

REPORT OF THE 6th EVALUATION
OF THE BIOTA-FAPESP PROGRAM
BY THE SCIENTIFIC ADVISORY COMMITTEE

8 to 12 July 2008

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NB. The BIOTA Program and the BIOprospecTA subprogram were evaluated separately and separate reports have been prepared. There are aspects, however, in both reports that have import to the other part of the Program and we urge that they be read in conjunction with each other and not simply as separate stand-alone reports. The two evaluation teams have held a number of joint discussions, and largely agree with the findings of the other team.

Executive Summary

1. The Committee continues to be impressed by the BIOTA program and by the advances that continue to be made. This is the first evaluation where the BIOTA Program and the BIOprospectaTA programs have been evaluated separately. The evaluators of the BIOTA program have been impressed with the rise of BIOprospecTA and the enormous strides that the sub-program has made since the last evaluation. It is important that the two aspects of these programs continue to be intimately linked as cross-pollination between the programs will be of benefit to both. This was evidenced in many projects in both areas – where some BIOTA projects had aspects of BIOprospecTA and vice-a-versa. As the databases in the BIOprospecTA sub-program are developed they need to be closely tied to those in the main BIOTA program so that information on common organisms is linked.

2. The BIOTA Program has made considerable progress since the last evaluation in two key areas – that of filling the gaps (many of which were identified in previous reports) and in integrating the results of the projects into useful products for conservation assessment. The production of the map of conservation priorities is a major step forward in integrating results from the program to date and in providing a guide to the State Government on priorities, not only for conservation, but for continued research. The map should be recognized, however, as being just the first step in a long process of developing robust priorities for conservation and environmental protection within the State. The production of this map has highlighted significant gaps in the knowledge base that need to be filled (for example, data in the SinBiota and SpeciesLink databases accounted for only about 1% or landscape fragments) and this is an area the program needs to address as a matter of urgency. It has also highlighted the need to work with new methods for determining priorities in order to overcome these difficulties in the short term, to refine the priorities in the mid-term, and to develop robust solutions for the long-term. There would be benefit in the program considering the bringing of international expertise to this question either via exchange of personnel, by bringing in an external partner, or by advertising for Post Docs in Australia and elsewhere for someone to work on conservation. Australia is a world leader in the development of software and tools, and we suggest that any such advertisement include the University of Queensland (and in particular the laboratory of Hugh Possingham) in its distribution.

3. The science in the projects, as presented to us, continues to be first class and we were impressed by the confidence and competency of the young student presenters during the symposia. One of the evaluators has been present at all previous evaluations, and has seen a marked improvement in this area over the life of the Program. It is obvious to the evaluators that the symposium series held in conjunction with the evaluation are helping the project through education of the students and through the interchange of ideas between projects.

4. The evaluators were impressed with the improvement in the integrated presentation of posters at the poster session. It is obvious that the sub-projects are working much closer together than was evident at previous evaluations. We did note, however, that the posters presented were largely restricted to those projects being evaluated. We believe that this is a pity, as it would have been beneficial to the evaluators (as well as to the students) to have been able to see a wider range of the Biota projects.

5. The scope, publications, and impact of the program in the nearly ten years since the program began have been enormous and the program continues to be a resource not just for Brazil but for the world. The Biota program continues to provide an example, and sets standards, that many countries and other states within Brazil would be happy to follow.

6. As already mentioned in previous evaluations, biodiversity and ecosystem functioning have been increasingly impacted by human activities throughout the world, and even those portions of biodiversity captured by protected areas have started to dramatically erode in many tropical countries. As the impacts start to be described and predicted, a great demand for solutions naturally grows, opening the field for more applied disciplines involving conservation planning and policy (including economic opportunities for biodiversity conservation), restoration ecology, long-term biodiversity monitoring, ecosystem services, bio-indicators, and others covered by modern conservation science. These disciplines are currently under represented within the Program and are needed to naturally integrate much of the information (such as via multi-taxa approaches) and capacity generated by the Biota Program. As these are advanced they will begin to generate timely and broad-spectrum guidance for public policies. This is the key new agenda area that this committee believes this program must begin to increasingly incorporate.

7. In conjunction with the last point, we continue to stress the importance of the issue raised in the last report on incorporation of human activities. Human activities are the greatest force acting upon the environment (at least as great as climate change), and already account for the greatest impacts on ecosystems, the cycle of nutrients, and the survival of species through habitat alteration. If the goals of BIOTA are to be achieved—especially its very first goal (to understand the processes that maintain biodiversity or lead to the loss of biodiversity)—it is urgent that BIOTA projects address more fully, how human activities impact the biodiversity being studied and documented. We note that some of the new projects are beginning to address this urgent need by looking at the areas around conservation units where a lot of the current work is concentrated, and we urge that this continue. As stated in the last report, by taking on the surrounding landscape, often with a more anthropic character, it will be possible to examine fundamental questions of interest to existing projects and begin to address the urgent need to examine the human dimensions of biodiversity.

8. The change in infrastructure management has not happened as smoothly as it might have. For example, the movement of the SinBiota databases, Biota Neotropica and the program Web page to UNICAMP has not yet been finalized and a gap has occurred where the system is continuing to be maintained by CRIA without the requisite resources. It would appear that this situation could be resolved through a meeting between the Director of FAPESP and the directors of CRIA (and possibly with the proposed new managers). It is not in the interests of the program or of CRIA or UNICAMP for uncertainty in the management of these infrastructure resources to continue as new data are likely not to be adequately incorporated or maintained and thus require considerable effort to later bring back up to a suitable standard. As mentioned in the last report “It is unproductive to develop such databases and then not to provide funding for the continued maintenance and development as well as the open access, long-term maintenance, archiving and support for the very valuable resource held therein. The data are a major asset of any program such as this, and like all assets require regular maintenance if that asset is to be preserved.”

9. As mentioned in the last report current laws on collecting in Brazil and in sharing and exchanging data and information internationally (for example via the Global Biodiversity Information Facility) are restricting development of Brazilian science. It has been evident during this evaluation that this situation has not improved over the last three years, and we suggest to FAPESP that they continue to lobby government to free up laws that currently restrict scientific activities – both with respect to collecting and to the sharing of data and information. It is only in this way that the benefits of Brazil's science will flow back to the country.

10. The Advisory Committee was presented with a list of over 800 refereed publications that have arisen from the BIOTA Program over the past nine years. The list of papers included that are published in well-respected international journals, including Science and Nature has increased and the Evaluation Committee has been pleased to observe this along with the increasing numbers of papers now being published in journals at the next level of impact (e.g. Quarterly Review of Biology), and we urge researchers to continue to publish in this manner.

11. Finally, this committee would like to congratulate FAPESP and Coordenação Biota for the comprehensive way it has examined the 5th and previous reports and implemented many of the recommendations. We note for example, the increase in international activity and the integration and coordination with DIVERSITAS and others. This can only help the Program's effectiveness as a program both nationally and internationally and we urge the Coordenação Biota to continue activities in this area. We do note, however, (as expanded below) that several recommendations with respect to the evaluation have not been implemented and we urge that these be addressed prior to the next program evaluation.

Major Recommendations

i. Coordenação BIOTA consider the need to fill gaps identified in the production and publication of the map of conservation priorities in the São Paulo State. This is particularly important with respect to the knowledge of all aspects of landscape fragments and fragmentation.

ii. Coordenação BIOTA encourage the development of at least one major thematic grant on broad-scale conservation across all biomes and geographic areas within the State using robust methodologies. We also encourage Coordenação BIOTA to consider bringing international expertise to this question either via exchange of personnel, by bringing in an external partner, or by advertising for Post Docs internationally. Australia is a world leader in the development of software and tools, and we suggest that any such advertisement include the University of Queensland (and in particular the laboratory of Hugh Possingham) in its distribution.

iii. FAPESP give urgent consideration to the transfer of databases from CRIA to UNICAMP. It would appear to the evaluators that this can only be done through meetings between the Director of FAPESP and the two institutions involved, and should include the drawing up a Memorandum of Understanding with both partners. We also urge FAPESP to consider how funding can be provided for the long-term maintenance of BIOTA databases and infrastructure, As a first step we suggest the setting aside of a percentage of each project's budget, up-front, for management of program infrastructure to ensure that there is no lack of resources for maintaining the database and to ensure their continued development.

iv. We urge FAPESP to continue to lobby the Brazilian Government to free up laws that currently restrict scientific activities – both with respect to collecting and to the sharing of data and information.

v. Coordenação BIOTA develop a matrix of projects, themes, subjects and sub-themes that would serve as a better way to organize the program's cross-cutting themes. Some could maintain the current thematic order but also provide a richer and more problem-focus that cuts across the current thematics: e.g. sustainable development, modeling, evolution & ecology, conservation, etc. This was recommended in the 5th Evaluation report, but appears not to have been implemented. The current evaluation thus again makes this recommendation.

Introduction

12. As part of its review and quality assurance policy the Biota-FAPESP Program has its achievements evaluated by a committee of independent experts. This report is the sixth evaluation by such a committee.

13. The BIOTA Program has grown dramatically between 2005 and 2008 – however the current web site does not provide statistics on total number of projects and/or researchers involved. This may be something to consider adding to the web site. The project has generated 104,056 records (up from 67,466) in its central SinBiota databank. The speciesLink database has seen a dramatic increase in records linked, but not all of these are from the state of São Paulo or projects associated with Biota-FAPESP. SpeciesLink now links 155 collections and sub collections (up from 41 in 2005) with over 2.7 million records on-line.

14. The introduction of new projects and of the subprogram BIOprospecTA to the BIOTA Program as more projects have been added has led to continuing change in the direction of the Program and to high levels of energy and enthusiasm as new participants come into the program.

15. The evaluation took place in conjunction with the VI. Biota Symposium in Araraquara attended by a large number of students. Nine mini-courses were also conducted. The evaluation was conducted in conjunction with a parallel evaluation of the BIOprospecTA subprogram.

Methodology followed by the Evaluation Committee

16. The evaluation committee spent a brief period examining the BIOTA Program between July 8 and 11 during the VI Symposium of BIOTA and the associated Evaluation meeting.

It established its opinion through:

- attending oral presentations and poster sessions;
- interviews held with members of the Coordenação Biota (Professor Ricardo Rodriguez, Dra Vanderlan Bolzani, Dr Naércio A. Menezes and Dr. Carlos Joly), as well as with project leaders, students and presenters at the symposium
- document material, including a brief description of the current thematic projects and a list of the publications from the whole Program.

- previous evaluations of the Biota-FAPESP Program including the 5th Evaluation prepared by Arthur D. Chapman, Emilio Moran and Robert Verpoorte in 2005.
- A visit to CRIA by one of the committee, where the Informatics core of the project was demonstrated, including SinBiota, SpeciesLink and Flora Braziliensis Revisited
- Studying information offered via the Internet, especially the Biota website, Biota Neotropica, SinBiota, and associated web sites.
- Using personal expertise of committee members and discussions with the evaluators of the BIOprospecTA subprogram, Professor, Gordon Cragg and Professor Robert Verpoorte and Professor Joao Batista Calixto.

17. The Committee endorses the report of the fifth evaluation as it represents a comprehensive analysis of this program and we do not wish to repeat much of what is stated therein. We endorse the comments and recommendations it provides and respectfully suggest that this report be read in conjunction with it. We have reiterated some points, however, that we regard as continuing to be critical to the successful continuance of the BIOTA program.

General Issues

18. As mentioned in previous reports, the Coordination Committee needs to establish a regular rotation to ensure that scientists from a range of communities contribute to the dynamism of the BIOTA program.

19. The committee noted the increased coordination within projects evidenced during the VI Symposium and Evaluation. The poster sessions, in particular showed the integration of projects with their subprojects and highlighted a real strength of the Biota Program which includes its broad multidisciplinary and integrated approach. We did note, however, that the posters presented were largely restricted to those projects being evaluated. We believe that this is a pity, as it would have been beneficial to the evaluators (as well as to the students) to have been able to see a wider range of the Biota projects.

20. The number of current thematic projects presented would appear to be dramatically small, although we were provided with only a subset of the program's projects and this did not include thematic projects that had been finalized. Many of the thematic projects shown were single-taxa studies with limited scope and impact. This is more critical considering that (1) the current budget would appear to allow many more studies to be supported, and (2) a great number of senior scientists within the State remain uninvolved in the BIOTA initiative. We encourage BIOTA, via its coordination, to continue to stimulate new groups to get involved. This is crucial in order to reduce the tremendous gap we have identified in the program scope and scientific coverage.

21. As mentioned in previous reports, we believe it is important that a matrix be developed by Coordenação BIOTA that would serve as a better way to organize the projects into families of projects, and cross-cutting themes. Some could maintain the current thematic order but in addition provide a richer and more problem-oriented focus that cuts across the current thematics: e.g. sustainable development, environmental modeling, evolution & ecology, conservation, etc. We reinforce the need for such a matrix presenting all projects according to major themes and problems. This matrix may offer a big picture of the program and it is a prerequisite for effective long-term planning, evaluation and publicity. It also helps to document

the Program's memory and offer a roadmap for future evaluations. Such a matrix, once prepared, should be placed on the Programs web site.

22. Biota-FAPESP is a comprehensive and ambitious biodiversity program, and we suggest that the Biota Program needs to identify key personnel and capacity needed to attend the themes already being, or intended to be addressed by the Program in the future. This is particularly the case of the biodiversity conservation agenda. The Program would be more proactive and induce universities to build such capacity. International collaborations with top-ranking scientist and teams would also stimulate and improve capacity-building, and help cover gaps (such as in conservation assessment and priority setting) and largely enhance project impacts.

23. The committee notes the increase in international activity such as the integration and coordination with DIVERSITAS and others. This can only help the Program's effectiveness as a program both nationally and internationally. As mentioned in the last report, such international collaboration can later form the basis for international grant applications to support such collaborations, e.g. with the EU-programs for international collaborations. We urge the program to continue with these efforts.

24. As stressed in a number of previous reports, internationalization should be a major goal. Sharing data with the international scientific community will result in more studies by other researchers around the world. This can only increase the value of the efforts already made and be a benefit to Brazil both in the short-term and in the long-term. It is of great concern to the Committee that efforts for Brazil to become a member of the global community, for example through membership of the Global Biodiversity Information Facility (GBIF), seem to be waning. Membership of GBIF would benefit Brazil and especially the Biota project immensely and we urge all Biota participants, FAPESP and the Coordenação BIOTA to strengthen efforts to have the Federal Government take the step of becoming a member of the GBIF community.

25. We also reinforce the need for a closer relationship between the Biota Program and the State and Federal environmental and development agencies in order to directly and quickly inform decision-makers and environmental managers about the Program's major findings and its implications for economic and development planning. An example is the biodiversity priority-area maps which, as an instrument of public policy, is a crucial step in this direction. This relationship is also important for feed-back from policy areas to inform researchers about specific demands that may produce threats to biodiversity conservation brought about by new economic/development initiatives.

Recommendations

vi. We suggest that the Coordenação BIOTA begin to rotate members by having at least two current members rotate out and two new ones rotate in, and that this process take place either annually or biannually.

vii. We encourage BIOTA, via its coordination, to continue to stimulate new groups to get involved in the program. This is crucial in order to reduce the tremendous gap we have identified in the program scope and scientific coverage.

viii. Coordenação BIOTA develop a matrix of projects, themes, subjects and sub-themes that would serve as a better way to organize the program's cross-cutting themes. Some could maintain the current thematic order but also provide a richer and more problem-focus that cuts

across the current thematic: e.g. sustainable development, modeling, evolution & ecology, conservation, etc. This was recommended in the 5th Evaluation report, but appears not to have been implemented. The current evaluation thus again makes this recommendation.

ix. That the BIOTA Program identify key personnel and capacity, needed to attend the themes already being, or intended to be, addressed by the Program. This is particularly the case of the biodiversity conservation agenda. Consideration should also be given to International collaborations with top-ranking scientist and teams which would also stimulate and improve capacity-building, and help cover gaps such as in conservation assessment and priority setting.

x. We encourage the BIOTA program to continue its efforts towards internationalization of the program. In particular, we urge all participants in the BIOTA program (program coordinators, FAPESP and the Coordenação BIOTA) to lobby the Brazilian Government to become a member of the Global Biodiversity Information Facility.

xi. The Biota Program strengthen links between the Program and the State and Federal environmental/development agencies in order to directly and quickly inform decision-makers and environmental managers about the Program's major findings and its implications for economic and development planning.

Project Management

26. Many current and future projects could greatly benefit from better sampling design, increased sampling effort, and robust data-analysis procedures, including the use of multivariate statistical procedures. Current weaknesses in these areas are obvious, and greatly reduce the chance for producing competitive and high-impact papers. These weaknesses appear to be particularly frequent in "hybrid" projects; i.e. those initially conceived to assess biodiversity but that have later incorporated conservation and/or ecological themes. Training on experimental design and data-analysis should be frequently provided to graduate students, pos-docs and even to senior researchers.

27. As a follow on from this, it would also appear that many projects are being developed without considering at the start as to what the question is that the project is trying to answer – i.e. the hypothesis that the project is attempting to address. This should be an adjunct to the aims and goals of the project, and is something that may constantly change throughout the life of the project, but is something that researchers should have in mind at all times in order to keep the project on track.

28. The evaluators were impressed with the improvement in the integrated presentation of posters at the poster session. It is obvious that the sub-projects are working much closer together than was evident at previous evaluations. We did note, however, that the posters presented were largely restricted to those projects being evaluated. We believe that this is a pity, as it would have been beneficial to the evaluators (as well as to the students) to have been able to see a wider range of the Biota projects.

Recommendations

xii. That the Coordenação BIOTA organize regular training courses to address experimental design, data-analysis and statistical methods for graduate students, pos-docs and even senior researchers.

xiii. We would encourage future Symposia to include a broader range of project posters than just those pertaining to projects being evaluated at the associated Evaluation meeting.

Human Dimensions, Conservation and Climate Change

29. A really successful biodiversity program would be expected to comprehensively address topics and themes ranging from biodiversity description and mapping, up to biodiversity use and conservation. As already mentioned in previous evaluations, biodiversity and ecosystem function have been increasingly impacted by human activities throughout the world, and even those portions of biodiversity captured by protected areas have started to dramatically erode in many tropical countries. It appears that the scientific community has already acquired the instruments and the information required to set up some initiatives designed to address the major impacts resulting from human activities such as habitat loss and fragmentation (land-use change), pollution, climate change and human over-exploitation. As the impacts start to be described and predicted, a great demand for solutions naturally grows, opening the field for more applied disciplines involving conservation planning and policy (including economic opportunities for biodiversity conservation), restoration ecology, long-term biodiversity monitoring, ecosystem services, bio-indicators, and others covered by modern conservation science. These disciplines (greatly under represented within the Program) will naturally integrate much of the information (via multi-taxa approaches for example) and capacity generated by the Biota Program; and then be able to generate timely and broad-spectrum guidance for public policies. This is the key new agenda area that this committee believes the program must incorporate after it has started the large (but always endless) task of describing biodiversity.

Please note also the Human Dimensions of Biodiversity and Conservation topic in the fifth report which hinges on this and which we fully endorse. There would be benefit in the program considering the bringing of international expertise to this question either via exchange of personnel, by bringing in an external partner, or by advertising for Post Docs in Australia and elsewhere for someone to work on conservation. Australia is a world leader in the development of software and tools, and we suggest that any such advertisement include the University of Queensland (and in particular the laboratory of Hugh Possingham) in its distribution.

30. As a number of BIOTA projects have achieved a reasonable level of biological description for several taxonomic groups, researchers should be stimulated to proceed with multi-taxa analyses in order to describe consistent patterns of biodiversity distribution and organization across multiple spatial scale, as well as the major impacts caused by human activities on long-term biodiversity persistence and ecosystem functioning. This approach can support perspective and synthesis papers, which are expected to reach a broader audience via publication in more prestigious journals. This sort of information is essential to support effective conservation strategies and provide secure guidance for public policies addressing biodiversity conservation.

31. It was evident from the project that mapped broad-scale conservation priorities across the State that there are major gaps in information for the large majority of landscape fragments. These fragments are critically important in any study of conservation in the State of São Paulo, as for a large proportion of the State these fragments are the only remaining examples of extant native vegetation. This is a key area that will need to be addressed when considering the design and coverage of future projects. It is also obvious that species distribution modeling will need to

be carried out in order to fill many of these gaps and be used in any future detailed conservation planning activities.

32. Climate change was identified in the last report as being an issue that needed to be addressed by the program, but in the projects reports submitted to the evaluation committee this time, there was little mention of climate change and very few projects addressed this issue. We expect that the data obtained from the two projects using the climate towers will feed into future climate change studies and we applaud this aspect of these projects.

Climate change in a globally warming world is a certainty and predicting what those impacts may be on environment and society must be a priority. We urge the committee to revisit the 5th Evaluation report with respect to this issue. For example, the last report suggested that one “obvious project that could be encouraged by the Coordinators of both the BIOTA and Climate Change programs of FAPESP, is one on modeling climate change and the impact of different scenarios on the spatial and temporal distribution of a range of species present in São Paulo and the Neotropics. Associated with this might be focused attention to land use change as an intermediary in these interactions between climate and biodiversity”.

33. Projects integrating and scaling-up from plant behavior to ecosystem functioning and atmosphere performance have a great potential to be replicated across both ecosystems and landscape configurations in order to establish a network for monitoring possible impacts caused by land-use and climate changes. We see this approach as a promising path to modeling future scenarios and their implications for biodiversity conservation, ecosystem services, climate change impacts and sustainable development.

Recommendations

xiv. That the Coordenação BIOTA encourage the development of at least one major thematic grant on broad-scale conservation across all biomes and geographic areas within the State using robust methodologies. We also encourage Coordenação BIOTA to consider bringing international expertise to this question either via exchange of personnel, by bringing in an external partner, or by advertising for Post Docs internationally. Australia is a world leader in the development of software and tools, and we suggest that any such advertisement include the University of Queensland (and in particular the laboratory of Hugh Possingham) in its distribution.

xv. When considering future projects:

a. as mentioned above, high priority should be given to developing a broad-scale multi-disciplinary thematic project on conservation within the State of São Paulo utilizing robust modern techniques and methodologies.

b. high priority should be given to filling gaps in the knowledge base for fragmented landscapes. Careful consideration should be given to project design and coverage to take into account human dimensions and the broader scale conservation aspects of the very important environments;

c. an obvious project that could be encouraged by the Coordinators of both FAPESP programs (BIOTA and the Climate Change and as recommended in the 5th Evaluation Report), is on modeling climate change and the impact of different scenarios on the spatial and temporal distribution of a range of species present in São Paulo and the Neotropics. Associated with this

might be focused attention to land use change as an intermediary in these interactions between climate and biodiversity;

d. integration and scaling-up from plant behavior to ecosystem functioning and atmosphere performance have a great potential to be replicated across both ecosystems and landscape configurations in order to establish a network for monitoring possible impacts caused by land-use and climate changes.

xvi. Where practical, researchers be stimulated to proceed with multi-taxa analyses in order to describe consistent patterns of biodiversity distribution and organization across multiple spatial scale, as well as the major impacts caused by human activities on long-term biodiversity persistence and ecosystem functioning.

Data Basing and Infrastructure

34. The databases being used by the BIOTA Program continue to be world class and have set a standard for dealing with biodiversity information management. Data cleaning and quality control tools that have been developed by CRIA and that are being used by the SinBiota and speciesLink databases are now being adapted for use by the Global Biodiversity Information Facility, and others. Some of the databases developed through the BIOTA program (for example speciesLink) are now expanding beyond the boundaries of the State and becoming major resources for the whole of Brazil. This is a credit to the BIOTA Program and to all involved in the development of these databases.

35. It continues to be essential that the long-term funding of the Program's infrastructure databases such as SinBiota, as well as the e-journal, Biota Neotropica and the programs web site be maintained. These infrastructures are core to the continuance and continued success of the program and are relied upon by all the projects. They are also the Program's public face to the community and researchers throughout the world. It is unproductive to develop such databases and then not to provide funding for the continued maintenance and development as well as the open access, long-term maintenance, archiving and support for the very valuable resource held therein. The data are a major asset of any program such as this, and like all assets require regular maintenance if that asset is to be preserved.

36. The change in infrastructure management that followed on from the last report has not happened as smoothly as it might have. For example, the movement of the SinBiota databases, Biota Neotropica and the program Web page to UNICAMP has not yet been finalized and a gap has occurred where the system is continuing to be maintained by CRIA without the requisite resources. It would appear that this situation could be resolved through a meeting between the Director of FAPESP and the directors of CRIA (and possibly with the proposed new managers). It is not in the interests of the program or of CRIA or UNICAMP for uncertainty in the management of these infrastructure resources to continue as new data are likely not to be adequately incorporated or maintained and thus require considerable effort to later bring them back up to a suitable standard.

37. As the BIOprospecTA databases are developed, it is essential that links be made between them and the SinBiota and SpeciesLink databases established under the BIOTA program.

In many cases the same organism will be referred to in more than one way – a plant or animal collected as part of a bioprospecting activity, should have a voucher specimen or specimens

placed in a museum of herbarium and the information logged into the SinBiota database. Being in a museum or herbarium will mean, also, that it will eventually find its way into one of the speciesLink databases, and as the material is worked up under the BIOprospecTA process, records will be added to the BIOprospecTA database. It is essential that the same organism can be identified in all three databases in a consistent way (for example using a barcode id or something similar). This should be considered at this early stage in the BIOprospecTA database development.

SinBiota

38. In checking data in the SinBiota database recently, one of the evaluators noticed a number of data errors, including a number of geographic errors, for example three records in the Antarctic, one in Africa, etc. It is important that all project participants be mindful of the need for the quality of the information in the SinBiota database to be of the highest level. We understand that the delay in having the databases transferred between CRIA and UNICAMP may be contributing to a lack of maintenance and we urge that this situation be resolved as soon as possible.

SpeciesLink

39. Although speciesLink is now being maintained outside a current FAPESP-Biota project, it still plays an important role in the BIOTA program, and its continued maintenance is no less important than that of the other databases like SinBiota. We urge that its continued upgrading and maintenance be considered by the program and by FAPESP – possibly through an ongoing MOU between FAPESP and CRIA if this is not already the case.

Biota Neotropica

40. The Biota Neotropica e-journal would now appear to have come of age and is recognized as an important journal in the field of biological sciences throughout the Neotropics. It has maintained a consistent high quality and is regarded by many as an example to be followed in the development of e-journals in biodiversity around the world. Only recently, one of the evaluators was involved in an on-line discussion on e-journals and Biota Neotropica was cited as a lead example on using appropriate technologies. We notice the rapid expansion the journal has undergone since the last review (from two to four numbers per year), and the improved output and expansion of the hard copy and pdf outputs. We applaud the program on this initiative and its continued high quality production. We would encourage members of the BIOprospectA subprogram to take advantage of this resource where appropriate.

41. As mentioned in the 5th Evaluation report, we feel that the journal could be further improved by

- applying open access protocols

- adopting on-line submission and review by using technologies such as the Open Journal System (OJS). See for example the Journal of Biodiversity Informatics (<http://jbi.nhm.ku.edu/index.php>). This is probably best undertaken once management responsibility for the journal moves to UNICAMP.

Recommendations

xvii. FAPESP give urgent consideration to the transfer of databases from CRIA to UNICAMP. It would appear to the evaluators that this can only be done through meetings between the Director of FAPESP and the two institutions involved, and should include the drawing up a Memorandum of Understanding with both partners. We also urge that funding be provided for the long-term maintenance of BIOTA databases and infrastructure. We note that an academic cooperation agreement was signed last August has aspects that relate to the long-term maintenance of the databases and infrastructure and we urge all involved to ensure that this is enabled. In addition to those arrangements, we suggest the setting aside of a percentage of each project's budget, up-front, for management of program infrastructure to ensure that there is no lack of resources for maintaining the database and to ensure their continued development.

xviii. That the program ensure that in the design and implementation of the BIOprospecTA databases, that there is appropriate linking between the BIOprospecTA, SinBiota and speciesLink databases so that the one organism can be consistently identified in all three databases.

xix. The issue of quality control of data in the SinBiota database be addressed.

xx. That consideration be given to the long-term maintenance of databases developed through the program, but that are no longer part of an on-going BIOTA project. Although no longer part of an on-going BIOTA project, they remain an integral part of the program and it is essential that they be maintained. As a first step, and if not already done, we suggest that an MOU be drawn up between FAPESP and CRIA for the long-term maintenance of speciesLink and any other databases in a similar position.

xxi. That members of BIOprospecTA subproject be encouraged to publish in the Biota Neotropica journal where appropriate.

xxii. Biota Neotropica be improved through updating to allow for on-line submission and refereeing of articles and to introduce open access protocols.

Other Issues

Gaps in coverage

42. The evaluators noted that a number of gaps had been filled since the last evaluation; however, without a full list of projects, it is difficult for us to determine what gaps still remain. We urge the Coordenação BIOTA to revisit all previous reports to assess remaining gaps in the program coverage. In addition, this evaluation committee were able to identify several gaps that need to be filled:

a) all aspects of landscape fragments and fragmented landscapes.

b) use of robust methodologies for conservation assessment, planning and identification of priorities, study of restoration ecology, long-term biodiversity monitoring, incorporation of ecosystem services, use of bio-indicators, and other aspects covered by modern conservation science.

c) assessment of impacts of global change; including climate change and the human dimensions of change.

d) more integrated approaches, both vertically through taxa, and horizontally across biomes. There were a couple of excellent examples of this in a couple of biomes, but this needs to be extended.

Evaluation Committee

43. In the 5th evaluation report, the Scientific Advisory Committee made several suggestions for future evaluations to better carry out their work. Many of these were not implemented for the current evaluation, and we would like to repeat them here. Because not all members of the evaluation committee have attended previous evaluations, they are at a disadvantage in knowing much of the background of the program and what has gone before. This includes the scope of previous (finalized) projects, aspects of the databases, achievements of the program to date, etc.

44. An early SAC made a recommendation that the Committee be provided with an office for two days following the evaluation meetings to allow the SAC to write up its report. This was not provided for in this evaluation. Not having such a provision has made it extremely difficult for the SAC to work together as a team to write up its report, and prepare for discussions with the Director FAPESP. The provision of such a room should ideally include projection equipment to allow the projection from one computer for discussion by other members of the evaluation panel.

45. As noted previously, the SAC Committee would urge the Coordenação BIOTA to better prepare the SAC members for the meeting by providing (at least one month before the meeting):

- guidelines on what are the tasks to be achieved by the committee
- a one to two page summary of projects with objectives, timing of the project, results, progress made, difficulties encountered, statistics on publications including rejection rates of the journals published in, number of citations in citation index where appropriate, number of records added to SinBiota, etc. Some of this was provided for this evaluation – but not all – for example, none of the projects identified difficulties encountered.
- a proposed timetable asking for approval of the agenda and asking for any suggested changes. The timetable should include scheduled times, both at the beginning of the evaluation and at its end, for the SA Committee to meet with the program coordinators. This is essential and the lack of such an opportunity greatly restricts the ability of the evaluators to carry out their tasks.
- In addition, some time should be set aside for the evaluators to hold discussions with the project coordinators. One suggestion is that this could be done by
 - 15 minute presentations as was done this time, followed by
 - Discussion between evaluators and project coordinators possibly in conjunction with and using the posters
 - Links to relevant web sites (Biota, Biota Neotropica, BIOprespecTA, FAPESP, SinBIOTA etc.), including to the previous SAC reports. This was done for this meeting.

46. Upon arrival the SAC should be scheduled to meet with all members of the Coordenação BIOTA to discuss the schedule for the meetings, review priorities for the review, look at the facilities for the SAC to do its work, and make adjustments in the timetable.

47. A final, wrap up session should be scheduled between the SAC and the Coordenação BIOTA at the end of the meetings with projects to allow the SAC to get clarification of points, to ask questions, and to provide a final opportunity for the Coordinators to share information necessary for the review, before undertaking their two day write up period.

48. The facilities available for the evaluation, and especially the writing up of the report should include privacy, access to the internet, availability of fast printers, and projection equipment, etc. Both evaluating teams at this evaluation found the lack of decent facilities for writing up extremely restrictive. We were given a space in a noisy dining room, under a blaring television and without access to projection or printing facilities or access to the internet. We urge the committee to ensure that the facilities for this part of the process are improved for the next and following evaluations.

Young Investigators

49. We continued to note the benefits accruing to the program of the coupling of the Young Investigator Award with BIOTA projects and we urge that this continue and even be expanded.

Legal Instruments

50. Current conservation laws are restricting scientific research through the difficulties in scientists being able to collect specimens in many areas. Indeed, a search of the speciesLink databases shows that very few collections have been made in many areas over the past five years. This lack of being able to collect is likely to restrict conservation efforts through the lack of data on which to base robust decisions.

51. We suggest to FAPESP that they help alleviate this situation by lobbying government to free up laws that currently restrict scientific activities. It is only in this way that the benefits of Brazil's science will flow back to the country.

52. Also restrictions at the Federal level on sharing and exchanging data and information internationally (for example via the Global Biodiversity Information Facility) are restricting development of Brazilian science. It has been evident during this evaluation that this situation has not improved over the last three years, and we suggest to FAPESP that they continue to lobby government to free up laws that currently restrict scientific activities – both with respect to collecting and to the sharing of data and information. It is only in this way that the benefits of Brazil's science will flow back to the country.

Recommendations

xxiii. We continue to encourage the Coordenação BIOTA to attempt to fill gaps in the program.

We recommend that the committee revisit all previous reports and reconsider the recommendations there on gaps that needed to be filled, as well as looking at the gaps identified in this report – gaps related to conservation, landscape fragmentation, global change and integration.

xxiv. We draw the attention of the Coordenação BIOTA to the recommendations made in this report and the 5th Evaluation Report with respect to the Evaluation and in this report in Paragraphs 43-48, above.

xxv. We urge FAPESP to continue to lobby the Brazilian Government to free up laws that currently restrict scientific activities – both with respect to collecting and to the sharing of data and information.

Conclusions

53. The evaluation committee continues to be highly impressed with the progress made by BIOTA as a scientific program. Several projects are of world-class quality and should allow scientists to become global leaders in the study of biodiversity. We urge FAPESP to continue to support this outstanding research program, and if possible expand it further given its quality, and the urgency of the issues it addresses. The program, moreover, is doing an outstanding job of education and training of a very large cohort of students at undergraduate, graduate, and postdoctoral levels—and through the Young Investigator Program beginning to also impact university faculties.

54. The BIOTA program is a program that is increasingly becoming the envy of other States and Countries in its organization, attention to detail, multi-disciplinary approaches, documentation of results through robust database systems, training of new researchers and integration. We urge it to continue along these paths and to continue along paths towards greater internationalization.

55. As highlighted in the last report, and again this year, there is an urgent need to address the continuing maintenance of the data and databases arising from the project. It is not sufficient to develop such infrastructure and not continue with provisions for their maintenance, otherwise resources already spent became a wasted resource. This means that resources need to be allocated to maintaining full functionality of the databases that are the foundation for all scientists, policy makers at both the State and Federal level, and the public.

56. We congratulate the program and FAPESP on the development of the summary map of conservation priorities within the State and we regard this is a major step forward in integrating results from the program to date and in providing a guide to the State Government on priorities, not only for conservation, but for continued research. The map should be recognized, however, as being just the first step in a long process of developing robust priorities for conservation and environmental protection within the State. Perhaps the greatest contribution the production of this map has made is in highlighting the significant gaps in knowledge that need to be filled (for example, data in the SinBiota and SpeciesLink databases accounted for only about 1% or landscape fragments). These gaps must now provide guidance to the program on deficiencies that need to be addressed as a matter of urgency. It has also highlighted the need to work with new methods for determining priorities in order to overcome these difficulties in the short term, to refine the priorities in the mid-term, and to develop robust solutions for the long-term. This may require working more closely with conservation experts both within the State, more broadly within Brazil, and internationally. We believe that only in this way will the assessments on conservation be made in a timely and robust manner.

57. We thank FAPESP for the opportunity to evaluate the BIOTA program and the Coordenação BIOTA members for their help, candor and time, and the project leaders and participants for their openness and willingness to share their ideas.

REPORT OF THE EVALUATION OF THE
BIOprospecTA program

BY THE SCIENTIFIC ADVISORY COMMITTEE

8 to 12 July 2008

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Summary

- BIOprospecTA has developed rapidly into a major virtual center of excellence of international stature.
- The education of a new generation of multidisciplinary scientists is very successful.
- BIOTA Databases are essential for bioprospecting, and the BIOprospecTA database needs to be linked with this with a longterm perspective of maintaining these databases for future generations.
- A system for IP-protection has been implemented, and the next step that is required is to develop business model for the valorisation of the IP rights
- More in depth projects aimed at developing interesting findings into products for advanced development and commercialization are necessary.
- The sale of extracts from the BIOprospecTA program repository of extracts, subject to a Material Transfer Agreement protecting the rights of the program, should be explored.
- Current national regulations concerning the collection of materials are a serious hurdle, if not a complete block, for valorisation of the sustainable use of biodiversity.
- Further internationalization is required also in connection with valorisation.

NB. The BIOTA Program and the BIOprospecTA subprogram were evaluated separately and separate reports have been prepared. There are aspects, however, in both reports that have import to the other part of the Program and we urge that they be read in conjunction with each other and not simply as separate stand-alone reports.

The two evaluation teams have held a number of joint discussions, and largely agree with the findings of the other team.

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- 1.1 Methodology for the evaluation
- 1.2 Recommendations
- 2.1 Evaluation of the *BIOprospecTA* program
- 2.2 Opportunities
- 2.3 Recommendations
- 3 Open questions

1.1 Methodology for the evaluation

To prepare us for the evaluation, FAPESP sent us extensive information material on the BIOTA and BIOprospecTA programs and the address of the website where further material was available. This reading material provided an excellent introduction for the evaluators to gain an overall view on the activities and how the network functions.

The actual evaluation took place during the week of July 6-12 during which the following events took place:

- 2-days symposium on the occasion of the 10 years jubilee of NuBBE group
- BIOTA-FAPESP Symposium
- Mini-courses and Workshops

The events were hosted by the Faculty of Chemistry of the University of Araraquara.

During the final day of the evaluation the coordinators gave presentations about the progress of the various projects and some young scientists gave short presentations on their projects. The week closed with the BIOTA project coordinator giving an overview on the future plans.

For the evaluation of the Natural Products research the NuBBE symposium and the BIOTA symposium were excellent occasions to get a good, more detailed insight into a number of projects. The BIOTA and the BIOprospecTA parts of the program were presented in separate sessions, which was very helpful as otherwise there would not have been sufficient time for all presentations. The posters presenting the major projects of the program were very useful for discussing details with the scientists involved with these projects.

The symposia provided a unique opportunity to meet with the people behind the projects: MSc-students, PhD-students, postdocs and senior researchers, and thus experience their great enthusiasm and the warm ambiance of the projects. The many young people, both male and female, were full of energy and creativity studying biodiversity, and developing methods for its

exploration for novel products that can benefit the country, as well as benefit mankind. Thus they are contributing to the primary task of science: to make this a better world.

The BIOTA/BIOprospecTA meeting program was well planned, having a good balance between more general lectures and more specific ones on results from the BIOTA and BIOprospecTA projects, with ample time for discussion during the coffee breaks at the posters. A weak point was that during lunchtime and the evening people went to different places, reducing chances for further contacts between the participants. Unfortunately there was no time for a meeting of the advisory board with the coordinators to ask questions and discuss future plans. The posters on the different collaborative projects, however, gave us a good chance to discuss these aspects with some of the scientists of these projects.

The final step in the evaluation procedure for the advisory board was to meet during the weekend to discuss the major conclusions and recommendations.

We did not discuss the individual projects but considered only the total program and its strong and weak points and possible future development.

In conclusion we have been provided with all necessary information in an adequate way, which greatly facilitated our task to evaluate the program.

1.2 Recommendations

- Holding the poster session with review posters of the projects after the general, short oral introductions by the coordinators will give a better chance for interaction with the scientists involved. This could concern specific scientific questions, plans for the future, bottlenecks, etc.
- Holding a final session with all coordinators after the advisory board had the time to prepare a first draft of the report in order to obtain further information about those aspects that raised questions for the advisory board.

2.1 Evaluation of the BIOprospecTA program

Overall impression

The various projects of the BIOprospecTA have only been started recently, but despite this, they have already shown great productivity in terms of results in high quality published papers, patents and output of MSc and PhD-students.

The program contains a number of projects that meet all international standards of very high quality. The advisors are very pleased and impressed with the apparently very successful program!

Presentations

The level of all the contributions on the projects, both oral and posters, was of high quality, and easily matches international scientific standards. Having the posters of all projects was very helpful to obtaining an overview of the different projects and getting a clear picture of all the

collaborations within a project and between projects. This was an excellent complement to the short oral presentations given by the coordinators.

Strong points

- The program brings together quite a large number of scientists from different, but complementary fields. A number of scientists of high international standard are included in the projects and they serve as models for the younger generation of scientists and show them that it is possible in Brazil to meet the highest standards in science if they are prepared to make the efforts needed. These scientists, through their international networks, also have the possibility to help young researchers do internships in renowned laboratories all over the world, and attract scientists from all over the world to come to meetings and give courses in Brazil. This is a major contribution to the internationalization of Brazilian science, helping to improve its international profile, e.g. by having more Brazilians on editorial boards of leading scientific journals.

-The program is able to work like a strong power field that helps to align and direct a large number of researchers to more or less work in a similar direction and collaborate to make optimal use of the available infrastructure and expertise. At the same time it still leaves space for novel ideas and creativity. A coordinated effort on the scale of BIOprospecTA is unique in the world, and could serve as a model for others on how to optimize the research and educational capacity to the benefit of the country.

-The program plays a very important role in educating a new generation of scientists capable of operating in multidisciplinary teams in the field of life sciences with a clear vision on the importance of science for the country and for the people in general. The projects and their researchers are characterized by a very positive attitude and ambiance of friendship, creativity, and intellectual challenges.

-The program is aimed at the exploration of the State's extensive biodiversity, to find novel products, or concepts, that can translate into novel sustainable exploitation through commercial activities, applying the scientific and natural resources of the State to the benefit of the State. At present internationally the keyword for science is valorisation, valorisation of our present knowledge, including traditional knowledge.

-The researchers have been able to patent a number of findings, an important achievement and an absolute must for the success of the bioprospecting program.

-The BIOTA project and its databases are a unique starting point for bioprospecting, and give an excellent framework for finding and collecting materials for further studies aimed at generating potential uses.

Weak points

-The program has only started recently and most research activities concern the screening for novel biologically active products. However, organisms, enzymes, proteins and genes are also targets for novel applications in some of the projects. To be able to systematically screen the

biodiversity at random or based on ethnobotanical information, small scale collection of material is necessary, which in no way has any impact on the ecosystems, or carries risks of extinction of species. However, the present national legislation is a major administrative hurdle for such collections, and due to the ongoing destruction of the ecosystems, many species will be lost before being studied for any potential interesting applications.

-The program has already generated a series of patents on promising products. These patents should eventually generate funds for the project, as well as funds for the State. However, a mechanism to explore commercialization of the patents is not yet in place. A business development agency or unit with experience on the global market would be useful in this context.

-The process of developing a novel product from biodiversity is like a funnel, in which from many organisms, step by step, the most promising one(s) are selected. The extreme of this is found in drug development where in industry screening of an estimated number of 100,000 compounds results finally in one single novel medicine. Each step in this process adds value to the organism, and to the compound, but at the same time at a certain point the compound, and thus the organism may lose interest, e.g. due to toxicity of the compound. It should be noted, however, that failure at this stage does not mean that the compound or organisms loses all value. With the development of new screens, "old" compounds may be shown to have valuable new activities. Proper storage of the data as well as of the extracts and compounds is thus of great importance for future datamining. In this process step by step the assays become more complex, starting with a simple screening assay, ending in clinical trials. The costs for each step increase with the complexity of the tests. This requires that at a certain point external partners need to be found to further develop the product, in other words going from more R to the D in R&D. So far the program is mostly still in the R-phase, but one should consider how to come to the D-phase to valorize the research results. In this connection clear selection criteria should also be set up as to what should be considered as an active compound based on the concentration at which activity is found. . FAPESP and Bioprospecta program should make efforts to incorporate other recognised scientists of several biological fields (pharmacology, physiology, biochemistry, molecular biology, etc), necessary to investigate the mechanism of action of the most interesting substances. This is a critical point to add values to these substances and for future partnership with industries. Structure activity relationships and other (pharmaceutical) parameters of interest for the further development (e.g. toxicity) should be considered in case of the development of a biologically active compound. In the case of other applications of e.g. genes and proteins, novelty and other factors related to possible applications should be defined as selection criteria. This should avoid wasting time and money on products lacking sufficient promise.

-We found that in an excellent project, recently a project application was rejected based on review reports that encouraged the applicant to develop independent projects instead of working in the BIOprospecTA program. Though we do not know the details, we see the problem to some extent. Young promising researchers should make their own choices, develop their own careers, and should thus have their own projects and find funding for this. However, we believe that the broad scope of the BIOprospecTA program is such that for all individual researchers there is sufficient space to develop their own projects within the program. The complexity of finding novel products is such that it requires close collaboration between many researchers.

Particularly the in depth bioassays and further development of products should offer great opportunities for individual projects with the BIOprospecTA cadre.

-Knowledge of the lingua franca of science, English, is still a problem at the student level. More attention to English reading, writing and speaking in the education of MSc-and PhD-students would be important for internationalization of the program.

2.2 Opportunities

Much of the program is now focused on the discovery of high value molecules, such as medicines, crop protectants, cosmetics, etc. There are also interesting projects aiming at the discovery of industrial useful enzymes for bioconversion and genes for molecular biological applications. Looking at the challenges of the coming years there are several areas that could be of interest for the BIOprospecTa program:

- **local diseases** (e.g. dengue) and other neglected diseases that are spreading among the population due to climatic changes. The BIOprospecTA program is already screening for a number of local diseases. Further development of these lines of research to advance from hits to actual leads should be of paramount interest.

- **need for biofuels** The program could contribute in many ways, e.g. by finding novel plants or microorganisms that could be used for the production of biofuel, or improving existing production plant systems by screening varieties for improved production, resistance, etc, thus identifying candidates for breeding programs. Also on the level of processing, the program could contribute by the search for e.g. enzymes that could increase amounts of carbohydrates available for fermentation, or that alter fatty acid contents of oils.

- **requirements for increased and improved food production.** By understanding plant resistance against pest and diseases one may develop more resistant plants by classical breeding or genetic modification, that would require less use of agrochemicals and may have higher yields.

All these opportunities require natural products chemistry and biochemistry as major fields of expertise, i.e. the expertise that is now encompassed in the BIOprospecTA program, and which particularly in close collaboration with BIOTA can have a major impact in taking a lead in these fields internationally. In part already several projects are working in the relation to these topics.

2.3 Recommendations

- A scheme showing the complete network of projects, including names of coordinators and project leaders would be useful.

- Further efforts aimed at making the BIOTA and BIOprospecTA programs internationally known should have high priority; it would be of great help for the valorisation of the projects, by attracting interest of potential international users of information from the program.

- The strength of the program is the BIOTA as a platform for bioprospecting; maintaining and further improving this link will be of utmost priority. The databases are the core of the projects; to assure longterm success, these have to be kept updated and include the state-of-the-art technologies. The databases must be the responsibility of an independent organization which has a longterm commitment for such an important task (e.g. comparable with the organisations responsible for databanks with gene and protein sequences). The databases will be the platform from which the bioprospecting can be organized in a systematic way, a platform which will allow datamining and thus avoid unnecessary duplication of work and may lead to novel concepts about relationships between organisms. The databases may also be part of the valorisation of the acquired knowledge by making certain information commercially available.

- A model for commercializing patents by selling them or out licensing should be developed. It requires a network of contacts with all possible users, nationally and internationally and standard contracts for benefit sharing for negotiation with interested partners. Contracts for insight into the results of the program before publication and first right of refusal, could be of interest in this connection as well.

The possibilities of using an external business development agency or organizing a business development unit in the program should be considered.

- As the BIOprospecTA program expands, a valuable bank of extracts will be established. Mechanisms for selling (or providing) these extracts to external organizations for testing in new screens should be explored. Such distribution should be subject to recipients signing a Material Transfer Agreement guaranteeing the rights of the BIOprospecTA program in terms of collaboration, compensation and benefit sharing in the development of promising discoveries which advance through preclinical and clinical studies to possible commercialization. This could be based on the model used by the US National Cancer Institute.

- To develop a model for valorisation of the project results a small workshop with representatives of local industry and some international companies (e.g. pharmaceuticals, cosmetics, food, flavour and fragrances) would be important for finding a business model to generate funds for the bioprospecting work of BIOprospecTA.

- For valorisation of the research it will be necessary to include or develop more advanced pharmacology, toxicology and molecular biologists for promising compounds coming out of the primary screening which is used in the program. In case such expertise is not available in the State, this could be accomplished through collaboration with qualified groups in Brazil or internationally.

- Clear selection criteria should be set up for selection of products for further study, e.g. what should be considered as an active compound, i.e. the concentration at which an activity is found. This would avoid waste of money on products with little promise for development.

- Young scientists should be encouraged to make applications that particularly go into the depth of the present projects. Too much spreading into more superficial projects staying in the screening phase should be avoided.

- Novel project applications should make clear how they fit into the BIOprospecTA program, and referees should also comment on added value of a project for the total program. Maybe the Scientific advisory board could play a role in this respect.

-More attention to including English reading, writing and speaking in the education of MSc-and PhD-students would be important for internationalization of the program as well.

3 Open questions

There is still concern about the Databases of the projects. Particularly the longterm maintenance, and linking the natural products projects to BIOTA database, is not clear to the advisory board. The status of the BIOprospecTA database was not discussed with the project coordinators. In our view a Database with all available extracts and their measured activities for more rapid identification of interesting extracts for further testing is an absolute must for the program. Such a database with different levels of access to keep information confidential in connection with patent rights is necessary to avoid redundancies in the research. A proper link with the BIOTA database is absolutely necessary to have all metadata on all collected and studied materials.