$$q_1 = NPV(V_t) + V_f \ . \tag{3}$$

Based on Quinn (1992), the net present value of standing forest is written as

$$NPV(V_t + V_f) = \left[p(T)h - c(h) + a(t)u(t,T)\right]\sum_{k=1}^{\infty} e^{-rkT} \ , \tag{4}$$

Where *p(T)* is the marginal revenue of timber harvested at age T,, *h* is the amount of cut timber, *c(h)* are the cutting costs. *a(t)* as suggested by Quinn, is the contribution to the amenity value of one unit of age *(t)* forest left standing for one year (i.e., the recreational and the ecological contribution to the society and nature), *u(t, T)* is the density function, and *r* is the discount rate calculated to infinity (k=1….∞).

3.2. *Pasture*

The pasture characteristic is referred to the land used for grazing livestock; it is a form of food production. The main essence of this characteristic is the use of land as a substitute for synthetic food. In other words, the pasturing of grazing livestock implies that the herds consume trees and other woody vegetation instead of manufactured food. As such, herd owners who pasture their animals require smaller amount of purchased manufactured food than those who decide not to pasture their livestock.

Good pasture allows efficient management of open spaces, lowers the risks of fire, enlarges the biodiversity in nature habitats and preserves the open space landscape.

The value of pasture, q_2, is the marginal saving in costs of animal food, *SV*. The herd's owners reduce their expenditures on food. That is,

$$q_2 = TC - TC_{sub} = SV \ , \tag{5}$$

where, *TC* are the total costs of the herd owners without pasturing and TC_{sub} are the total costs..

3.3. Medical Use

Throughout history, mankind has used a large variety of plants as medicines. Nowadays, the demand for medical plants from the pharmaceutical industry is still growing (Lev and Amar, 2000).

The market price of medical plants is established in a stock exchange of medical plants in Germany where the majority of international trade in medical plants and herbs takes place. The price of medical plants as set by this stock market is used here for the value of medical plants characteristic, q_3. . To be more specific, the value of medical is, thus, equal to the marginal revenue of medical plant, $V_{i,}$ *as* determined by the market. That is,

$$q_3 = V_i \, . \tag{7}$$

The price of medical plants set by the stock market is in terms of "dry" leafs. A more appropriate value, however, is one which is based on "live" leafs. The stock market price thus needs to be adjusted to obtain a correct value of medical plants. This implies a translation of the stock market price into a price that is based on "live" leafs. To put it more formally,

$$P_{wi} = adj(P_i) \, , \tag{8}$$

Where P_{wi} is the price of wet leafs after the adjustment. Finally, the correct marginal value of a medical plant should be cast in terms of standing plant:

$$V_i = a_i P_{wi} \,, \tag{9}$$

Where a_i is the relative abundance of plant species *i*. The relative abundance of plant times the price of wet leafs of the plant is the value of an individual species in the habitat. This value is the real value of natural herbs and medical plants.

3.4 Agricultural gene reservoir

Agriculture as a human effort is actually a long-term bet. We don't have complete information which of the species will have the highest importance in the future (Brown and Goldstein 1984). A human interference in order to improve, to praise and to adjust species into modern agriculture using chemical fertilizers etc, caused changes in ecosystems in order to provide agriculture products. An extinction of species may cause an irreversible damage and loss of information to the reservoir of genes. Therefore the real value of the agricultural gene characteristic q_4 is the value of genes diversity V_{GEN}. Since there are no known applied methodologies to calculate the value of genes diversity, we use the proxy market of cultivated seeds. Which to our understanding reflects an under valuation because of the reasons mentioned above.

(10)

3.5 *Landscape values*

The two main components of this characteristic have a use value. These landscape values q_5 reflect on the one hand the value of beauty and ornament, which has a use-value of the total habitat UV_h and the value of land –by preventing and storing erosion V_{land}. The use-value is calculated by using the data collected by Shechter et al (1998).

$$q_5 = V_{land} + UV_h \tag{11}$$

3.6. *Pharmaceutical products*

"Biodiversity is a source of new industrial pharmaceutical products. Wild species in their struggle to capture prey, escape predators, resist infection, and enhance reproductive success have developed chemical mechanisms more elaborate and inventive than those chemists can now synthesize. If these chemical mechanisms could be adapted and refined for human use, they could be of great value" (Craft and Simpson, 2001). The evaluation of this characteristic is based on the work of Craft and Simpson (2001), who suggest the use of the Dixit-Stiglitz model for evaluation of pharmaceutical products. The social value of the species which are used, as raw material in the pharmaceutical industry, q_6, is the social welfare that is derived by the aggregate of utilities of *n* consumers U_i and profits of the *m* producers Π_j.

$$q_6 = \sum_{i=1}^{n} U_i + \sum_{i=1}^{m} \Pi_i \tag{12}$$

The full welfare equation (under the assumption of Craft and Simpson) is:

$$q_6 = m^{\frac{1-\rho}{\rho}} \frac{\rho y}{c} + (1-\rho) y \tag{13}$$

with y being the consumer's expenditure on pharmaceutical goods, and c being cost per unit.

3.7 *Endemism*

Endemic species are species that are commonly found in a specified area. Species competition, lack of genetic adjustment, and discrepancy to the area a prevent the transfer an endemic species to other location where they are not endemic.. Therefore an extinction threat for these species in the event of habitat destruction is severe and real. Rich geographic areas with endemic species are called "hotspots". Identification of a certain area as a hotspot, means that this area contains a large variety of endemic species, with an extinction threat, (McAllister et al. 1997). Once an endemic species is extinct, all the genetic information embodied in that species is lost. This may happened only when all the habitat is lost which make the endemism value, q_7, equivalent to the habitat value, 3.8 *Rarity*

The Rarity of species in a natural park or reserve does not imply that these species are non-renewable. A rare species in a reserve can be widespread in another area. A rare species may be facing a threat of irreversible loss, since its population is relatively small. Some of the species are naturally rare and some of them are exogenously rare (e.g. human actions may damage the species). Part of the rare species may be endemic species, that an irreversible damage will extinct them forever. Rare species have existence value, which reflects the moral value of the society. Since the species are locally rare the value of this characteristic q_8 is the non-use value of habitat. That is the value placed on these species being in that very location.

Once all the characteristics are evaluated, the species value is calculated by giving each characteristic its wait for each and every species. In the following section an application of this methodology to the evaluation of Mediterranean grove in the Mount Carmel National Park.

4. Evaluation of Mediterranean forest at Mount Carmel National Park

The Mount Carmel National Park has a total surface area of about 21,000 acres and it is Israel's largest national park. Although only one-third of the park is a nature reserve, the entire area is dedicated to nature conservation in general, and to the maintenance of the Mediterranean forest habitats in particular. Located in the northern part of Israel (see Figure 2.1), the central part of the park is the mountainous Carmel ridge, with peaks rising to 546 meter above sea level. The slopes to the west and sea are gradual, whereas they are very steep to the east. The average annual temperature is 20^{O} Celsius with mean temperature differences between winter and summer of 12^{O} Celsius. Mount Carmel receives more rain than any other part of Israel – average annual precipitation in the area is 700 mm, so the area is particularly fertile and green. One of the most striking aspects of the national park is its typical Mediterranean scrub forest. The predominant trees in the national park are Palestine oaks and Aleppo pines.

Palestine oaks (*Quercus calliprinos*) commonly grow on limestone and Chalk Mountains. They regenerate quickly after fires via dense basal sprouts, producing – under optimal conditions of soil type and climate – a dense, sheltering brush for herbaceous plants that prefer to grow beneath them.[4] This dense thicket is generally known as "maquis"[5], which, as a rule, is so tangled that people cannot walk between the trees. Aleppo pines (*Pinus halepensis*) are one of the best pine trees for the desert. Forests of Aleppo pines grow on the chalk in the higher reaches of Mount Carmel. The forests on Mount Carmel have been exposed to human disturbance including frequent fires for as long as 60,000-70,000 years. Fires are the main factor affecting communities and shaping landscape in this ecosystem.[6] Fire is a common disturbance of short duration (only few hours). However, the ecological recovery is a very long process, which may last several decades.

Not only disturbances in the past, but also recent human usage of Mount Carmel, such as grazing, produced a patchwork of habitats. As a result, communities of plant species comprise a mosaic of patches at different stages of succession. This mosaic of different vegetation types permits a great diversification of life in the national park. All in all, the area is highly diversified in terms of natural topography, rock distribution and flora and fauna (Shoshany and Goldshleger, 2002). (The ecological importance of Mount Carmel is recognised worldwide by the declaration of a certain part of it as a so-called Biosphere Reserve. To introduction) Anthropogenic activities not only resulted in an ecological enrichment of the area through the creation of a patchwork of habitats, they nowadays also threaten the Mediterranean forest, nature reserves and recreation areas of the National Park.

Seven study plots that are representative of the area were selected, each about the size of 4000 m^2 in size. The plots represent the different types of vegetation and due to

[4] These optimal conditions are a Terra Rossa soil and an average annual precipitation of more than 400 mm.

[5] "Maquis" is a French term that has gained wide international usage. It stands for a dense type of growth typically made up of low evergreen shrubs and oaks.

[6] Primack (1998) asserts that fire appears to be a major factor in the maintenance and development of the rich flora found in many Mediterranean scrub ecosystems.

different levels of human pressure; they also represent different succession stages. The seven plots and their ecological features are briefly described in Table 3.1.

Table 4.1 Case study plots and their most important features.

Plot	Characteristics	Tree coverage
1	Dense and "undisturbed" forest of Palestine oaks on the northern slope. Many mesophillic species, such as sweet laurel and Judas tree. Shrubs and annuals only in well-lit locations.	80-90%
2 and 3	Open maquis, with forest of Palestine oaks on the northern slope. Shrubs cover 20-40% of the area, with cistus species and Greek sage as predominant species.	40-60%
4	Open maquis with a clear dominance of the same shrubs as plot 2 together with dwarf shrubs such as thorny burnet	10-20%
5 and 6	Roadsides (2-10 m zone around unpaved roads)	0%
7	Disturbed roadsides (trampling, parking and picnic areas)	0%

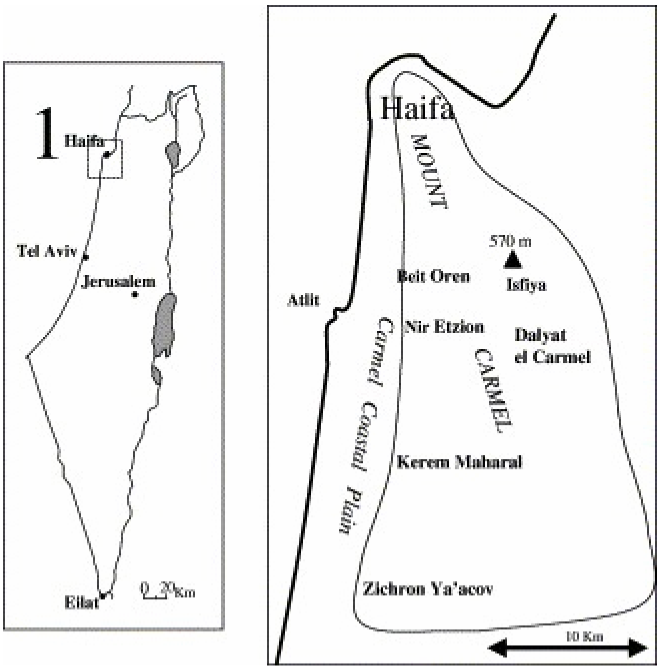


Figure 4.1 Mount Carmel National Park.

Source: Shoshany and Goldshleger (2002).

The economic values of the characteristics of the Mediterranean forest discussed above are presented bellow for the Mount Carmel Habitats. The evaluation was not free of assumption and simplifications as averaging and statistical estimation. All the assumptions are provided in the appendix.

4.1. *Forestation*

The value of recreation is the most significant value of the trees in this forest. Therefore it was used as a proxy for the standing value. We used existing data from a research project that had taken place at the same area (see Shechter *et al.*, 1998). The value of forestation is the net present value of the industrial use of timber (100$). The majority of this forest value arise from recreation amenities which measured up to 4,300$ (Shechter *et al*, 1998) in addition the industrial value which is negligible its sums up to 4,400$.

4.2. *Pasture*

Mount Carmel is a biosphere. This means that the nature is cooperating with the humankind. Therefore we can see cattle and flocks of sheep grazing in open spaces.

Applying data from the ministry of agriculture, the value of this characteristic is divided into two types of herds according to the payment which is taken by the ministry of agriculture, and five shrubs' densities' ranking of habitats (0 – inappropriate for grazing till 5 – grazing areas as described by the ministry ecologist).

Table 4.1 – The marginal saving value per Dunam (10000 sq meters)($)

Shrubs' density	Cattle – grass/scrub-land/grove	Sheep – grass/scrub-land/grove
5	64600	63750
4	64670	63850
3	64700	63920
2	64750	63970
1	64770	64005
0	64780	64030

A remark - the diversity of the density is not so big but the drier or less grass area, the saving is higher.

4.3 Medical uses of forest plants

We used data of the medical plants stock exchange, which was calculated in dry weight, and applied it to the natural plant species of Mount Carmel National Park. This resulted in the following values – see Table 3.3. The mentioned species are types of medical plants which grow in the study area.

Table 4.2. – Market price of wet biomass

*Medical plants species**	Wet weight of . (gr)	Dry weight of . (gr)	Market price of 1000 gr / $	Calculated Market price of. ($/1000 gr)	Capitalized market value (To infinity $)
Pistacia palaestina	5000	650	37	24	410
Pistacia lentiscus	5000	650	37	24	410
Rhamnus palaestinus	300	39		0	0
Phillyrea media	3000	390	37	15	246
Ceratonia siliqua	3000	390	17	7	113
Salvia fruticosa	170	22.1	28	0.6	11
Salvia hierosolymitana	150	19.5		0	0
Sarcopoterium spinosom	70	9.1	17	0.15	3
Asphodelus microcarpus	75	9.75		0	0
Ruscus aculeatus	250	32.5		0	0
Laurus nobilis	5000	650	37	15	246
Cyclamen persicum	30	3.9	82	0.3	5

* As surveyed in the case study plot.

The values differ from each other since it has different use value which derived in the national market. The values reflect the medical use of the plants (as a medicine or as a spice).

4.4. Agricultural, genes reservoir

As mentioned in section 2, the value of this characteristic is based on proxy market data - the price of cultivated seeds.

The value of one Dunam of cultivated soil is – 8545$ (capitalized to infinity). According to the formula provided by the Israeli ministry of agriculture the value of one cultivated seed for agriculture is calculated as follows: given that the average weight of one seed is 0.4 gr, then w by (weight of 1000 seeds*expected sprout standard/sprouting percentage*10)*security coefficient (Ministry of agriculture, 1999). This monetary value represents the market value of one species with the agricultural characteristic. Note that, this calculated value is probably an underestimation, because it does not include other values of gene diversity.

4.5 landscape value

This characteristic is defined as the value of landscape per dunam of open space. Landscape and its ornamentals contribute our utility as a whole. Therefore the value of this characteristic is an exogenous value and calculated for the whole habitat and not per individual species.

Data:

1. The rent value of agricultural duman per year is 2130 $.
2. There are 28,000 dunams of national park and natural reserve in the Carmel national park and it is assumed it contains 10 typical habitats.
3. Use value, which was calculated bellow (section 4.7), is 11,996,550 $ (capitalized to infinity).

For the assumed interest rate, the partial value of this characteristic per year is assessed to be 359,896 $.

In order to accept the total value, the partial value and the land value are summed up. The total value per year/dunam is 2043$. The total value capitalized to infinity is 68,120 $ per dunam of habitat.

4.6 Potential use as a raw material in the pharmaceutical industry

This value reflects the social welfare based on the scientific knowledge in the pharmaceutical industry. The social welfare contains two variables – consumers' welfare and producers' profits per year. The total value of this characteristic capitalized to infinity is 48190. Note that the value of this characteristic is lacking since information of undeveloped and preserved of species and of their potential use in the pharmaceutical industry is unavailable.

4.7 Endemism

Using species' survey data, there was found one endemic species in Carmel National Park at the habitat of open-grove. The species is defined as a rare and endemic plant. It doesn't have any other role in the ecological characteristics. Therefore its value is the total non-use value of the habitat. The non-use value (based on Shechter et al 1998) per family is 10.6$. 36% of the households that were questioned (Shechter et al 1998) have non-use value. Therefore the number of households who have non-use value to the Carmel National Park is 630,000[7].

The NUV of the park capitalized to infinity is: 222,957,447$.

The NUV per habitat is: 22,295,744$.

This is the value of the endemic species at the open grove plot. If it had any functionality importance in other ecological characteristics we should have add its use value.

4.8 Rarity

The value of this characteristic is the non-use value per dunam taken from a study by Shechter et al (1998).

Capitalized to infinity the value of this characteristic is: 7,963$.

5. Evaluation of the habitat and its components

5.1 Monetary Values of the Selected Species

Each characteristic has an ecological ranking based on the appearance of the characteristic in the species' genes collection (i.e, is the species has a role in forestry and /or pasture and is it a full role or partial role). The numbers 0 to 5 represents the ranking. Zero means unfunctionality whereas 5 stands for full functionality. We assume that the distance between each functionality characteristic is equal; that is, we use an interval scale. Therefore, 0 will get 0%, 1 will get 20% until 5, which will get 100% of existence of the characteristic in the species. The ranking reflects the existence of the characteristic in the species as defined by expert (Dafni 1999).

After assessing the characteristics' values, a species' survey was carried out. A coverage percents of the species were calculated for each study plot. Then Number of species was collected for each habitat. After elaborating the data of the species survey, economic values of the characteristics were calibrate for each species. Then the total values of each species from the survey were assessed using the importance

[7] The data is taken from the CBS (Central Bureau of Statistics). The total number of household in Israel is 1,750,000. Using the conclusion of Shechter et al (1998) that 36% of the household have non-use value we get – 0.36*1,750,000=630,000.

ranking of each characteristic. The total value of the main species is shown in table 5.1[8].

Table 5.1 – main species values

name	**Value ($/per species)**
Pistacia palaestina	31
Quercus calliprinos	6100
Pistacia lentiscus	9200
Rhamnus palaestinus	4300
Phillyrea media	4300
Gramineae	300
Ceratonia siliqua	4400
Anemone coronaria	35
Cistus sp.	14
Salvia fruticosa	48200
Sarcopoterium spinosom	19300
Ruscus aculeatus	20
Laurus nobilis	4370
Arbutus andrachne	4350
Cyclamen persicum	35
Allium	8000

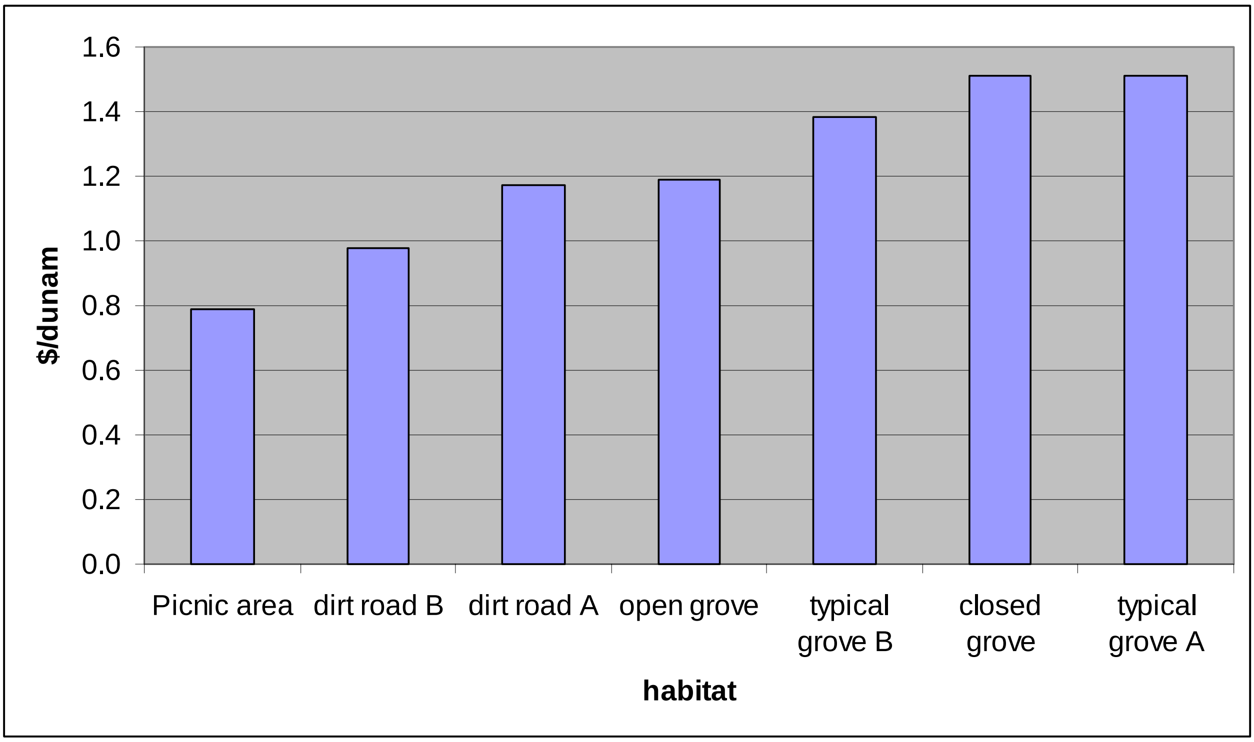
The species values have low and high values, which reflect their functionality as part of the ecosystem. For example, Salvia fruticosa has a high value since it has several valuable ecological characteristics, such as medical use and its potential use as row material in the pharmaceutical industry).

5.2. Economic Valuation of Habitats

[8] The full list of species can be given from the authors upon request. It is too elaborate to present here.

The total value of a habitat is the sum of the total value of all species in that habitat multiplied by the relative abundance of these species per area unit. The values are shown in figure 2. The values range from 800,000$ for picnic area to 1,500,000$ for typical grove. The variety of species and their functionality characteristics for each type of habitat determine the value of any given habitat.

Figure 2 - Total Habitat Values (mil. $ / dunam)



The habitats' values are between 0.8 million dollars and 1.5 million dollars for area unit. Habitat with high plant diversity has higher monetary values than habitats of low plant species richness. Road sites have the lowest values. These values, however, are still fairly high. The reason for this is that especially medical and cultivated plants, with high use values, grow close to roads. Other possible reason for the rather high values of road habitats are the availability of water and human fertilization near roads and lower densities of herbivore animals. When we ignore the road habitats, we see that the open grove has the lowest value. The small number of plant species in this habitat reflects this. The typical and closed groves have the higher economic value, probably because the contain the wider variety of species.

The analysis above is limited since it excludes many functions of the park. The total value the natural habitats of the Mount Carmel National Park includes the various functions of the area. Many of these functions, however require further modeling and theoretical effort before they can be accounted for. Other functions like tradition preservation such that the fact that the area also serves as a pastureland for the Druze farmers of the nearby villages of Usphiya and Daliat el Carmel. In addition, the forest provides a wide variety of marginal ’marketable’ products, such as, nuts, latex, and herbs and plants for medical purposes for a population that is not easy to track down. Also the economic value of the interaction between the vegetation and wildlife in times of climate change should be included. In light of these omissions, all we can claim is that our estimates can only serve as a first approximation for the actual value of the forest.

6. Conclusions

In this paper characteristics of habitat were evaluated in order to find the total value of the habitat. The value of the habitats was found by refining the interactive basis between biological inventories and economic valuation methods. Our approach is based on the assumption that a natural habitat consists of a portfolio of distinct plant species. To this end, we first identify the individual plant species in the habitat under consideration, and then we put a price tag on the various characteristics of these species. Subsequently, we estimate the monetary value of the identified species themselves, by making use of the prices that are attached to their characteristics. The outcomes of these estimations are finally used to calculate the value of the habitat.

Thus, the values of habitats depend on the existing plant species in each habitat and their ecological characteristics. Differences between the prices attached to ecological characteristics stem from different use and non-use values. These differences, however, also result from the functionality importance of the characteristics, which is reflected in the economic and ecologists way of thinking.

A case study for the evaluation of Mediterranean forest at the Carmel Mountain National Park in Israel follows. In the example, we ignored the value of gene diversity and the value of ecological or functional relationships between species, and thus this valuation provide an under value of the Mediterranean forest habitat. We could not found in the literature . Another weakness of the research is that was not taken another species survey in different climatic conditions.

Future research is required to develop a complete account of the externalities, inter species relationships and the interaction between society and ecosystems

Appendix A – main assumptions

1. Density of trees is 80 units per dunam or 2.4 tons trees per dunam.
2. There is one wood industry factory, which is located in north of Israel.
3. T, the optimal age of harvesting a tree, is 60 years.
4. p(T), price of ton wood 45$.
5. h, the tree clearing speed 2.4 trees per dunam.
6. c(h), cost of clearing is 10$ per ton trees. We need to generalize the transportation costs to the gate of the factory, 6$ per ton for 100 km. the distance between the park and the factory is 49 km.
7. The contribution of the amenity value of area at age T – is calculated by recreation value, which was evaluated to the Carmel national park as a while, divided to 10 typical habitats. Since it is difficult to calculate the use value for any unit of tree or plant, the use value is attributed as an exogenous value which is added to NPV. From this point we don't use the density function as suggested by Quinn (1992).
8. Discount rate – 3%.
9. There are 28,000 dunams of national park and natural reserve in the Carmel national park.
10. Number of visitors in the Carmel national park is 2 million per year. Average household in Israel counts 3.3 individuals. Therefore 606,060 families are visiting in the park.
11. Value of one cultivated seeds for agricultural use is 147$.
12. Weight of one seed is 0.4 gr.
13. Expected sprout standard=250, security coefficient=1.3, sprouting percentage=75%. Sowing rate is 1733.33 kg/dunam. This means that we need 1.733 ton seeds for dunam.
14. Each firm produce one type of medicine, which is produced from one type of species.

15. Three main pharmaceutical firms are in Israel.
16. There was not found any utility sensitivity to changes in ρ . Therefore we can assume that ρ is any number between 0 - 1. From this reason we assess that $\rho = 0.4$.
17. Average salary in the economy is 1960$.
18. Since there are no available data on the costs of producing medicines, we assume that firms work with cost plus profits. Average price of un-vital medicine is 4.2$, assuming that the cost of medicine is 3.2$.

Appendix B - coverage percent presentation by habitats

	Coverage percent by habitat							
name	**Picnic area**	**Typical grove**	**Typical grove**	**Open grove**	**Close grove**	**Dirt road B**	**Dirt road A**	**Coverage by meters**
Pistacia palaestina	16%			1%	6%			8.00
Quercus calliprinos	50%	26%	41%		97%	12%		9.00
Pistacia lentiscus	8%	11%	7%	7%	2%	1%	1%	4.00
Asparagus aphyllus					1%			0.60
Rhamnus palaestinus	0%							5.00
Vicia narbonensis	0%							0.80
Phillyrea media	1%	42%	15%	29%	23%	4%	3%	6.00
Coriandrum sativum	1%							0.45
Gramineae		5%	5%	7%		7%	0%	0.15
Clematis cirrhosa					1%			3.00
Bellevalia flexuosa	0%	0%	0%	1%			0%	0.35
Ceratonia siliqua				4%				9.00
Lathyrus blepharicarpus				0%				0.20
Stelaria media	1%							0.30
Anemone coronaria	1%	0%	0%	0%				0.15
Thrincia tuberosa						0%	0%	0.25

Arum palaestinum	1%							0.70
Cistus		20%	31%			17%	31%	1.20
Salvia fruticosa		2%	1%	1%	2%		0%	2.00
Salvia hierosolymitana					0%			2.20
Senecio vernalis	1%			0%			0%	0.25
Sarcopoterium spinosom	0%	1%	5%	1%		14%	14%	2.50
Asphodelus microcarpus		1%	0%	9%				0.30
Ruscus aculeatus					0%			0.75
Laurus nobilis					8%			9.50
Rubia tenuifolia					1%			0.65
Acanthus syriacus		0%						0.45
Arbutus andrachne					13%			10.00
Calycotome vilosa		3%	2%	4%			3%	0.75
;1Smilax aspera	8%	1%			19%			0.85
Mandragora autumnalis	1%							0.35
Cyclamen persicum	0%	1%	3%	1%	0%		0%	0.15
Allium				0%				0.35
Trifolium							0%	0.35

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