



BioScore 2.0

A tool to assess the impacts of European Community policies on Europe's biodiversity

Report of the workshop on BioScore 2.0, a biodiversity model for EU28

Brussels 16-10-2014.

Produced by Tamsin Burbidge (ECNC) in cooperation with Marjon Hendriks, Arjen van Hinsberg, Onno Knol and Jaap Wiertz (PBL).



SAPIENZA
UNIVERSITÀ DI ROMA



PBL Netherlands Environmental
Assessment Agency

Preface

BioScore 1.0, a biodiversity impact assessment tool was developed in 2009 as part of a research project, funded by EC DG Research and Technological Development FP6. At the time of delivery it was recognized that BioScore was a useful first version, allowing coarse impact assessments at an EU-wide scale. A sequel version, BioScore 2.0 is now being developed and will be rigorously improved in terms of resolution (5*5 km) and data quality (dose response relations based on quantified data). It is not positioned as a monitoring tool, but rather will produce indicators relevant for Target 1 of the EU Biodiversity Strategy to 2020: Fully implement the Birds and Habitats Directives.

On October 16 2014, PBL and ECNC arranged a workshop on BioScore 2.0 which was attended by 17 participants. During this workshop the potential use of the model was discussed as well as the options for its improvement. Participants were informed about the aims of the workshop beforehand; they have received a description of the technical aspects of BioScore 2.0 (in the form of a Draft report) and the summary of the responses of three reviewers. This note contains the minutes and the outcomes of the workshop.

Presentation: BioScore and the scope of the workshop (Arjen van Hinsberg)

Arjen van Hinsberg briefly presented how modelling may support policy making, the history of the BioScore project and the plans of PBL (Netherlands Environmental Assessment Agency) for future use of the model.

Recent studies show that in general models can be useful tools for policy support by providing information on effects of future trends and plans. PBL uses biodiversity models for scenario studies such as the Global Biodiversity Outlook. In 2006-2009 PBL contributed to the BioScore project, which aimed to develop a tool that is able to assess the possible impacts of community policies on biodiversity in a cost-effective way. Since then, the BioScore model has been used to examine the consequences of various scenarios, for example, the consequences of various land-use scenarios for greening the Common Agricultural Policy (CAP). Together with Alterra, Sovon Bird Research and Butterfly Conservation Europe, PBL has recently improved the model. The first aim is to use the model in PBL's next Nature Outlook in 2016. In BioScore 2.0, a priority was to produce policy-relevant output, related to the conservation status of species and habitats and High Nature Value Farmland. In addition we improved the quality by using fine-scaled data of species occurrences (modelling on 1x1 or 5x5 km) and by deriving quantitative cause-effect relations based on field-observation data. In this workshop, PBL wanted to discuss the following questions:

- (i) For what purpose/questions can the model be used?
- (ii) How to improve the model? And
- (iii) How can we improve trust in the model and deal with uncertainties?

Question: *What is the distinction between the BioScore-project funded by EC, BioScore 2.0 and PBL-Nature Outlook?* Answer: BioScore-project ended in 2009. In 2013, PBL started, together with different partners, the improvements to BioScore 2.0. The Nature Outlook is a separate PBL project, which aims to use BioScore 2.0 as one of the tools for scenario analyses.

Presentation: BioScore 2.0 (Marjon Hendriks)

Marjon Hendriks summarized the draft report on BioScore 2.0, which was sent to the workshop participants. BioScore 2.0 is set up to calculate the impact of future changes in human induced pressures on the biodiversity in the EU28. To achieve this, the model needs input from other models such as climate-change models (e.g. BIOCLIM, IMAGE) and land-use models (e.g. Corine Land Cover, Volante, CLUE). It quantifies changes in the status of protected species and habitats in terms of distribution range and amount of suitable habitat. It is a multi-species and multi-driver model, combining multiple statistical (regression) techniques.

The model calculates changes in four steps:

Step 1: Calculation of the species distribution range at current or future climate scenarios.

This is calculated using data-derived relationships between species occurrence and climate and soil conditions. Within the model there is information about 1000 plant, butterfly, bird and mammal species relevant for the EU Birds and Habitats Directives. Calculations are done on a 5 by 5km resolution.

Step 2: Calculation of the amount of available habitat within the distribution range, based on scenarios for land-use types.

Step 3: Calculation of the habitat quality/suitability due to effects of various environmental pressures on the habitats.

In this step, data-derived dose-response functions between species occurrences and various pressures are used. Dose-effects relations for land use intensity (forest management and agricultural intensity), fragmentation, pollution (air quality) and water-use are included in the model.

Step 4: Calculation of relevant policy indicators for the various EU biodiversity targets by aggregating all previous information.

Impacts of environmental/land-use changes on EU biodiversity targets are quantified by using indicators which are relevant for the long-term goals of the EU Habitats Directive. Changes between the present and future scenarios can be compared at country or European levels.

With these improvements, BioScore 2.0 can inform policymakers about potential effects of future environmental changes (trends, options or plans) on biodiversity.

Question 1: Are the presented dose-response functions between species occurrences and climate or other pressures based on field measurement? If so, please be clear about this, because this is a very important improvement. Answer: yes.

Question 2: From the scheme of the model concept it seems that interaction between climate factors and pressures are not taken into consideration. If so, how do you intend to deal with this in scenarios where climate is changing? Answer: Interaction between changing climate and changing pressures is taken into account in the scenario maps which are used as input for the model rather than in the BioScore model itself. These scenario maps are calculated with other models, which are able to calculate the effect of changing climate on the pressure.

Presentation: Results of the review (Arjen van Hinsberg)

Ahead of the workshop, the draft report had been sent to 4 reviewers, 3 of which had sent in their review before the workshop. These reviewers were asked if BioScore 2.0 would be an adequate biodiversity impact assessment tool, aiming to support decision-making processes at European, national or even regional level. Arjen presented a summary of the response of the reviewers.

The current draft report was not clear and wrongly suggested that:

- (i) the model aimed at measuring or evaluating ‘Target 1’, while this can only be done with field measurements such as included in the article 17 reports
- (ii) the model did not incorporate land use changes, while one of the main drivers is land use change (land abandonment, urbanization etc.) and
- (iii) focus was on the Atlantic region, while included species distribution covers the EU28.

Maybe partly due to this confusion, the reviewers varied in their opinions to what extent the approach is meaningful or salient in connection to possible policy questions.

Reviewers mentioned various options to improve the model with respect to the species (include new groups such as reptiles) and pressures (include additional drivers such as invasive species) that are

considered. In addition, options were given to improve the model's credibility (e.g. increase validation, extend the report with more detailed information).

Connection to policy questions (**saliency**) may be further improved by adding more pressures and improve the ones already present.

- *Land use* could be more fully addressed in calculating future trends.
- *Effects of land abandonment or urban sprawl* should be defined in a set of rules outside BioScore, describing the dynamics of vegetation succession by changing land use. This set of rules will be added in the report on BioScore 2.0.
- The dose-response functions on *Forestry management* are still rather coarse, based on one study and addresses potential management. This criticism on forestry will not be easy to cope with in the short term.
- Positive pressure '*Targeted conservation action*' is missing and '*Introduction of invasive species*' is missing. '*Targeted conservation action*' would require more detailed information about the present management of nature reserves. For invasive species, in our opinion, no general rules can be derived.
- *Improvements of the connection to policy questions* would also be possible by the incorporation of all protected species. Especially reptiles, amphibians, fungi or bryophytes are missing.

The **scientific credibility** will be optimized by better explanations of choices (used data, statistics, interaction of pressures) and more validation. Indeed, four reports on these data and the plausibility tests will become available soon, in 2014. An uncertainty test would be advisable at least in a qualitative form (in 2015?). The draft report is also still unclear on selection of the pressures, the definition of indicators, and the framing of the DPSIR-chain. This will be improved.

The **legitimacy and support** for the model could be further optimized by a clear executive summary with a table of policy options and related indicators, and by expanding the project team with partners from more biogeographic regions, especially from the Mediterranean region or with partners with more knowledge about 'weak' pressures (e.g. forestry).

There were no suggestions for a better, alternative model for these scenario-purposes, except an approach like GLOBIO using a more generalised biodiversity concept instead of the per species approach of BioScore. The latter is more data demanding but has the advantage of a possible check of predicted and observed distribution per species, and the test of modelling on monitoring results.

Pat Murphy gave some reflections on behalf of DG Environment:

- It is useful to make clear what questions policy makers want to have answered and to say what the model can and cannot do.
- We need to measure the progress in terms of halting biodiversity loss and restoring degraded ecosystems by 2020 (in 2010 we could not say how much biodiversity loss had been stopped and that is frustrating for policy makers).
- It is important to be clear which questions BioScore can contribute to. BioScore does not have to deliver the answer to measuring the 2020 targets, but it may be part of the answer.
- We should be open to what needs to be improved. The EU should be interested to define more precise targets. Most targets are not precise or are not measurable and are therefore difficult to evaluate.
- Action 5 calls for Member States to map ecosystems and their services. A Horizon 2020 project is helping national authorities with mapping ecosystem services. These maps may be the basis for (CAP-) subsidies in the future. There is a general recognition that we need better tools. Currently most tools are coming from private organizations. It is mutually advantageous to work together on this.

In two sessions the model was discussed:

Given the response of the reviewers, the first workshop session focused on three main questions:

- (1) For what purpose can the model be used – to answer what type of questions? (Kristijan Civic)
- (2) How to improve the model with regards to the pressures it considers (Add new pressures, improve current)? (Marjon Hendriks)
- (3) How can we improve trust in the model? (What kind of validation is needed? Should we make the model simpler or should we include more-complex ecological information?) (Rogier Pouwels)

In the second session the following questions were addressed:

- (4) *What are the DOs and DON'Ts for future development and application?*
- (5) *What are suggestions for next steps?*
- (6) *Which partners would be interested in or needed for BioScore 3.0?*

Ad (1) Results of sessions 1 with respect to question 1 – For what purposes can the model be used?

- It is very important to clarify the model output better so that purposes of the model and its underlying information/database can be fully identified. For example, the model includes information on species sensitivities for various pressures. Although the model is not intended for informing policy on individual species, the database might be of general use to inform managers about species sensitivity. BioScore is a data driven approach, combining data with pressures. This is a strong point which should be communicated to policy makers.
- The model can be used to show how many species will profit from a certain measure.
- The model can be used for information at European level policy making, for EU28 or at the biogeographical, national and perhaps even county scale.
- The model can be used to test/examine different approaches to achieve EU goals (e.g. green infrastructure, N2000 targets versus land use intensity in agriculture and forestry or integration with related policies such as the Water Framework Directive and air quality policy, ecological focus areas - farm level or network approach).
- The model can be used as a tool to quantify measures needed for realization of biodiversity targets by back casting scenarios.
- The model can help to identify or specify new policy measures (e.g. it can identify regions where the effects are large).
- The model can be used for sensitivity analysis of policy measures with respect to impacts.
- The model can be used in scenario analysis of pressures and impacts relative to the targets on species and habitats of EU 2020 BD Strategy. However, it is currently more suited for some targets (e.g. biodiversity conservation), while information is lacking for others (e.g. restoration of ecosystem services). For other ecosystem services / targets different models to BioScore will be required.
- BioScore could help in answering the question “did we halt biodiversity loss?” in 2020 or later. It could potentially explain why we did, or did not.

- The use of Driving force - Pressure – State – Impact - Response (DPSIR,) as described in the report, may not be appropriate regarding definitions on drivers and pressures but will not lead to a different result when using Driver – Pressure -State (DPS) instead. Including ecosystem services (ESS) will need a lot of attention, thought and explanation. (*remark for PBL: So the intention is to choose separate models for ESS beside BioScore*).

Ad (2) Results with respect to question 2: *How to improve the model regarding pressures it considers?*

- The selection of pressures can also be looked at from a species perspective. The model should consider those pressures that are relevant to red list species or indicator species. The list of current factors identified as being important threats to red list species could be used for a check on the currently selected pressures.
- We should know what policy-makers are asking for in order to provide guidelines for choosing additional pressures. This approach was followed in BioScore 1.0 and should be followed also in future improvements. The report should describe why the current set of pressures was selected. Do policies that are relevant on a European level have an important impact that we did not include? Which pressures are relevant for which targets?
- Fragmentation is a very important factor to be considered. During the development we have used many different maps to quantify fragmentation, but more guidelines should be given for using these maps. The focus now is mainly on spatial connectedness, the inclusion of effects of roads on fragmentation should be considered, because roads have a direct impact on habitat quality and there are EU policies on infrastructure.
- Forest management and agricultural intensity are important to keep on-board. It is important to include the lack of (nature) management.
- There is a difference between species that occur in natural and semi-natural/managed areas, because those in semi-natural areas can potentially be backed up by management processes but those in natural areas can’t. The model should include to which type of ecosystems a species belongs and whether nature management could be profitable for species. Maybe the model could include use or management intensity classes in other ecosystems than just in forests.
- Aerial photos or Remote Sensing data could be used to include data on the current management intensity. There is a lot of information in these photos about past and present conditions, which could potentially be incorporated into the model.
- In the report on BioScore 2.0 a clear distinction should be made between improvements for the scenarios (input data) and to the model itself.

Ad (3) with respect to question 3: *How can we improve trust in the model? What kind of validation is needed? Make it simpler or include more complex ecological information?*

- One concern is documentation. What has been done, what data was used, what model limits are identified etc. should be described more clearly. It is important to specify uncertainty, although that can be very difficult. There are errors at every step, but what is the final result of multiplying errors? The report should show the validation of each of the 4 steps separately and together at the various levels of spatial aggregation (e.g. separate grids, regions, countries). Qualitative

analysis/checklist should be used to assess errors. It is better to use a qualitative method than nothing at all. The type of validation differs for climate/soil and pressures.

- With regard to the question on the balance between model simplification and complexity, it should be noted that the model should be scientifically robust. As such, it does not matter if the model is complex. Oversimplifying it risks that the model will be criticized and thereby lose trust.
- In terms of trust: the scientific credibility of the dose-response functions should be reported. BioScore is data driven but data is often not free of errors, thus improving the model also means improving the input data. The modellers and users of the model output should be aware that input maps can contain mistakes. In the report of BioScore 2.0 this should be described and the choice of data should be explained.
- It is important to communicate the uncertainties to policy makers.
- Model output should be presented in a relative way for different scenarios. This will be more robust.
- Model results could be presented in both a spatially aggregated way or in detailed maps. This depends on the use of the model runs.
- The model could be used to calculate univariate or multivariate effects from pressures. The question is: should the effects of the pressures be weighted between each other?
- With respect to selection of drivers and pressures it is important to check whether important issues are missing, such as the relevance of land abandonment. Abandonment can be tackled by BioScore 2.0 by changing the considered land classes. Also, it is important to check if all the relevant pressures and species groups are taken into account. Amphibians are missing, despite being good indicators of water quality.
- In the model a huge amount of data is used. This might give the impression that no extra data is needed, however, it is clear that there are gaps in the data. Nevertheless, the use of data is very promising. There is huge interest across Europe. Many people are interested and want to see that their data is used in BioScore, which is a good starting point. Cooperation with and support from NGOs like European Vegetation Archive, European Bird Census Council, Butterfly Conservation Europe, European Mammal Society, etc. is very important.

Ad (4) With respect to the question on the '*DOs and DON'Ts for future development and application*':

[The highest prioritized aspects are depicted in **bold**.]

- Don't think about version 3 before version 2 is running.
- Don't think that the model can deal with all changes and pressures.
- Don't present the model output in the edges of the maps. The data for Russia, North Africa etc. is very limited.
- Do use BioScore in the Outlook report in a robust way to demonstrate it's potential.
- Do communicate more – internally and externally with, for example, politicians, NGOs. This is important for building trust.
- **Do show that the (half) products of BioScore are also relevant from a scientific or policy point of view.** For example, the information on species sensitivity top pressures is both scientific and policy relevant. Also, the distribution maps used in BioScore are relevant to show where sensitive species occur. Information about these useful (half)products should be presented and communicated in various ways.

- Do keep the model flexible in order to be able to include new pressures or to be relevant for new/changing policies.
- Do be aware of changes in policy.
- Do know what the model can and cannot do.
- Do develop a strategy for future use and development and **develop a strategy on how to communicate to the public**. Be clear on how the partners cooperate and if the model is open source or not.
- **Do make a pre-selection of relevant pressures.**
- Do directly include pressures into the spatial model.
- **Do present models in a relative way.**

Ad (5) with respect to the ‘*Suggestions for next steps*’:

[The highest prioritized aspects are depicted in **bold**.]

- Explore if other species groups can be incorporated into BioScore e.g. amphibians are a small group with good data and they indicate water pollution. Fish would be important but not enough data is available. Reptiles? Dragonflies? Additional groups are useful to include different pressures.
- Extending the number of included habitat types. Currently only 40 habitat types are included. Including more habitat types might be more important than including more species. In the long-term extending the model to all habitat types might be useful.
- Improve dose-response functions. Some response functions are not robust. The selection of included data (species presence and absence data) is an important factor for the quality of the response function. The data selection can be improved with respect to data on species presence and absence. The question is: whether this is important and possible for BioScore 3 or not? Probably the finalization of the current version is step one.
- **Incorporate more relevant pressures, such as the dependence on nature management.**
- **Communicate about the results and the possibility of half-products.**
- **More interaction with stakeholders (e.g. policy makers, Topic Centres) to build trust. Focus on policy relevant indicators and translate results to useable indicators at the right level. There is a gap between output and policy makers.**
- Extra attention on how to deal with fragmentation (i.e. by including other aspects of fragmentation than spatial connectivity).
- Consider how to gain access or incorporate more and better quality data for pressures.
- Technical details: (examine the) use of a multivariate approach.
- Perform a sensitivity analysis to examine where to prioritize improvements.
- Assess possible errors.
- Try to validate by historic backcasting to increase credibility.
- Add remote sensing data to include more detailed habitat changes e.g. height of forest.
- Include more detailed information on management in models and make links to financial costs of management.
- **Examine links with the Horizon2020-proposal, which is looking to consolidate data and make more data available within next 3 years.**

- Examine possibilities for improvements of BioScore in future EU-calls/tenders. Try to act as a group to bring BioScore further. One of the requirements in future EU-calls is to involve more partners inside or outside Europe. Nature based solutions will be the next future question in which BioScore might be useful.

Which partners would be needed for BioScore 3.0?

- ETC/BD (has capacity only for advisory role); organizations used to working at European scale
- JRC
- EEA (more data)
- Current partners especially the NGOs + BioScore 1.0 partners
- Partners of new-biomes (water and marine)
- IIASA
- MED WET Programme Tour du Valat
- ICP modelling and mapping
- Biofresh project
- IUCN spec. group on amphibians
- European herpetological society (atlas)
- OpenNESS project
- Montpellier forest and climate change

Lessons learned: reflection on the workshop (Arjen van Hinsberg)

At the end of the workshop Arjen thanked the participants and the reviewers for their good suggestions for improvements, practical options and willingness to cooperate.

With respect to the policy relevance of BioScore, he concluded that policy makers are interested. Based on the reflection of DG Environment it is clear that we must show what the model can and cannot do. One of the purposes is that the model can help to specify policy options and actions. The use of other models for ecosystem services is needed to address the current policy questions and targets and the linkage of BioScore and ecosystem services-models must be clarified. We must also address the fact that the model is data driven and combines biodiversity with pressures, because both points have been identified as very valuable for policy makers.

With respect to the usefulness of the model for addressing policy relevant questions, the workshop participants have identified many possibilities. For example, for scenario analysis, backcasting and analysis of why we did/will not reach targets. During the workshop it was also identified that the information in the model itself might be useful for nature policy. For example, the underlying database of species sensitivity for the various pressures might be useful for article 17 reporting processes.

With respect to improvements in the pressures that the model describes, various options have been described. Effects of roads, management (classes of management needed) and percentage of urban areas needs to be included as soon as possible. In addition, we should now only focus on pressures which can be described correctly. The need to use a multivariate approach based on ground truth/ good data has been underlined several times.

With respect to improving trust, good documentation is of prime concern. In the report attention needs to be given to the model limits and uncertainties. Complexity itself is not a problem. Again the use of ground truth/data is identified as a very strong point, however it needs to be clarified that there are still many gaps in species data and environment data. We also need to communicate better on the products which can be derived from the model (e.g. telling the story of historic biodiversity loss, showing the relevant half products and showing results from scenario analysis). This can only be done in different type of reports and presentations. In addition, trust must also be built with more interactions with policy makers.

Also, suggestions were made for cooperation. Some of the participants have already been asked to be involved in PBL's workshops on scenario making. PBL will also involve the participants in a review of the result of the scenario analyses.

Annex 1 List of participants

Name	Organization
Arjen van Hinsberg	PBL
Carlo Rondinini	Sapienza University of Rome
Chris van Swaay	Dutch Butterfly Conservation
Henk Sierdsema	EBCC/SOVON
Jaap Wiertz	PBL
Jean-Paul Hettelingh	CCE
Joop Schaminée	Alterra
Kristijan Civic	ECNC
Lawrence Jones-Walters	Alterra
Marjon Hendriks	PBL
Onno Knol	PBL
Patrick Murphy	EC DG Environment
Rogier Pouwels	Alterra
Sophie Condé	ETC/BD
Stephan Hennekens	Alterra
Tamsin Burbidge	ECNC
Wouter Langhout	BirdLife Europe
Yoan Paillet	IRSTEA