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Forest Eco-Compensation in the Context of Pipeline Constructions in Georgia

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Abstract

Disagreement between the Government of Georgia and international oil corporations on eco-compensation measures required off-set environmental damages caused by large scale oil and gas pipelines resultedin the application ofthe habitat-hectare methodology to define the necessary scope of eco-compensation measures for environmental damages related to the construction of the pipelines. The habitat-hectare scoring method is a common approach to determine the value of vegetation in non-monetary units. The environmental proxy used i.e. the "currency" in which the value of vegetation is expressed is the "habitat-hectare ". The habitat score is derived by assessing a number of site-based habitat and landscape components against a pre-determined 'benchmark'. Benchmarks have to be defined for different ecological vegetation classes (EVCs).

habitat area fhaj x habitat score = habitat-hectares

Since little information is available on the development of habitat quality of various forest communities (EVCs) in Georgia and since the data available for this ex-post assessment did not allow for a thorough assessment of biodiversity, the development ofthe dominant species in each EVC (as expressed in yield tables) was used as a proxy for the development of the habitat quality/value in each EVC.

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In total 262 plots with a total area of 141.82 ha of land classified as forest were assessed using the habitat-hectare methodology. The total value of these forest areas amounts to 80.51 habitat-hectares.

The scope ofthe eco-compensation measures (i.e. the compensation ratio) required to assure that no net loss inforest habitats occurs depends on the period oftime the party causing the deforestation can be committed to look after the afforestation, The compensation ratio required to assure that no net loss inforest habitats occurs was calculated for the totality of the forest areas in Georgia affected by the construction of BTC/SCP pipelines in decennial stepsfor care takingperiods o/20, 30 and 40 years. Depending on the EVC and the condition of the forest at the moment of clearing the compensation ratio for the care taking period variedfrom 1:2,5 up to 1:6,8 ha.

Keywords: Pipeline, flora and founa, compensation, biodervisity

1. Introduction - BTC/SCP-Pipelines in Georgia

BTC and SCP Pipelines

The BTC/SCP pipeline projects linking oil and natural gas fields in the Caspian Sea region with European markets are of considerable strategic global importance and of particular economic importance for Georgia. The pipelines cross Azerbaijan, Georgia and Turkey (Figure 1) and allovv to annually transport up to 50 million tons crude oil (= 1 million barrel per day) and up to 20 billion cubic meter of gas to Europe. Since the pipelines do neither cross into Russian nor Iranian territory they are of considerable importance for Europe's energy supply security and are thus being attributed a very high geopolitical importance.

The BTC/SCP pipeline projects cross the territory of Georgia on a 248 km length of with an average width of the right of way of 53 m. The route is characterized by very diverse ecological conditions and abundantly highly specific biodiversity which has been assessed only partially, so far - one of the reasons why e.g. the Environmental and Social Impact Assessment (ESIA) for the pipelines could be approved on a conditional basis only. Consequently, detrimental impacts to the protection of biodiversity, protected areas and forestry must be reduced to the absolute minimum and unavoidable residual environmental damages have to be offset by an appropriate eco-compensation scheme. This in particular applies to all impacts on forest ecosystems, which need to be evaluated and offset by adequate mitigation and eco-compensation measures with the goal to restore equivalent forest habitats.

Figure 1. Route of BTC/SCP pipelines.

BTC Co.,[1] the consortium unifying 11 national and international oil companies under the leadership of British Petrol, which has built and is operating the pipelines, has committed to restore equivalent forest habitats, to make sure that the Republic of Georgia, as the owner of the forests affected by the construction of the pipelines and at the same time representative of the people of Georgia who benefit from the extra-commercial functions of these forests, would not face any loss with respect to environmental goods and services.

Negotiations on necessary eco-compensation measures began in 2005, after the formal inauguration of the pipelines. Up till now, the Government of Georgia did not find a basis to agree with BTC Co upon the scope of the required eco-compensation measures[2]. Given BTC's initial offer to plant 150 trees per each 100 trees felled on the pipeline's right of way, this is hardly surprising.

Given the dead-lock in negotiations and given the project's dimensions (see info-box), the Georgian Ministry of Environmental Protection and Natural Resources requested support from the World Bank in terms of international expertise and mediation with regards to the

- calculation of damages to forest ecosystems by the BTC/SCP pipelines construction activities according to the "net gain principle" "habitat-hectare" approach, and
- recommendations on the exact ratio for forest eco-compensation based upon modern methodologies and international best practice.

This assignment was contracted to Peter Herbst and Christian Susan.

1 BTC Corporation.

2 Draft "Memorandum of Understanding between BTC Co. and the Ministry of Environment Protection and Natural Resources of Georgia for Forest Eco-Compensation" (Version BTC Co. of 12 November, 2004; Revised by EA, MoE, GIOC).

2. Material and Methods

2.1. 'No netloss', 'Netgain principle'

The 'no net-loss' as well as the 'net gain' principles originate from discussions about sustainable development, and how to best achieve it. Sustainable development requires that 'development today must meet the needs of the present generation without compromising the ability of future generations to meet their own needs[3]'. Sustainable development provides for protection of healthy environments while at the same time healthy economies and thriving societies develop.

Strict application of the 'no net-loss principle' can lead towards a sustainable development path in countries which are richly endowed with natural resources and where economic development processes have not (yet) led to a critical reduction of the quality of the environment.

In countries where past economic development processes have been carried out to the detriment of the environment, the application of the 'net gain principle' should help to 're-balance' the accounts. Simply put from a purely environmental point of view, net gain in this context means achieving a net environmental benefit [4]. From an economic point of view (i.e. from the point of view of the society as a whole as opposed to the financial point of view of a single investor) net gain means achieving economic development without causing negative impacts on the natural environment.

The legal framework is a crucial aspect: A precondition to apply the "net gain principle" is its inclusion into the regulatory framework and the provision of legally binding and transparent rules and regulations for calculation of offset ratios, there. In Georgia, however, neither the application of the 'net gain principle' nor the 'no net-loss principle' are explicitly found in the legal and regulatory framework.

Georgia is a country still generously endowed with forest resources, which have a rich and varied ecology. Nonetheless, maintenance of such forests as valuable stores for biodiversity and habitats for fauna and flora is not only a part of the National Biodiversity Strategy and Action Plan but also recognized to be of international importance [5]. Thus no net-loss must be allowed to occur in this domain.

On the other hand Georgia tries to attract direct foreign investment to curb economic development. The construction of the BTC/SCP pipelines has brought much-needed direct foreign investments and job opportunities and thus contributed to stability and economic growth in Georgia.

In order to ensure overall sustainability of Georgia's future development it had to be assured that further economic development occurs - but not to the detriment of the country's environment.

It is understood that BTC Co - in accordance with their formal commitments - will restore equivalent forest habitat to the necessary extent, where environmental damages and losses in habitat caused by the construction of the pipelines will be offset by an eco-compensation programme and no net-loss will occur in the environmental domain.

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3 World Commission on Environment and Development (Brundtland Commission), 1987.

4 Pollution probe, exploring applications of the net gain principle, 2004

5 Caucasus mixed forests (PA0408), WWF

Taking into consideration that the Government of Georgia (GoG) has already been compensated by BTC Co for the commercial value of the timber felled in the construction process of BTC/SCP pipelines (all forests in Georgia are state owned), restoration of the equivalent habitats necessarily will result in a net gain for Georgia from an strictly economic point of view: GoG has been compensated financially for the commercial loss of standing timber, and on top of that equivalent habitats will be restored.

It goes without saying that achieving such a net-gain from an economic perspective while assuring the occurrence of no net-loss from an environmental point of view, cannot be achieved by a mere replacement of the loss of standing timber at a planting ratio of 1.5:1 (i.e. 150 trees to be replanted for each 100 trees felled) as initially proposed in the ESIA [6].

If - and only if - the forest eco-compensation programme to be carried out by BTC Co will result in the restoration of the equivalent forest habitats it can be assured that no net-loss in environmental quality occurs and at the same time from an economic point of view a net gain is achieved.

2.2. Habitat-hectare assessment

The habitat-hectare scoring method is a common approach to determine the value of native vegetation in non-monetary units. The environmental proxy used (i.e. the "currency" in which the value of vegetation is expressed) is the "habitat-hectare".

habitat area [ha] x habitat score = habitat-hectares

This method is applied to assess a number of site-based habitat and landscape components against a pre-determined 'benchmark'. Benchmarks have to be defined for different ecological vegetation classes (EVC). The benchmark for each EVC describes the average characteristics of mature and apparently long undisturbed biodiversity and native vegetation occurring in the bioregions in which habitats shall be assessed. The habitat-hectare exercise foresees an in-situ assessment of natural vegetation to collect a range of visually assessed information of several vegetation components across the habitat zone. The closer a certain forest society comes to the benchmark, the higher its habitat score will be. The highest score a forest society can achieve is 100%, i.e. the forest society has the characteristics of apparently long undisturbed biodiversity and native vegetation.

The habitat-hectare method has been developed in Australia. The Australian State Government of Victoria, Department of Sustainability and Environment [7], uses the following components and weights presented in Table 1.

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6 Table 1-2 proposed mitigation measures, ESIA executive summary page 14

7 Vegetation Quality Assessment Manual - Guidelines for applying the habitat-hectares scoring method; Department of Sustainability and Environment; Government of Victoria; 2004

Table 1. Components and weights used in habitat-hectare assessment in Victoria, Australia

	Component	Max. value (%)
Site condition	Large trees	10
	Tree (canopy) cover	5
	Understorey (non-tree) strata	25
	Lack of weeds	15
	Recruitment	10
	Organic litter	5
	Logs	5
Landscape context	Patch size*	10
	Neighbourhood*	10
	Distance to core area*	5
	Total	100

*Components may be derived with assistance from maps and other (e.g. GIS) information sources.

Since at the time of this study the pipelines had already been built no pre-assessment of the then undisturbed right of way could be undertaken to support these calculations; only an ex-post assessment of the quality [8] of the ecosystems affected by the pipeline construction could be carried out - however, based on existing data [9] availed to the consultants. It is obvious that based on this limited set of available data (which had been collected for totally different reasons and under different approaches, but had to be used for this study due to the irreversibility of the original vegetation after clearing the right of way), a pragmatic approach had to be followed to allow the adoption of the habitat-hectare methodology to the - only available set of vegetation data.

These data-sets availed on the forest areas affected by the construction of the pipelines did mainly contain information on the dominant and co-dominant tree species and timber production related data, only. Since the data-set did contain only limited information with regards to biodiversity, the habitat-hectare assessment had to be focused on timber production related data, mainly. It is understood that this is a shortcoming of the actual approach but still the most reliable and objective methodology which possibly can be applied in such ex-post assessment data environment.

2.3. Applicability of the habitat-hectare methodology

Any vegetation data required to assess the various site conditions are usually collected visually during in situ inspections of the areas under assessment. Any

8 Vegetation Quality Assessment Manual - Guidelines for applying the habitat-hectare scoring method Version 1.3.

9 Saktkyproekti (Georgian Forestry Project) detailed forest inventory on the State Forest Fund inside the 44 m right of way for the Baku-Tbilisi-Ceyhan Pipeline, 2003 and secondary containment project and EDDF etc. 2005.

information required to assess the landscape context is usually derived from aerial picture interpretation or geographical information systems.

In the concrete context of this study, all relevant vegetation in the areas under assessment had already been removed and the areas been cleared and dug, several years ago. Thus only an ex-post assessment of the quality of the ecosystems affected by the pipeline construction could be carried out, based upon the data which were collected for the determination of classical financial compensation measures (detailed forestry inventory to identify premature utilisation of standing stock), GIS data and information contained in the environmental and social impact assessment (ESIA).

2.4. Identification of ecological vegetation classes

The habitat-hectare approach so far has not been applied systematically in Georgia. Therefore, as a necessary first step, forests affected by pipeline clearings had to be sorted by Ecological Vegetation Classes (EVCs). Such EVCs had to be identified according to dominant and, where applicable, co-dominant tree species [10](forest societies) and consequently benchmarks had to be defined for each EVC. In total 18 EVCs affected by the construction of the BTC and SCP pipelines could be identified during this study. The respective benchmarks could be derived from the descriptions of representative sample plots contained in the ESIA.

2.5. Components used to assess the habitat-hectare score

Based on that information, all necessary components for local application of the habitat-hectare methodology could be identified; available data were cross-checked for reliability and weighed, as follows (Table 2).

Table 2. Components and weights used in habitat-hectare assessment in Georgia

	component	score
site condition	average DBH	15
	average height	15
	canopy cover	10
	no of trees per ha	10
	grovving stock	10
	basal area	15
	vegetation/coppice	10
Landscape context	neigbourhood	10
	distance to core area	5

[10] The vegetation of Georgia (Caucasus); Gorgi Nakhutsrishvili; 1999.

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2.5.1. Site condition indices

That relative high importance of tree growth factors (site condition indices) is a specific issue of that specific evaluation, which had to be done ex post, based on the detailed forest inventory by Saktkeproekti, where the design obviously was focused on collecting information on the commercial value of timber standing in areas to be cleared. Based on that, indicators on site condition components were assessed by comparing data collected in the field during forestry inventory with the relevant benchmarks.

If e.g. the average DBH of an area to be assessed reached 10-19% of the benchmark DBH, the score for this component is 2 points, 60-70% result in a score of 10 points, more than 90 % yield the maximum number of 15 points (Table 3).

Table 3. Component: Diameter at breast height (DBH)

component average DBH	
10-<20% of benchmark DBH	2
20-<40% of benchmark DBH	4
40-<60% of benchmark DBH	8
60-<80% of benchmark DBH	10
80-<90% of benchmark DBH	13
>90% of benchmark DBH	15

Under this component, the average height of the dominant tree species in habitats/stands (estimated on the level of sub-compartment) cleared for the construction of BTC/SCP pipelines is compared with the average height of the dominant species for each of the applicable EVC benchmarks.

The closer the average height corresponds to the benchmark value, the closer the habitat is expected to correspond to the criteria of mature and apparently long undisturbed vegetation (Table 4).

Table 4. Component: Average height

component average height	
10-<20% of benchmark height	2
20-<40% of benchmark height	4
40-<60% of benchmark height	8
60-<80% of benchmark height	10
80-<90% of benchmark height	13
>90% of benchmark height	15

Under this component, the tree canopy cover of the trees in habitats/stands cleared for the construction of BTC/SCP pipelines is compared with the average canopy cover for each EVC benchmark (Table 5).

Table 5. Component: Canopy cover

component canopy cover	
10-<20% of benchmark cover	2
20-<40% of benchmark cover	4
40-<60% of benchmark cover	6
60-<80% of benchmark cover	8
80-<90% of benchmark cover	9
>90% of benchmark cover	10

Under this component, the number of trees per hectare in habitats/stands cleared for the construction of BTC/SCP pipelines is compared with the number of trees for each EVC benchmark (Table 6).

Table 6. Component: Number of trees per ha

no of trees per ha	
10-<20% of no in benchmark	2
20-<40% of no in benchmark	4
40-<60% of no in benchmark	6
60-<80% of no in benchmark	8
80-<90% of no in benchmark	9
>90% of no in benchmark	10

Under this component the growing stock of the dominant tree species in habitats/stands cleared for the construction of BTC/SCP pipelines is compared with the criteria of mature vegetation in each EVC class (Table 7).

Table 7. Component: Growing stock

component grovving stock	
10-<20% of benchmark stock	2
20-<40% of benchmark stock	4
40-<60% of benchmark stock	6
60<-80% of benchmark stock	8
80-<90% of benchmark stock	9
>90% of benchmark stock	10

Under this component, the basal area i.e. the area in square meter per hectare occupied by trees in habitats/stands cleared for the construction of BTC/SCP pipelines is compared with the basal area occupied by trees in the benchmark for each EVC (Table 8).

Table 8. Component: Basal area

basal area	
10-<20% of benchmark	2
20-<40% of benchmark	4
40-<60% of benchmark	8
60-<80% of benchmark	10
80-<90% of benchmark	13
>90% of benchmark	15

This component assesses the existence and quality of coppice, natural regeneration and under-storey, and the habitat quality of the herbs-/grasslayer which are crucial components to determine the quality of a forest habitat.

As mentioned before, the underlying detailed forest inventory by Saktkeproekti was obviously carried out with the main purpose to collect information on the commercial value of timber standing in areas that had to be cleared for the construction of BTC/SCP pipelines. Not surprisingly, therefore, information on coppice composition, quantity and height (+/- 5%); composition, quantity andheight ofunder-storey (+/-10%) and types ofvegetation cover, % of coverage (+/- 10%), which following the inventory design should have been collected by the field crews at each sample plot, in many cases turned out to be not available in the quality which would have been necessary for that study, i.e., to compare such components with the respective EVC benchmarks. Consequently, these components could not be assessed comprehensibly in the desirable level of detail.

However, since these data are important indicators of forest habitat quality, which should not be left out in any habitat-hectare assessment, they were taken into account albeit in a less detailed distinction (Table 9).

Table 9. Component: Coppice/regeneration/understorey

component coppice/regeneration/understorey	
no coppice/regeneration/understorey	0
single species coppice/regeneration/understorey	5
multiple species coppice/regeneration/understorey	10

2.5.2. Landscape indices

The assessment of landscape related components was based upon the interpretation of aerial photographs and surveyed GIS data.

The neighbourhood score indicates whether or not the patch of forest habitat under assessment is part of a larger forested area. This component reflects the importance of habitats to be interlinked with or in close distance from each other and the significance of the size of a forested area for its habitat quality. In our case, this component indicates the percentage of the total area within a radius of 1 km around the sample plot which is occupied by forested habitats (Table 10).

Table 10. Component: Neighbourhood

neighbourhood component	
>0-<20% of neighbourhood forested	2
>20-<40% of neighbourhood forested	4
>40-<60% of neighbourhood forested	6
>60-<80% of neighboulıood forested	8
>80-<100% of neighbouhoud forested	10

The "distance to core area"-component of the landscape context assessment is an estimation of the distance to the next 'core area'. For habitat-hectare assessments of forest habitats a 'core area' is defined as any singular patch of forest vegetation larger than 10 ha regardless of type and quality of this forest. Whereas a distance of more than 1 km does not result in any score points, a distance in between 0,2 km - 1 km results in 2 points, and a distance of less than 0,2 km results in 4 points and - if the area under assessment is part of a forest area larger than 10 ha, "distance to core area" would be considered "contiguous" and consequently be allocated 5 points (Table 11 and Figure 2).

Table 11. Component: Distance to core area

distance to core area	
>1 km	0
>0,2 to <1 km	2
<0,2 km	4
contiguous	5

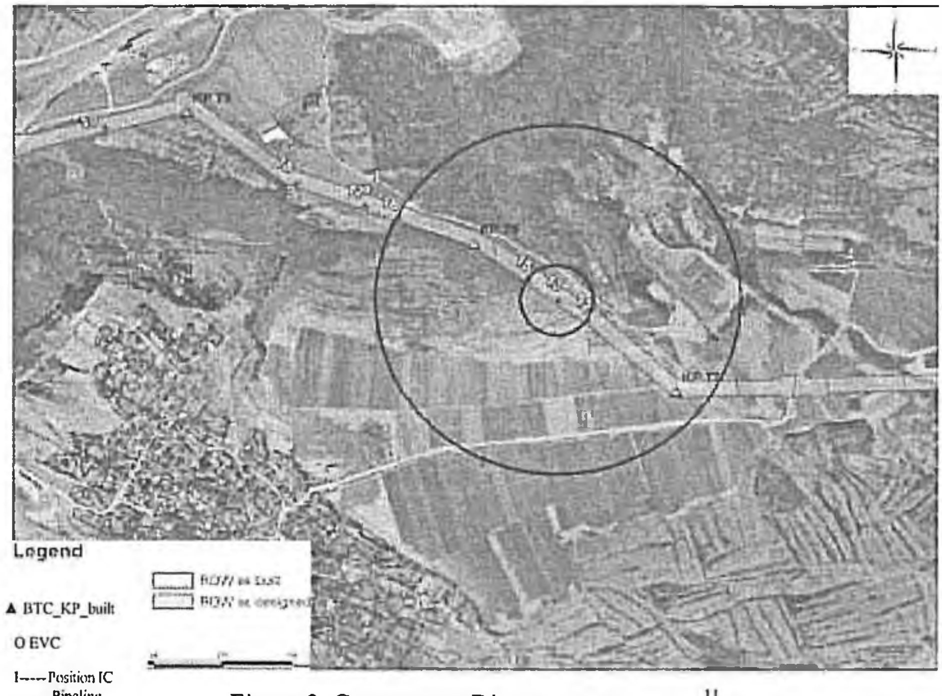

Figure 2. Component: Distance to core area [11]

3. Results

3.1. Calculation of damages, in habitat-hectares

Calculation in habitat-hectares of damages to forests caused by construction of the BTC/SCP pipelines followed a six-step approach:

1. Based upon the dominant species indicated in the detailed forest inventory cards (regularly on subcompartment basis), each of these forest areas affected by the construction of BTC/SCP pipelines was allocated to its relevant EVC.
2. To calculate scores for all site condition based components, the relevant indices (average DBH of dominant tree species, average height of dominant tree species, tree canopy cover, number of trees per hectare, growing stock, basal area and coppice/regeneration/understorey) were compared with their benchmarks, and scores attributed accordingly.
3. Scores based on landscape indices (neighbourhood and distance to core area) were derived using a Geographical Information System (GIS).
4. The area consumption as foreseen in the project (i.e., designed boundaries for the right of way (ROW) and other project components) naturally served as a basis for the exante Saktkeproekti forestry assessment. Area related

[11] BTC Corporation.

data therefore sometimes turned out to not fully reflect reality, as the area consumption "as built" differs in some locations from the area consumption as per the technical design. Thus, using a GIS, the forest area data were refined to the status of "effectively affected by the construction of BTC/SCP pipelines and other facilities".

5. Using these updated figures on areas as effectively affected, and multiplying them by their habitat score, the value for all the forest/habitat patches affected by the construction of BTC/SCP pipelines was calculated and quoted in habitat-hectares.
6. To determine the overall value of damages to forests/habitats within each EVC, the habitat-hectare values for each patch were classified and added-up according to their affiliation to their relevant EVC.

In total, 262 plots with a total area of 141.82 ha of land classified as forest, with an overall value of 80.51 habitat-hectares, were cleared for the construction of BTC/SCP pipelines. In addition, 37.15 ha of forest lands, representing a total value of additional 5.52 habitat-hectares [12], were found to not having been stocked with trees. A summary of the results is presented in Table 12.

Table 12. Areas affected and damages in habitat-hectares for each Ecological vegetation class (data/results displayed rounded to 2 digits after the decimal point)

Ecological Vegetation Class	Area [ha]	Habitat score	Habitat hectares
forest land with no standing stock	37,15	0,15	5,52
EVC 1 Georgian oak forest	17,41	0,62	10,82
EVC 2 high-mountainous oak forest	6,67	0,69	4,60
EVC 3 Georgian oak with high-mountainous oak forest	4,58	0,75	3,42
EVC 4 Georgian oak with Oriental hornbeam forest	7,70	0,81	6,25
EVC 5 high-mountainous oak Caucasian hornbeam forest	6,64	0,92	6,13
EVC 6 Caucasian hornbeam with oak forest	4,71	0,68	3,21
EVC 7 Caucasian hornbeam with high-mountainous oak forest	1,22	0,95	1,16
EVC 8 beech forest	7,53	0,84	6,31
EVC 9 beech with Caucasian hornbeam forest	1,18	0,88	1,04
EVC 10 beech with pine forest	5,26	0,73	3,85
EVC 11 pine forest	16,41	0,64	10,56
EVC 12 pine with high mountain maple forest	3,08	0,78	2,40
EVC 13 spruce forest	3,06	0,65	1,99
EVC 14 spruce pine forest	0,14	0,57	0,08
EVC 15 spruce fir forest	0,87	0,53	0,46
EVC 16 crook stem birch forest	0,95	0,92	0,87
EVC 17 riparian forest dominated by willow	10,03	0,65	6,51
EVC 18 riparian forest dominated by poplar	7,23	0,74	5,34
Total	141,82	0,57	80,51

[12] The results were calculated in detail for each plot, hereby only the summarized results of damages to forest habitats in habitat-hectares as per each EVC are being presented, while the results are shown rounded to 2 decimal places only, the calculations were carried without rounding, thus using the figures presented in table in a multiplication exercise might lead to slightly different results.

3.2. Determination of scope for the required eco-compensation

The question that remained now was how to determine the scope of the eco-compensation to assure no net loss in forest habitat.

A patch of forest with an area of 0,4 ha and habitat score of 1,0 represents the relative value of (0,4*1=) 0,4 habitat-hectares. A patch of forest in the same ecological vegetation class with an area of 0,8 ha but a habitat score of 0,5 only represents the same value of (0,8*0,5=) 0,4 habitat-hectares; thus, according to the habitat-hectare assessment methodology, these two areas are considered equivalent.

In the absence of anthropogenic influences, the habitat quality of any forest society is assumed to increase over time ((h_s=f(t)) until the forest reaches conditions of maturity and apparently long undisturbed biodiversity and vegetation as presented in Figure 3. At that specific moment in time (tb), the habitat score is "one" (h_s(tb)=1).

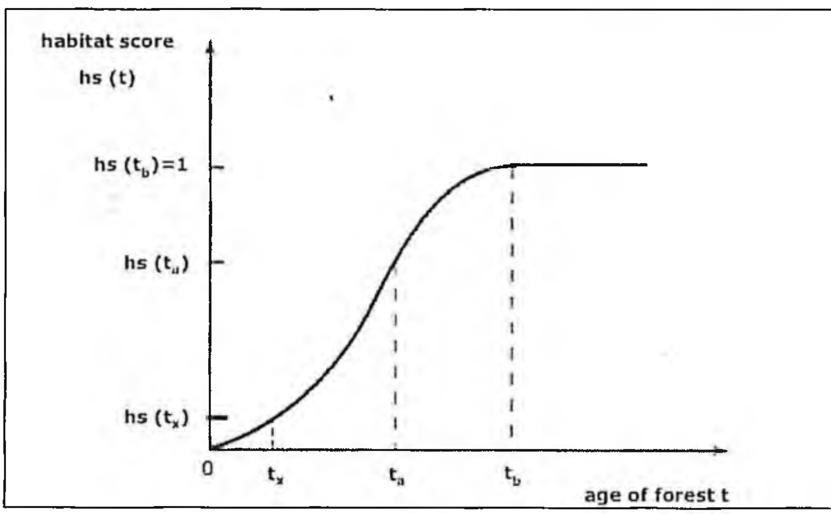

Figure 3. Development of habitat score over time.

Whenever it has to be assured that no let loss in environmental goods will occur, therefore, the factor "time" plays a crucial role for the determination of the scope of eco-compensation measures.

E.g., assuming that a reforested/afforested area can achieve a habitat score of 0.2 after 20 years, a compensation ratio of 4:1 (i.e. four times the area to be reforested/afforested and looked after for 20 years compared to the original area deforested) would be required to compensate for the loss of a patch of vegetation representing a habitat score of 0.8 if "no net-loss" is to be assured. If the habitat score increases to 0.4 after 40 years, then the compensation ratio guaranteeing "no net-loss" in habitat value would be 2:1 (i.e. two times the area to be reforested/afforested and looked after for 40 years compared to the original deforested area).

That means, the longer the period over which a party causing forest damage to forest habitats by clearing tem, can be committed to look after the afforestation/reforestation activities and to assure growth and protection of the afforestation/reforestation as such, the lower the ratio between areas to be afforested/reforested and areas cleared can be kept, without any net loss in environmental goods occurring.

Since little reliable information is available on the development of habitat quality of various forest communities (EVCs) in Georgia, data from standardized yield tables for the dominant and co-dominant tree species had to be used as a proxy for the development of habitat quality of a stand over time

A mixed index was introduced, by calculating the arithmetic average of average BDH, average height, basal area and standing timber volume of the dominant and co-dominant species. This mixed index was extrapolated by specialist of the Georgian Forest Service beyond the periods of time (age classes) as covered by the standardized yield tables (Figure 4). In this context, it was specifically crucial to assess the moment in time when the gradient of the mixed index becomes zero. This point in time - where the gradient of the extrapolated curve becomes zero - is used to determine the moment in time (tb) when the habitat reaches benchmark conditions and to determine the corresponding absolute mixed index value.

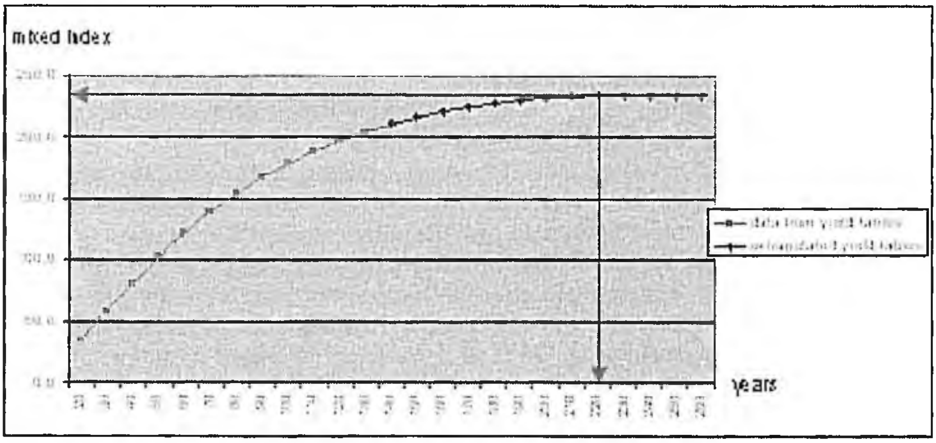

Figure 4. Determination of t_b and value of mixed index at t_b.

The habitat score of an area under assessment ($h_s(t_a)$) indicates, in percents, how close this forest area reaches to the benchmark conditions (mature und undisturbed forest) at the moment of the assessment (t_a). This percentage can be transposed to the mixed index as presented in Figure 5.

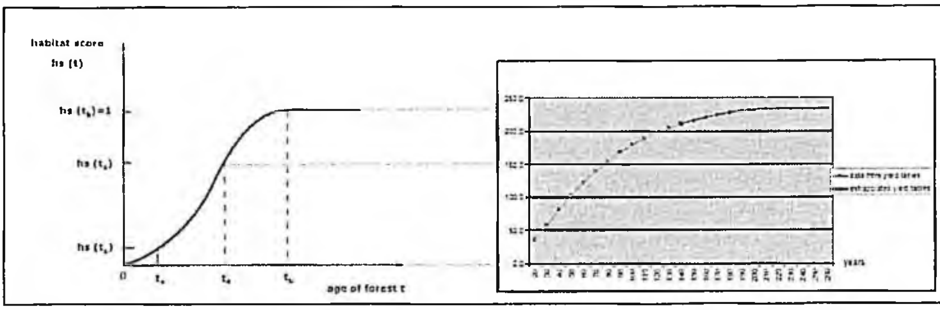

Figure 5: Interrelations in between habitat score and value of mixed index.

This allows allotting the corresponding value of the mixed index to each habitat score within each EVC and under the assumption of a corresponding landscape context.

The compensation ratio required, i.e. the ratio between area to be afforested/reforested and area cleared can be calculated in this way. This ratio corresponds to the quotient of a) the value of the mixed index at the moment for the equivalent eco-compensation and b) the value of the mixed index at the moment of the assessment.

This principle can be elaborated more plausibly in an example using concrete figures, as following:

A forest stand to be assessed had reached benchmark conditions at an age of 220 years. The corresponding mixed index is 234,6.

Assuming the habitat score for that area having been calculated to be 0,64, the corresponding value of the mixed index would be 150,1 (=234,6*0,64).

If the values of the mixed index for an afforestation in this EVC amount to e.g. 34,9 after 20 years, 58,4 after 30 years and 81,5 after 40 years, the compensation ratio can be calculated using these figures: In case the party causing the deforestation can be committed to look after the afforestation for a period of 20 years, equivalence can be achieved if for each hectare deforested a compensation afforestation of 4,3 ha (150,1/34,9) is realized. In analogy to this example, the compensation ration for a period of 30 years can be calculated to be 2,6 (150,1/58,4) and for a care taking period of 40 years with 1,8 (150,1/81,5) only.

In this way, the scope of the eco-compensation measures required to assure that "no net loss" in forest habitats occurs was calculated for the all forest areas in Georgia which were affected by the construction of BTC/SCP pipelines in decennial steps, for care taking periods of 20, 30 and 40 years, respectively. Depending on the EVCs and the condition of the forests at the moment of clearing, the compensation ratio for the care taking periods varied from 1:2,5 up to 1:6,8 ha.

4. Discussion and Conclusions

One of the core reasons for the development of the habitat-hectare approach was the necessity to make habitat condition and quality accountable in native vegetation planning and investment decision processes. When applied in investment decision making processes, the habitat-hectare assessment of ecosystems, likely to be affected by a planned economic development activity, has normally to be carried out before the onset of any such development activities. Only an ex-ante assessment allows all parties involved to objectively review the results of the habitat-hectare scoring exercise and to mutually agree upon the habitat-hectare score, which subsequently constitutes the basis for the determination of eco-compensation measures or biodiversity offsets.

Since the BTC and SCP oil and gas pipelines had already been built at the time of this study, at that stage only an ex-post assessment of the quality of the ecosystems affected by the pipeline construction could be carried out. The assessment was based on a set of data collected by the Georgian consulting firm SAKTYPROEKTI [13] previous to the construction activities. This detailed forestry assessment was contracted by BTC Pipeline Company as part of their obligations in the context of the ESIA and handed over to Georgian Ministry of Environment (MoE) for critical review and approval. Since the MoE did not contest the accuracy of these data and since an objective independent verification is no longer possible now, this set of data has to be considered to best possibly reflect the situation of the relevant ecosystems before any disturbances following pipeline construction activities. Even though this forestry assessment was conducted in a very detailed way, requirements of the habitat-hectare scoring exercise were not considered in the survey design to the desirable extent. In particular, classification of the forest associations into Ecological Vegetation Classes (ECVs) - as required by the habitat-hectare approach - was not undertaken by the surveyors in the field. After all, with all established shortcomings regarding accuracy and comprehensiveness, that set of data derived from the SAKTYPROEKTI survey still allows for the application of the habitat-hectare approach with a reasonable accuracy.

The proposed approach assures the restoration of the equivalent forest habitat, thus the approach is considered to be fair and equitable. The methodology takes into due consideration that forest habitats are extremely complex eco-systems, which need centuries before they can provide their full scale of environmental and habitat functions. The condition of forests at the moment of clearing is taken into consideration in the determination of the eco-compensation ratio required to assure "no net loss" in forest habitat.

Similar examples have shown that such times when natural resources could be sacrificed to economic development without any compensation for the associated environmental damages are - or by all means should be - over, today. To assure sustainable development, the true value of natural resources has to be reflected in the cost-benefit analyses of decision makers.

In the light of steadily higher pressures on natural resources which become progressively scarce, the proponents of economic development activities will be increasingly faced with comparable valuations of natural resources.

The habitat-hectare approach has been intentionally designed in a way that assessors will not be required to show highly specialised expert knowledge on native vegetation. However, at least an intermediate level working knowledge of native

[13] Forest assessment and detailed forest inventory conducted by Geoforestdesign (Saktyproekti) for BTC Oil Pipeline, SCP Pipeline, 2003, as well as for Secondary Containment Project, Drain Down Reservoir etc, 2005.

vegetation is required, in order to produce meaningful results. For a systematic and country wide application of the habitat- hectares approach, assessors will need access to reference material developed by local scientific institutions (e.g. country wide Ecological Vegetation Class descriptions, regional benchmarks and maps). If the Government of Georgia intends to systematically apply this approach, relevant reference materials will have to be developed.

References

Austrian Forest Act, 1975 i.d.F. 2002.

Biodiversity offsets and opportunities; International Finance Corporation, World Bank Group.

Kate, K. T., J. Bishop and R. Bayon, 2004. Biodiversity offsets: views, experience and the business case.

BTC Project ESIA Georgia, draft for disclosure, 2002.

BTC Project ESIA Georgia, response to comments (from ESIA public disclosure phase), 2002.

BTC Pipeline Project, Georgia. Kodiana Projects. Emergency Drain Down Facility (EDDF) Environmental and Social Evaluation Report, 2006.

BTC Pipeline Project, Georgia. Secondary Containment Project. Environmental and Social Evaluation Report, 2007.

Caucasus mixed forests (PA0408), WWF.

Draft "Memorandum of Understanding between BTC Co. and the Ministry of Environment Protection and Natural Resources of Georgia for Forest Eco-Compensation" (Version BTC Co. of 12 November, 2004; Revised by EA, MoE, GIOC).

Garrod, G. and K. G. Willis, 1999. Economic valuation of the environment, methods and case studies.

Host Government Agreement for BTC pipeline; Georgia, 1996.

Pollution probe, exploring applications of the net gain principle, 2004.

Gvritishvili, M. and M. Kimeridze. Report on literature review and field survey of flora and vegetation along the Baku-Tbilisi-Ceyhan major export pipeline project route.

Saktkyproekti (Georgian Forestry Project) detailed forest inventory on the State Forest Fund inside the 44 m right of way for the Baku-Tbilisi-Ceyhan Pipeline, 2003 and secondary containment project and EDDF etc. 2005.

Status review of biodiversity conservation in the Caucasus: Achieving 2010 goals (Georgia).

The Forest Code of Georgia, 1999.

Freemann, A. M. III, 2003. The measurement of environmental and resource values;

The vegetation of Georgia (Caucasus); Gorgi Nakhutsrishvili; 1999.

Vegetation Quality Assessment Manual - Guidelines for applying the habitat-hectares scoring method; Department of Sustainability and Environment, Government of Victoria; 2004.

Victoria's native vegetation management - a framework for action, 2002.