

**REPORT OF THE 4th EVALUATION
OF THE BIOTA-FAPESP PROGRAM
BY THE SCIENTIFIC ADVISORY COMMITTEE**

08 to 17 December 2003

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Hotel Panorama, Água de Lindóia– 08 to 17 December 2003**

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Objectives of Biota

Biota is a program established to provide the scientific basis:

- to inventory and to characterize the biodiversity of the State of São Paulo;
- to define the mechanisms for conservation of biodiversity; and
- to explore the economic development and sustainable use of biodiversity.

Introduction

1. As part of its review and quality assurance policy the FAPESP-Biota Program has its achievements evaluated by an international committee of independent experts. This report is the fourth review by such a committee.
2. The Biota Program currently encompasses 46 projects in 37 themes, some 400 researchers and an equal number of students working at about 30 institutes and organizations throughout the State of São Paulo. The project has generated 38,000 records in its central SinBiota databank, and links to 12 distributed databases via *speciesLink*.
3. The introduction of new projects and the subprogram REDEBIO to the Biota program as many original projects are completed, has meant an apparent subtle change of direction of the Program as it matures towards this, its 5th year of operation. This course correction, achieved during an internal review, was taken into account by the Committee.
4. The evaluation took place simultaneous with the Biota Symposium in Água de Lindóia, visited by 276 participants of which 90 participated in mini courses.

Methodology of the Evaluation Committee

5. The evaluation committee has only been able to spend a brief period examining the Biota Program. It established its opinion through:
 - Visiting meetings in Água de Lindóia from 8 till 13 December consisting of:
 - presentation of the results of running projects
 - presentation of the results of the internal evaluation
 - poster session presented to the meeting by both the students and project leaders
 - presentation of the new and continuing projects accepted since the last evaluation meeting in 2001
 - Interviews were held with the members of the Coordenação Biota (Professor Carlos A. Joly (Program Leader), Dr Vanderlei Perez Canhos, Dr Naercio A. Menezes, Dr Luiz Antonio Martinelli, project leaders students and presenters of the talks.
 - A visit to CRIA, where the Informatics core of the project was demonstrated (SinBiota, SpeciesLink).
 - Studying information offered on the web, and on the Biota CD-ROM.
 - Examining and discussing various aspects of the program in the light of previous evaluations, recommendations and goals set out by Biota at the start of the program.
 - Placing its findings in a context of international endeavors with respect to other biodiversity projects.
 - Using personal expertise of committee members.
6. Due to time constraints no site visits could be made. The Committee is confident that a fair and objective opinion of the Biota Program was formed.
7. Apart from its observations, the Committee has formulated a number of recommendations. The Committee wishes to emphasize that not all of these recommendations have to be carried out immediately but need to be prioritized by the Coordenação Biota and implemented over a period. It is important the original scope of the program is maintained.

FAPESP-Biota Coordination

8. As mentioned in the 3rd SAC report, the Biota Program is a complex program and has provided a number of challenges to FAPESP that it may not have previously faced with its other programs. This 4th SA Committee notes that a number of the recommendations made in the 3rd SAC report have now been implemented. These include providing the Coordenação Biota with the opportunity of seeing the final project proposals, and this has led to a major advancement of the program. There are, however, a number of coordination issues that still need resolving or that need continual assessing. These include the relationships between FAPESP Biota and Biological Sciences Programs. There continues to be some overlap between projects within these two Programs. It is important for the long-term aims of the Biota Program that projects funded under these or other biodiversity programs, continue to be brought under the broad umbrella of the Biota Program with the approval of the Coordenação Biota.
9. The Committee notes that coordination between FAPESP and the Coordenação Biota has improved considerably in the two years since the last report. There is a need for this to continue and for ongoing review of the coordination relationships between the two committees. This will be particularly important during the next phase of the Biota Program with likely changes to membership of both the Coordenação Biota and FAPESP Directorate.
10. The Committee was given some details of the initiation of the REDEBIO sub-program of Biota to deal with bioprospecting and related aspects of the Biota Program. This is a major initiative and one that we commend highly. We believe that this initiative will be a very important one for the State of São Paulo and for Brazil as a whole. It is likely that this program could become partly self-funding in the long-term as products from the projects are commercialized. It is also pleasing to see that some of the profits from the REDEBIO projects will be applied to conservation and restoration operations within the State. This is a unique and exciting initiative, and one that can only benefit the long-term conservation of biodiversity in the region.
11. One area of concern is the issue of bringing high quality works to publication – monographs with lots of coloured illustrations, education materials, etc. This is elaborated below under the section on Public Education and Outreach. The Biota program requires coordination of funding and support for the increasing number of high quality publications. It is extremely difficult, and usually not productive, for individual projects to have to seek this type of support for their publications. FAPESP, with its connections to industry is probably in the best position to seek some form of sponsorship for the totality of publications that arise from the Project. This could be done through FAPESP itself, or through the hiring of an outside agent somewhat akin to how sporting organizations obtain sponsorship for sporting teams.
12. In an earlier SAC evaluation, a recommendation was made for the inclusion of some Young Researcher Fellowships within the Biota Program. We note with pleasure that there are now two such researchers included in the program, and the projects introduced to us were of extremely high quality. See comments under Capacity Building below. We commend FAPESP on this initiative, and believe it will reap long-term benefits from it.
13. Since the last evaluation where an increase in Membership of the Coordenação Biota was recommended, the committee numbers have been increased from 4 to 5. Consideration now needs to be given to beginning to rotate membership, with a sufficient period of overlap, so that there is new blood and new ideas coming on to the committee on a regular basis.

We continue to recommend from previous reports:

- i. *Coordenação Biota set minimum specific targets for the levels of co-ordination between thematic projects running separately. (Not done)*
- ii. *FAPESP fund a full-time program co-ordinator to work within the Biota program to liaise with project leaders to secure the agreed set of target coordination goals. (Not done).*
- iii. *FAPESP facilitate improved liaison between the directors of the Biota and Biological Sciences Programs to create a proper balance between these two programs. (Some progress – requires continuance)*
- iv. *Discretionary funds be made available each year to the Director for targeted repair, linkage and co-ordination actions. After discussion with Coordenação Biota and the Program Coordinator, up to 4 assistants could be placed by the Director in particular project centers. (No progress)*

We recommend that:

- v. *Consideration be given to regular rotation of membership of the Coordenação Biota with at least one member being rotated each year. This should not restrict any member to a maximum period.*

Biota Coordination

Sociology of the project

14. The Biota Program is a multidisciplinary enterprise encompassing 46 projects carried out in a great many different institutes across the state, involving a significant part of the State's available human resources (some 400 researchers and 400 students). Optimal collaboration and cost effective use of the financial resources means continuous attention by the coordination committee is needed for the interaction and participation of Biota members.
15. In particular the participants of the new projects need to be made to feel part of the 'Biota family' to secure sufficient transfer of the program's spirit, aims and sharing of knowledge. This will maintain and further enhance the integration between the themes and the subprojects, and between finished and new projects. One way to achieve this is to ensure participation of all participants in the entire symposium, not only to their specific project themes. Students should be stimulated to briefly present their findings to their peers, to be able to exchange information and forge cross-project partnerships.
16. Between the annual evaluations, regular sectorial meetings (e.g. freshwater, marine, ethnobiology, conservation) as well as targeted training courses of a longer duration could be considered as a means to share and transfer knowledge, ensure project integration and corporate identity. A newsletter, or news flashes with summarized findings on the Biota website would assist in sharing information internally as well as help with outreach.
17. Entering data into SinBiota needs to be made a continuing part of the Biota culture and it is important that the new projects are well aware of this. It would be ideal if there were a map of the geographic boundaries of all projects on SinBiota: (a) to help new projects to quickly find out what projects are in their area, and (b) to be part of justification within project submission. Similarly this could be done with the taxa covered. Additionally the

web Biota page could have a graphic database 'growth indicator' to reward those who enter data.

We recommended that:

- vi. *The Coordenação Biota maintain and strengthen the sociology and corporate identity of the Biota project to ensure a smooth continuation and transfer of spirit from finished to new projects and to closely guard the integration between the program parts.*
- vii. *Annual program-wide evaluation meetings be continued where all participants are present as well as run more targeted open sectorial meetings (on subprojects and cross cutting issues) and training courses. We recommend that every third year, the evaluation be an internal evaluation, with an external evaluation on the other two years.*
- viii. *That a newsletter, or news item page on the web site be instituted whereby participants can submit news items etc, from their projects. An open discussion forum may also be beneficial.*
- ix. *Stimulate data entry in SinBiota. The web page should include a map showing the geographic boundaries of current and past projects.*

Collaboration and cohesion amongst Biota projects: achievements

18. The Coordenação Biota has made good progress in encouraging linkages between projects. The Committee encourages Biota to continue expanding cohesion among projects in view of the above-mentioned sociology.
19. The Committee took note that a number of the recommendations from the previous evaluation were followed up or are in the process of being followed up. Some recommendations need continued attention.

We continue to recommend from previous reports:

- x. *Linkages were made among related (running) projects but attention is required to tie in with new projects.*
- xi. *Some gaps identified in taxonomic coverage were filled but will further filling in will need a long term policy in the Biota Program. The Internal Evaluation identified geographic gaps that need attention.*
- xii. *The promotion of data standards and methods for sampling and site selection need further attention.*
- xiii. *In addition to workshops on cross cutting issues, meetings between BIOTA and NGO's with respect to outreach, products are required.*
- xiv. *Progress was made with integration into SinBiota of data from projects arising under other FAPESP Programs, and other State programs, that are related to the Biota objectives. More integration is desired (especially with respect to the Public Policies Program).*

Program Balance

20. The Committee applauds the emergence of Biota as one of the premier biodiversity science programs in the world. As with any program that attempts to be comprehensive in scope, there will be inevitable gaps in the knowledge base due to unequal coverage of taxa, habitats and regions. The Committee wishes to acknowledge the excellent activities of the Coordenação Biota in encouraging and soliciting projects and in filling a number of the gaps.
21. The Committee wishes to state at the outset that while we mention a number of the gaps below, caution must be exercised in attempting to add additional projects. The Coordenação Biota must be judicious in expanding the program so that the core strengths are not lost or the Biota Program does not become too diffuse.
22. One issue that emerged from the Biota Evaluation Meeting was that some of the gaps are currently being filled by research that is currently not included in the Biota Program. For example, while information on fungi comprises an important gap, there are no current or pending fungi proposals, despite much research activity. We suggest that the Coordenação Biota meet with representatives of the fungal community as well as other well-known scientific communities to: i) explain the importance and goals of the Biota Program; ii) learn why these groups are not participating; and iii) solicit their participation in the Biota Program.
23. Of the priorities that were recognized by both Coordenação Biota and the Committee in the past, we would like to acknowledge that progress has been made as follows:
 - a) Invertebrates: one study underway
 - b) Birds: one pre-proposal submitted
 - c) Higher plants: two funded projects and many others now bringing data on plant morphology, genetics, phenology, ontogeny, etc.
 - d) abiotic characteristics of ecosystems (e.g. sediments in freshwater, marine and terrestrial systems): several funded projects
 - e) the human dimension of biodiversity (e.g. cultural and social aspects): several funded proposals
 - f) marine organisms and ecosystems, <45 m depth: several funded projects.
24. The following represent important gaps that should be included over time:
 - a) soil organisms (e.g., bacteria, nematodes, earthworms, crustacean, soil arthropods)
 - b) fungi
 - c) Arthropod groups: Coleoptera, Homoptera and Hemiptera
 - d) terrestrial Mollusca
 - e) secondary, regenerating and planted forests
 - f) marine organisms and ecosystems >45 m
 - g) aquatic micro-organisms.
25. Much of the ongoing research in Biota has focused on relatively pristine areas of the State, including old-growth forests, conservation reserves and marine reserves. Although excellent progress has been made with projects in both freshwater and terrestrial habitats, it is important to continue to include studies that include less pristine, degraded and agricultural habitats. These will become even more valuable as baselines for relatively pristine habitats become known and studies on regeneration and extractive values in less-pristine areas become more advanced.
26. Though many projects include conservation as one of their major foci (see conservation section below), more studies need to be added on sustainable development. This could be

accomplished from either the solicitation of new proposals or adding new modules to existing projects.

We recommend that:

- xv. *The Coordenação Biota develop a strategy to fill in the knowledge base gaps that are listed above. The plan should add new projects without increasing the diffusion of the Biota Program or losing its core strengths (e.g., inventories).*
- xvi. *The Coordenação Biota should seek the inclusion and participation of select scientific communities, such as the fungal community, to fill in some of the gaps of the program; and set priorities for the order in which those gaps may be filled with projects beginning in the next 2-5 years.*
- xvii. *As more projects are added to the Biota Program it is critical to maintain a high level of integration among the projects and among the sites that are selected for study.*
- xviii. *Core programs such as, inventories, the human dimensions of biodiversity and conservation programs should continue to be solicited and funded.*

Future Planning

- 27. The success of Biota will be judged by progress towards the three programmatic goals and the integration among them. To remain on track, Biota should establish achievable targets and develop strategies for achieving them; establish criteria for monitoring their success; and establish criteria for addition or modification of projects within the context of the entire program. This was aided by an internal evaluation meeting last year. The Committee found the evaluative summaries and suggestions for future planning to be excellent; we concur with the recommendations. Further, the Committee acknowledges that the Coordenação Biota procured successful proposals for marine systems, on sustainable use and on economic aspects of biodiversity. These had been identified as priorities in the last evaluation report.
- 28. An important issue that must be dealt with in this phase of the Biota Program is integration of current and impending projects. This integration is both thematic and regional. The Committee found that a number of the projects dealing with human dimensions of biodiversity and sustainable use had overlapping themes but were largely unaware of the each other's particular definitions or methodologies.
- 29. The potential for integrating information or concentrating studies from many taxonomic or intellectual disciplines in a common geographic region is a missing element. This would enable both scientists and managers to develop a complete picture for a region and stimulate thinking on methods for integrating information into synthetic environmental descriptions. Suggestions include:
 - a) ensuring that both the project pre-proposal and proposal include a section in which the potential project coordinator must state explicitly how the project integrates with other studies (by science and region);
 - b) encouraging investigators to undertake studies in critical regions or across critical habitats as determined by the Coordenação Biota
 - c) undertaking one or more multidisciplinary studies across a terrestrial transect or a watershed, perhaps using one of the rapid assessment protocols (e.g., AquaRAP)

We recommend that:

- xix. *the Coordenação Biota continue to establish a strategy for developing the Biota program, and setting criteria for determining priorities with a clear statement of expected time frames for each of the Biota objectives.*
- xx. *the applications for pre-proposals and proposals require explicit statements of how the proposed research project will integrate thematically and geographically with former and current Biota projects.*
- xxi. *the Coordenação Biota should be proactive with project solicitations and project design to stimulate more integrative research, such as multi-disciplinary assessments.*

Capacity Building of Students and Professionals

- 30. A critical element of the Biota Program is building the capacity of researchers within São Paulo State at all levels of training to carry out world quality research on biodiversity and the environment. The Committee applauds the accomplishments of the program in this area. Evidence for this may be found in the excellent quality of the students (both graduate and undergraduate), and young or senior investigators. Clearly the number and quality of the data, theses and publications (n=351 in total) deriving from Biota projects serves as testament to the capacity building of the Biota Program. Currently there are more than 800 people (400 researchers and 400 students) involved in Biota programs.
- 31. The Biota Program can continue to enhance the educational and professional development of participants. It is crucial that personnel continue their professional development at all educational or professional levels throughout their careers. We address capacity building in three separate categories: (i) student career development, (ii) young investigators, and (iii) the Biota Symposium, mini-courses and workshops.

Student Career Development

- 32. The Committee applauds the achievements made by the Biota program in the training of students through individual projects, short courses and the annual symposia. Through discussions with individuals and examination of the work of the students (poster presentations, etc.) we have been impressed by the high quality, enthusiasm and knowledge of the students.
- 33. We note again this year that the Biota program should develop cross-training opportunities for students in other projects, and develop specific training in management and related skills. Students that have access to a broader range of techniques and skills in biodiversity sciences through exposure to different projects are likely to become scientists with broader and with integrated approaches.
- 34. Students should be strongly encouraged to attend annual meetings of the Biota Program. The Coordenação Biota and the coordinator of the annual meetings have done a great job of arranging good venues that have offered affordable prices for the students and professionals alike. The responsibility of ensuring student attendance really rests with their professors and project leaders who should do all possible to ensure that their students attend the annual meetings.
- 35. Students would like to participate in sessions of the Biota or evaluation meetings that address long-term accomplishments and directions of the Biota Program. They have also requested that they attend sessions that deal with the integration among projects within

the Biota Program. The sessions in which the goals, accomplishments, gaps and evaluation of the five main areas of the Biota Program should have students as well as the current project personnel in attendance.

36. The students would also benefit from increasing involvement with policy makers, environmental managers and environmental lawyers. The students mentioned that they would like very much to hear a presentation from a politician about how the research and data from the Biota Program could feed into conservation initiatives at governmental levels.

Young investigators

37. The coupling of the Young Investigator Award with Biota projects has been extraordinarily beneficial and should be developed further. The excellent research being carried out by Drs. Lilian Casatti and Adriano Melo demonstrate the success of such a coupling. We have little doubt that the future employability of these researchers will be greatly enhanced from the experiences provided from the combination of these programs. We encourage increasing the number of Young Investigator Awards with Biota projects to increase the number of highly trained young investigators that will then enter the university ranks.
38. Other programs that would increase the number of post-doctoral participants or young investigators with independent projects should also be initiated. Furthermore, programs that encourage international exchange of post-docs to acquire skills that are necessary for Biota projects should also be developed.

Biota Symposium, Mini-courses and Workshops

39. Almost all of the students and some of the former presenters of mini-courses agreed that changes are necessary. Currently, the mini-courses are too short (4 hrs) and try to address too many educational levels to be as effective as they could be. Beginning students have found the mini-courses present too much information too quickly while advanced students have found the mini-courses to be too dilute. Meetings could be rearranged easily to accommodate mini-courses of 6-9 hrs without difficulty.
40. A number of workshops are needed that will provide standard, and in some cases novel, methodologies for the analysis and interpretation of data generated in the Biota Program. The workshops that have been identified so far include statistical analysis of spatial patterns, use of informatics database products, environmental modeling and reserve selection methodologies. These workshops will also allow for professional development of graduate students, young investigators and professors.
41. We note that the external evaluators have the willingness and would be appropriate to present either mini-courses or workshops. This should be left to the discretion of the Coordenação Biota.
42. The symposia at the annual Biota meetings have increased in both quality and relevance to the Biota program through the years. We applaud these developments and encourage the Coordenação Biota to continue integrating the symposia with the projects and goals of the Biota Program.
43. The posters at the annual Biota meetings serve important functions for both the team making the projects and for the participants in general. For the team members, it forces all of the sub-projects to integrate their results with each other and to participate in the

formulation of overall conclusions. We recommend that the posters be also put on the Biota web site.

We continue to recommend from previous reports that:

- xxii. *through intensive field courses, develop the breadth of natural history knowledge among students or junior researchers. This could be accomplished with a program of rotation through different projects for short periods. (small amount of progress here, more needed to be done)*
- xxiii. *Institute a management training course of 1-2 weeks for Biota students that may include*
 - *Program management*
 - *Grant and report writing*
 - *Staff and contract management*
 - *Ethics*
 - *Legislative environment*
- xxiv. *(There is now a 3 day course in Campinas to train students in entering museum data. Similar courses need to be introduced to cover other themes, and be held in other parts of the State).*
- xxv. *FAPESP increase the number of Young Investigators posts and allow them to be linked with Biota Projects. (Three have been implemented and needs to be continued)*
- xxvi. *The Young Investigator or Biota programs encourage applications using partnership arrangements in order to stimulate activities in areas or with groups not presently covered by Biota researchers. (Being done, needs to be continued).*
- xxvii. *Coordenação Biota identify 'young star performers' and encourage them to take roles within the program and/or to make further applications to develop their research. (Being done, needs to be continued).*
- xxviii. *We further recommend that:*
- xxix. *Mini-courses, symposia and sessions of the annual meetings be modified and workshops be implemented, in order to contribute to the professional development of students, young investigators and professors as follows:*
- xxx. *Mini-courses should be of longer duration, given separately for beginning and advanced students*
- xxxi. *Allow and encourage students to attend evaluation reports of the Biota Program*
- xxxii. *Continue to increase integration of symposia with Biota projects*
- xxxiii. *Implement workshops for graduate students, post-docs, young investigators and professors on topics such as statistical analysis of spatial patterns, bioinformatics, environmental modeling and conservation selection.*

- xxxiv. *Programs be developed to allow post-docs, young investigators and professors to study with scientists, national or international, that have expertise needed for projects in the Biota Program (e.g., reserve selection with Dr. C. Margules in Australia).*

Dissemination of Results, Public education and Outreach, Internationalization

Dissemination of Results

44. The Committee finds output of the Biota program highly satisfactorily. The Internal Review lists 351 publications in the “Publications Database” generated from the first 5 years research. Most of these are scientifically oriented, but handbooks, field guides and newspaper articles are also listed.
45. From interviews and the internal review it became clear that financing the publication of handbooks and field guides, and large (taxonomic) monographs is a bottleneck. This is an issue that needs immediate attention of the Coordenação Biota and FAPESP. Compact disc media (e.g. CD, DVD) should be considered for publishing large monographs. This is accepted under the zoological code for publication of new species. They present a low cost alternative that allows for inclusion of (nearly) unlimited multimedia materials (images, videos, sound recordings). Softwares (e.g. Linnaeus II, LUCID, DELTA, etc.) to accommodate the publication and dissemination of such ‘e-monographs’ on compact disc or in the web environment are available in the public domain. Special numbers of the e-journal, Biota Neotropica could also be considered where this is appropriate. (See also Biodiversity Informatics).
46. Biota Neotropica has developed into an international journal with an international board and provides a suitable platform and cost-effective electronic outlet for publications. The Committee suggests that scientists of the Biota program be encouraged to also publish their research papers in other international, peer reviewed, scientific journals. This will enhance the visibility of their work.
47. An on-line newsletter should be considered to improve communication in the large Biota science community. The newsletter should include findings, progress in the various subprojects, achievements, and discussion of cross-cutting issues. Several scientist and students suggested such a forum to the committee. The newsletter could include a news flash service on the Biota web pages.

Public Education and Outreach

48. The Committee is impressed by the various projects’ use of scientific output for public awareness and appreciation of the habitats and organisms of the São Paulo State. The video production aired on TV (Série Biota) is a major achievement in public education. The development of high quality handbooks and field guides and their distribution into public, educational, and commercial arenas is expanding. Next year a photographic exhibition (potentially travelling) has been planned that will use the excellent images collected by the projects. Some projects exemplify great public outreach. Of special mention is the Underwater Interpretative Trail with so far 1000 people using it – amazing! The Cerrado project is producing posters, post cards and bookmarks, and the marine project will soon publish some excellent guide books.
49. The respective roles of FAPESP, the Coordenação Biota and researchers in the financing of communication products for education, tourism and the general public were not clear. The area of public education and outreach will benefit from public-private partnership,

sponsorship and consultation. As previously mentioned, the support of FAPESP is essential in the seeking sponsorship for expensive publications.

50. Scientific information that is generated by the projects needs translating into products that can be used in schools and fit into the educational curriculum. Writing clear, understandable messages for education and for the general public, is a profession in itself. For the development and production of such products there are advantages to using professionals and external organizations who are specifically trained in this area.
51. Activities by the FAPESP to obtain sponsorship for the publication of handbooks, and the development of outreach products are necessary for the Biota Program to fulfil its public outreach goals.
52. There is an opportunity for the Biota program to develop student assistantships for public outreach. Students enlisted as 'teachers' could become the basis for natural history tours to areas such as the Mata Atlantica and Cerrado parks or reserves within São Paulo State. This would contribute directly to both conservation and the training of students.

Internationalization: visibility and collaboration

53. The evaluation committee established that the Biota Program is unique in its set up, comprehensive in scope and with a broad platform of institutes and human resources. To the Committee's best knowledge there currently are no other biodiversity programs like it in the world. The Coordenação Biota and FAPESP should consider increasing national and international outreach to ascertain better visibility of the Biota Program outside the State of São Paulo. This will benefit the scientists involved as well as the world community, who will learn from the Biota experience.
54. The learning curve with respect to the informatics component of Biota is of particular interest to the Global Biodiversity Informatics Facility (GBIF). Documentation of the experiences in setting up SinBiota and *speciesLink* would form a valuable document for the GBIF Country Nodes who are attempting similar tasks (see also Biodiversity Informatics).
55. Another form of international outreach that will be of benefit to the now well-established Biota project is to seek or enhance links with other biodiversity programs outside Brazil (e.g., international ones such as GBIF, ENBI, Species2000, IABIN). In particular, collaboration with programs that may result in matching funds for Biota, and the exchange of students or professionals with foreign scientists should be investigated (see also Capacity Building).

We recommend that:

- xxxv. *Alternative, low cost, media such as CD-ROM and Biota Neotropica be considered for publishing large articles and monographs with large amounts of illustrative materials, using software tools and services that are available in the public domain.*
- xxxvi. *The publishing of large monographs as special numbers of Biota Neotropica with additional distribution by CD, DVD, be considered.*
- xxxvii. *Public-private partnerships, sponsorship and consultancy are considered for developing and outputting products in the area of Public Education and Outreach.*

- xxxviii. *FAPESP actively seek sponsorship for the publication of handbooks, and development of outreach products to help the Biota Program to fulfill its public outreach goals.*
- xxxix. *There be collaboration with State and National Park administrations to develop intensive training courses for local natural history guides and to make use of student assistantships to improve trail systems that maximize access to both characteristic and unusual habitats or organisms, especially old-growth forest.*
- xl. *Support be granted for additional projects within Biota for developing a master plan on ecotourism for São Paulo. This should include travel to other states and/or countries to learn more about their experiences and techniques, with the objective of developing improved ecotourism.*
- xli. *The Coordenação Biota and FAPESP increase national and international publicity to assure better visibility of Biota and enhance links with other biodiversity programs outside Brazil, in particular those that may result in matching funds for Biota or exchange with foreign scientists.*

Biodiversity Informatics

- 56. The Biota Program has introduced a number of exciting and innovate informatics projects into its scope in order to deal with the massive information being generated by the Biota projects. These include AtlasBiota, SinBiota, etc. and are significant contributors to the integration of projects and information, as well as to the dissemination of information to the public and researchers. More recently, we have seen the inclusion of *speciesLink* with links to Species Analyst and these continue to be world-leading in both their development and implementation. The projects are now beginning to incorporate the massive legacy of data held in museums and herbaria, as well as in large private collections. This means that centuries of historic data, with appropriate cleaning and preparation, can be integrated with new data being generated by the Biota programs.
- 57. The *speciesLink* project has already received attention from the Global Biodiversity Information Facility (GBIF) and the coordinators have recently been asked to write a case study of the project as an example for other projects around the world. The participants in the project have been heavily involved in assisting in the development of international standards, and in developing the open-source software for use by other institutions. This is a significant contribution to world biodiversity informatics and continues to increase the profile of Biota internationally.
- 58. Participants in many of the Biota projects, as well as the internal review, identified Biota informatics initiatives as being core to the whole program. A number of people stressed the necessity for them to continue and to be funded in some core way to ensure their continuity (see under Infrastructure). Many believed, that without this core infrastructure, the project would not be able to continue.
- 59. The *speciesLink* project has highlighted the need for more digitization of important collections, and the bringing of these collections online. So far, only about 200,000 collections out of an estimated 7 million have been digitized. Along with the support needed for infrastructure mentioned elsewhere in this report, support for the digitization of these very important collections should not be ignored.
- 60. The informatics projects have now accumulated a significant amount of data and information, and this is likely to increase many-fold as new projects come on line and

existing projects are completed. Consideration now needs to be given to the long-term storage and archiving of this information.

61. Issues that need to be considered with further enhancements of SinBiota include improved interfaces for public, educators and students; improved metadata, and inclusion of a method of indicating the current completeness or level of certainty of each piece of data, including the use of appropriate caveats on maps, etc.
62. It is obvious that a number of projects are developing their own multimedia databases, computer assisted keys, etc. Good public domain software already exists for carrying out these tasks. We believe it is not productive for projects to continue to develop their own software. We suggest that the Coordenação Biota encourage the adoption of existing software, and organise a workshop or training courses on existing alternatives. Some of the available software may also assist in the integration of information within projects and in the dissemination and publication of results (both electronically and in hard copy). Some (e.g. LUCID, Linnaeus) are character-based databases, and would be valuable tools for incorporating, storing, and integrating the information developed within many of the projects.
63. One area of increasing concern is the ability to store information about absences. Some of the better modelling software requires absence information to accurately predict likely occurrences. However, very few databases are able to store this type of information. At least one project mentioned that they were beginning to collect absence information and SinBiota may need further development.

We continue to recommend from previous reports that:

- xl.ii. Each database include a clearly displayed version number or edition number and date (Not done yet).*
- xl.iii. Each database have an agreed system of acknowledging contributors, collaborators and employees. These issues need to be addressed at an early stage to avoid disputes at a later stage. All contributors, including employees and collaborators, should clarify the terms and conditions on which they contribute to all database and other products. (Some progress has been made, but more needs to be done).*

We further recommend that:

- xl.iv. As SinBiota develops, consideration be given to improving user interfaces to better present information to the public, educators and students.*
- xl.v. Consideration be given to the inclusion of some form of completeness indicator or indicator of degree of certainty on records within the SinBiota database and which feeds into caveats on the maps.*
- xl.vi. Consideration be given to including provision for absence data in SinBiota.*
- xl.vii. Coordenação Biota encourage projects to adopt existing multimedia, character-based, and computer-assisted key generation software where appropriate rather than develop their own and that Coordenação Biota institute training courses and/or workshops on these for the information of project participants.*

- xlvi. Consideration be given to developing and/or expanding a 'software links' site on the SinBiota website for linking to appropriate museum/herbarium databasing software, multimedia software, computer-assisted key generation software, data standards, etc.

Infrastructure

64. The successful implementation of the Biota Program requires significant infrastructure in the form of collections of natural history and other relevant materials (e.g., recordings, images, etc.). Without these collections and collections institutions the capacity for undertaking biodiversity research and providing information to the public and policy makers would diminish dramatically. It is therefore, critical that the infrastructure for biodiversity research resources develop international standards that are designed to protect biodiversity resources for perpetuity. While FAPESP has provided important help to museum collections and institutions in the past, we note that many collections and collection facilities need funding for physical and environmental facilities to protect their specimens. This is crucial for collections that contain type specimens or specimen/objects that are unique in the world. We encourage new programs to support collection's facilities in order to protect these invaluable resources for the long term.
65. The objectives of the Biota Program include bringing information of the various collections into a distributed database (*speciesLink*) and into SinBiota. The successful accomplishment of this objective requires more than the digitization of specimen information. It also requires, geocoding of the data, error checking and, in many cases, labelling. The current staff dealing with collections are insufficient to accomplish the task on a scale that is required by the Biota Program. More technicians and student-technician positions are urgently required. We encourage FAPESP to develop longer term funding strategies to accomplish these goals. It may be that existing programs within FAPESP (e.g., TT4, TT5) can be modified to accommodate some of these needs.
66. Within the State of São Paulo there are a number of special collections that require immediate attention. These include, but are not limited to the pollinating bee-collection of J.M. Camargo (USP-Ribeirão-Preto) and the bird-song collection of J. Veillard (UNICAMP). These are both unique resources. For example, the song bird collection contains the only recordings of species that have gone extinct in São Paulo State and in other parts of Brazil and includes around 25,000 magnetic tapes that urgently need digitizing before they deteriorate beyond repair. For a variety of reasons, proposals that have been submitted to curate, preserve and informaticize these collections have not met with good reception in the reviewer community. We urge a broader view and that FAPESP consider positively the attempts to protect these threatened resources before unique and critical information is lost.
67. The biodiversity research resources as well as informaticized collections information are in the national interest as well as in the interest for the State of São Paulo. It may be possible for FAPESP to seek a partnership with the national government to provide long-term funding or to seek international funding (e.g. through GEF) to accomplish the goals.
68. SinBiota is a magnificent and important product and is fundamental to the Biota Program. It is fundamental because it brings all of the data and information together from the projects of the Biota Program. It must be realized that computer service projects such as SinBiota cannot remain stagnant – that is once developed then completed. SinBiota has two completely different aspects that make it both a vital and usable resource for the Biota Program. The first is that it requires continued maintenance to keep pace with the range of operating systems, user interfaces, web browser developments, etc. The second is that SinBiota has maintained itself at the leading edge of biodiversity technologies

because of continued development, addition of tools and mapping services. We see maintenance of SinBiota as a cost that should properly be paid for by the Biota funded projects through line items in their budgets at a fixed rate relative to the size of project budget (this rather than through a payment from the technical contingency funds which should not be altered). FAPESP should also continue to allow the developers of SinBiota to submit fundable projects through the Biota Program for their world-leading activities.

69. An important area of the Biota Program involves projects that are developing, and will continue to develop, germ plasm facilities for plants. The activities among the projects should be coordinated and thought given to an official germ plasm facility. This may require a separate proposal but thought must be given to the long-term maintenance of germ plasm lines as they are being developed by current and future projects.
70. An important way to support the infrastructural needs of biodiversity research in the State of S. Paulo would be to establish a subprogram of Biota to include elements that are contained in the above paragraphs. Such a subprogram would also have important benefits in linking museums and collections institutes into virtual museums that will enhance coordination of products, resources and investigators.

We recommend that:

- xlix. *FAPESP develop, and initiate a long-term strategy and funding program, to support the physical facilities, informaticization, and additional technical personnel to protect biodiversity collections in the State of São Paulo for perpetuity and to bring their crucial information on line. This strategy should be formulated with leaders from the collections community.*
 - i. *Attempts should be made to enjoin the federal government as a partner for long term funding of collections facility, personnel and informaticization proposals.*
 - ii. *FAPESP develop programs to train and hire technicians and students to aid in the informaticization of collections information without penalizing their future educations.*
 - iii. *FAPESP solicit Biota projects to protect and to informaticize special collections of biodiversity research, such as the pollinating-bee and song-bird collections. FAPESP and the Coordenação Biota must recognize the unique and critical value of these and some other collections and overrule conflict in the reviewer community.*
 - liii. *SinBiota should receive funding from FAPESP in two distinct ways:*
 - i. *projects pay maintenance costs from a line item in the budgets of projects*
 - ii. *proposals for continued development of SinBiota.*
 - liv. *It is crucial to hold a meeting to plan for the infrastructure and costs of long-term maintenance of germ plasm resources for the State of São Paulo.*
 - lv. *The Coordenação Biota and FAPESP give strong consideration to establishing a new sub-program within Biota to support the infrastructural needs of the Biota Program. These infrastructural needs include collection facilities, database and informatic projects (including the personnel). These are the core of the Biota Program.*

Conservation and Sustainable Development

71. At present, all Biota projects are required to have a conservation aspect within the project. This is an excellent initiative, however, it does mean that most conservation issues are being looked at in isolation. The Committee believes that it is now time to consider a much broader view of conservation and reserve selection across the State.

71. Following the 1997 workshop in Serra Negra, a number of thematic books were produced that summarized the then state of knowledge as far as conservation was concerned in the State of São Paulo. Since then, a lot of new information has been gathered through the work of the Biota projects. Much of this has been concentrated in small areas and this is valuable for setting regional conservation priorities. The Coordenação Biota has recently begun to integrate, the information arising from combined projects at a regional level (e.g. Estação Ecológica Juréia-Itatins: meio físico, flora e fauna).

72. It was obvious from the presentations of projects that many projects were wrestling with the problem of the selection of methods for conservation-priority setting and a number of presenters called for some sort of standardization. This was also an issue raised in the internal review report.

73. The Committee believes that there is now enough information available to begin a preliminary assessment of conservation priorities across the whole State. Robust conservation and reserve-selection methodologies exist for carrying out these assessments at the scale of the State of São Paulo. Initial studies have been carried out using some of these (e.g. in the Cerrado), and a core of people with some expertise in their use exists. There are number of things that the Committee believes needs to be done. These include the development of a cross-cutting conservation project (somewhat parallel to the informatics project) to carry out an integrated conservation priority/reserve selection exercise for the State. We believe that this project should include researchers involved with running the software, representatives from as many projects as possible, policy and state environmental decision makers, NGOs, and representatives of rural and indigenous communities.

74. There is also a need for some form of reserve/conservation priority selection training within the State. Many of the techniques being used around the world were developed in Australia, and there may be some advantage in either bringing one or two of the developers from Australia to Brazil to run a series of workshops, or else supporting one or two researchers from here to go to there to study the techniques. Such workshops and training would also need to cover topics such as biodiversity surrogates and use of indicators.

75. The Committee believes that there are also advantages in standardizing methodologies, where appropriate, for conservation priority selection within projects. However, there needs to continue to be some flexibility as no one method is appropriate in all circumstances or at all scales.

We recommend that:

- lvi. Coordenação Biota and FAPESP consider the development of a cross-cutting project to look at coordinated conservation-priority setting across the State of São Paulo. Such a project should include policy, environmental decision makers, NGOs, and representatives of rural and indigenous communities in addition to project scientists.*

- lvii. *Coordenação Biota and FAPESP consider either running a workshop on conservation/reserve priority setting with invited international participants, or supporting the placement of one or two researchers with appropriate specialists overseas for a period of time in order to learn appropriate methodologies.*

Conclusions

76. The science in most Biota projects is of high quality equivalent or exceeding to that in other countries, and in several projects it is of outstanding quality at the cutting edge of international efforts. In many respects the Biota program provides an example and sets standards that many countries would be happy to follow. We would respectfully suggest that there may be benefit in the Brazilian Federal Government looking at the Biota Program as an example and possible template for a similar National Program covering all regions of Brazil.
77. 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.