INTERNATIONAL BARCODE OF LIFE PROJECT (iBOL)
INTERNATIONAL CONSORTIUM INITIATIVE (ICI)
INTERIM REVIEW WRITTEN REPORT FORM

ASSESSMENT

1. RESEARCH PROGRESS

Progress against the original research plan is assessed as:

[X]	Excellent	[ ]	Good	[ ]	Satisfactory	[ ]	Not Satisfactory

Please provide comments to justify your assessment. If there are significant variances in the progress of specific components of the ICI, provide specific comments by sub-project or activity while taking into account factors such as the:

- level of funding received to date;
- duration of the funding period;
- problems encountered;
- progress relative to other research groups working on similar projects; and,
- research team's responsiveness to advances in the field and/or availability of new technologies since the project's inception.

After a challenging start, iBOL has kicked into high gear and has made significant, impressive, and rapid progress with regards to the most important deliverables: (1) the number of barcode records in BOLD, both in terms of specimen and species (BINs); (2) the taxonomic and geographic representation of barcoded species, and the representation within major areas of emphasis; and (3) the transfer of data and collaboration with Genbank and therefore the general accessibility of barcode data. This has been facilitated by logistical progress as well as wide-ranging international collaborations that involve contributions from many countries and the processing of specimens from international collaborators in Guelph. CCDB is the major contributor of records now, and its share of the total contribution of barcodes into the databases is expected to grow further. According to the progress report, there were more than 50,000 species (BINs?) barcoded in the first 18 months. On March 3rd, BOLD showed a total of 96,080 "formally described species" with barcodes, with 83% of the specimen sequences having been generated in Canada.

Data warehousing, accessibility, and usefulness of the barcode data have been enhanced by informatic advances developed by the BOLD team. These include species' individual web pages, APIs to download data, establishment of the BIN framework, the genbank collaboration, and mirroring of BOLD.

Thus, Theme 1 and Theme 3, arguably the nuts and bolts of iBOL and the focus of the bulk of the funds, have succeeded, and indications are that they will continue to deliver in the future.

Progress in the other two scientific themes, 2, "Methods", and 4, "Applications", is a bit harder to assess and appears to have been slightly spottier.

There are three subthemes that are tasked with generating new barcodes. Biota barcoding at the Churchill site has progressed nicely (though note the cautionary comments below), as has museum collection barcoding. The plan to expand international outreach to museums is sensible and will tap into well-documented sources of material, and more biota barcoding at international sites is to be encouraged as well. Paleobarcoding seems not to have progressed much, which perhaps reflects the considerable technical expertise and investment, and the operational specialization, that is required when ancient DNA is processed.

The “Methods” working group has a diverse set of tasks. The “Forensic/Troubleshooting” unit for example seems to be tasked with both developing new primer sets for difficult groups as well as dealing with degraded samples. Dissemination of operating procedures to other sites is also in the purview of this working group, as is cost lowering. Progress by this working group is hard to quantify but it seems to serve essential tasks, so I would leave it as is.

Integration of next generation sequencing has been attempted with 454. While the exploration of newer technologies is laudable, I found the extent of the foray to be the most disappointing aspect of the progress report. I think the iBOL team should get more creative about harnessing next generation technologies. Long reads per se are not absolutely necessary in principle to get full coverage of a region. My concern is motivated by the fact that a single run of an Illumina HiSeq would provide such massive sequence coverage that all barcoding would be done! (This is a ridiculously naïve viewpoint that would be difficult to achieve right away, but I am making the point: The potential cost savings of utilizing Illumina technology and outsourcing the sequencing would be so massive, even over 454, that such avenues should be explored.)

Mobile barcoding as a mission should be struck entirely from the project. I understand that people might get excited about a hand-held (or otherwise mobile) device to “read barcodes” but the metaphor belies the technological complexities of developing such a device. The statement in the progress report (page 60) that “There is no serious technological barrier” to develop a portable device is naïve at best. The portable devices referred to are merely DNA sequencers. Upstream lab work and downstream computes do not reside in the same instruments and technology development is still a long way away from accomplishing that. When and if tech companies develop such platforms the iBOL project should evaluate them immediately upon release (see my comments above about NGS approaches).

2. CHANGES TO THE RESEARCH PLAN

If significant changes to the research plan have been made or are proposed for the future, what is your assessment of these changes?

[X]	Recommended as proposed	[ ]	Recommended with modifications	[ ]	Not recommended

Please provide comments to justify your recommendation. Provide details of any modifications or additional changes that you would recommend.
There are no changes to the research plan that obviously violate the spirit or substance of the original proposal. To the extent that changes are proposed, they reflect the necessary adjustments in response to a learning period. They include relatively modest adjustments to the target numbers (e.g., downward adjustment for vertebrates, and upward adjustment in terrestrial organisms), or the renaming of Theme 4 from "Technology" to "Applications" while the substance of the Theme remained mostly intact.

3. GE^{3}LS

The project leaders were asked to identify the ethical, environmental, economic, legal and social aspects (GE^{3}LS) arising from their proposed research and to develop and implement a plan to address them.

The progress towards achieving the goals of the GE^{3}LS subproject is assessed as:

[ ]	Excellent	[X]	Good	[ ]	Satisfactory	[ ]	Not Satisfactory	[ ]	N/A

Please provide comments to justify your assessment including comments on the progress towards achieving the GE^{3}LS milestones and the research team in place. Please take into account factors such as the level of funding received to date, duration of the funding period and problems encountered.
I am grateful for the reviews provided, as I am not an expert in GELS issues. That said, given the international scope of the project, I appreciate the importance of studying and ascertaining, for example, the origin of samples (endangered species, collection in protected areas, etc) and the impact on and involvement of native cultures. And given the fairly high profile nature of the project, studying the educational benefits will also be important. I am less sure about the importance of making barcoding a model for international trade, or why barcoding carries significant intellectual property issues; (isn't the information supposed to be free of such entanglements, in order to benefit science and society?). Activities 1 and 4 seem most valuable and most closely related to iBOL's goals and procedures. I cannot say that I am enthusiastic about the other activities, but that may reflect my lack of background in those areas.

4. ABILITY TO ACHIEVE THE OVERALL OBJECTIVES

Is the research team likely to achieve the overall objectives of the project?

[X] Very likely [ ] Possibly [ ] Unlikely

Please provide comments to justify your response. In cases where you identify issues that would prevent the team from meeting their objectives, please state the issues and where possible, propose solutions.
I am confident that the initial vision in terms of "deliverables" laid out in the original proposal will be accomplished. (See section 1. above.) Whether barcoding will really have the wide-ranging impact that is hoped for will remain to be seen, and will develop over the course of the next years, perhaps decades. At the very least barcoding will have been an important and needed bookkeeping and taxonomic exercise that benefits species science. (And I do think it will go well beyond that.)

5. BENEFITS FOR CANADA

Based on progress to date and the future plans, please assess whether the anticipated results of the research are likely to, a) contribute to job creation and economic growth in Canada, b) social benefits c) improvements in the quality of life, health, and/or the environment, and d) contribute to the creation of new policies in these areas. If commercialization is proposed, please comment on the strategy for IP management and ownership, technology transfer and benefit sharing.

The progress towards realizing the Benefits for Canada is assessed as:

[X] Excellent [ ] Good [ ] Satisfactory [ ] Not Satisfactory

Please provide comments to justify your assessment. Have any opportunities been missed?
I am not involved in any large-scale international efforts myself and so I may be easily impressed, but I have to say that the degree to which the iBOL project has catalyzed, enabled, and driven the international scope of this effort is truly impressive. This is really a Canadian signature project and I think Genome Canada should be proud of being primary supporters of this project. I do not know whether the project has resulted in much economic growth, but this being science, this should not be held against iBOL. Social benefits will be realized if iBOL continues to pursue education and outreach. Improvements in the quality of life will be realized downstream, in the applications of barcoding to global species diversity research and preservation.

6. GOVERNANCE & MANAGEMENT

Are the established governance and management plans, processes, and structures appropriate and effective?

[X] Yes [ ] Remediable Concerns [ ] No

Please provide comments to justify your assessment including comments on the: • governance and management structures and processes; • decision-making processes – do these ensure that critical decisions about the research direction can be made and provide the ability to respond to unanticipated difficulties? • effectiveness of communication mechanisms within the project.
iBOL has attracted an impressive list of directors and scientific advisors and is engaging them actively. As judged by the supplied meeting reports, the meetings have been productive in addressing all aspects of the barcoding project, from GE3LS to Science. Given the massively international nature of the project, and the potential for having an uphill cat-herding battle with so many distinct groups involved, the iBOL leadership must be credited with supplying a project vision that produces results at the projected rate and across many national and regional nodes.

7. HANDLING OF SCIENTIFIC DATA & RESOURCES

Are the plans for handling scientific data and sharing of data and resources created by the project appropriate and effective?

[X] Yes [ ] Remediable Concerns [ ] No

Please provide comments to justify your assessment and, where appropriate, make suggestions for the improvement of the plans.
The final committee consensus report on the application, from Nov 2008, cited “a number of significant concerns” regarding data release. Two stood out in particular, that not enough records had been released at the time, and that QA/QC steps were preventing timely data release. The rate at which data have been made available in recent months has increased substantially and so, judging from these ‘results’, these two issues seem to have been mostly resolved. It will be important to see that the still substantial gap between GenBank records and BOLD records narrows further in the next few months, and for the duration of the project. This should be accomplished by further streamlining the QC efforts, which appear to have been largely automated at this point. BOLD, the iBOL data repository, now contains barcodes from more than a million specimens and just south of 100,000 species (BINs). The data transfer to GenBank (in this reviewer’s opinion the most important data management issue) is now working smoothly after considerable effort by both parties. Deserving of special mention is the idea, and its implementation, by the iBOL team to place specimen sequences into BINs. BINs are clusters of closely related sequences, allowing iBOL researchers to generate a single record for specimens that likely belong to the same species without getting into the thorny issue of whether they really belong to the same species, and also sidestepping the pitfalls of classification that are inherent in the genetic structure of populations. iBOL thus makes no pretense that it has the definitive answer as to whether specimens belong to the same species, and leaves that ultimate determination to the experts and further research. I would encourage iBOL to make BINs work beyond animals, for plants, protists, and fungi as well.

8. TRAINING, RECRUITMENT AND PROFESSIONAL DEVELOPMENT

Has the project team been and/or will they continue to be successful in training, recruiting, and professional development of highly qualified personnel?

[ ] Yes [X] Remediable Concerns [ ] No

Provide comments to justify your assessment and, where appropriate, suggest possible new approaches. Please comment on the responses to any challenges faced to date.
Section 8 in the original proposal, “Training Programs”, mentioned an optimistic expansion of the ranks of Masters and PhD students. (“At present, 10 graduate students are working at BIO and their ranks will increase dramatically during iBOL …”). It appears that, as of the writing of the progress report, no PhD students and nine Masters students are enrolled. This should be addressed in the future by critically asking whether there is a place for PhD work in what is essentially evolving into a production effort. It may be more appropriate to train Masters students and focus on the vocational aspects of the work. It would also be beneficial to explain directly and specifically how the degree-granting programs of the University of Guelph are interacting with iBOL. The iBOL program to involve visiting scholars and scientists to learn barcoding work is very active, with thousands of species barcoded by the visitors. This is clearly a point of strength, although, from a 10,000-foot perspective, it is really an iBOL/CBOL collaborative point that would fit equally well into the “Benefit for Canada” category.

9. PUBLIC OUTREACH & COMMUNICATION ACTIVITIES

Do the activities that have been undertaken or are planned ensure that the research is communicated to the public and other interested parties?

[ ]	Yes	[X]	Remediable Concerns	[ ]	No

Please provide comments to justify your assessment and, where appropriate, make suggestions for improvement.
The director of Media and Communications, John Chenery, developed a communications strategy presumably some time in 2009. It is reprinted in Appendix III. The strategy paper clearly lays out the opportunities for iBOL in communicating its efforts to a wide range of audiences, diagnoses some of the challenges, and serves as a blueprint for how to use specific communications tools (the web site, forums, newsletters, etc) to engage a diversity of target audiences. The progress report, while mentioning the strategy paper, falls somewhat short of clearly enumerating what has been accomplished in this area since the strategy paper was conceived, and does not specifically reference the goals laid out in the strategy paper. A planned evaluation in November 2010 is mentioned and it would have been great to see those results (but perhaps it was after the progress report deadline).

It would be important in my opinion to distinguish between outreach to the lay public, and outreach to scientists, preferably with more fine-grained distinctions within these two categories. The strategy paper does a nice job with that, but the progress report's table IX.1 lumps everything together with no classification as to what the target audience was, but with a seemingly strong skew towards expert audiences. This leaves the undesirable impression that outreach to the non-expert public has not been as successful as it could have been.

Some progress has been made, such as the release of newsletters, engagement of the media, update of the web site, etc. These efforts are to be applauded.

10. FINANCIAL

Is the research progress commensurate with how funds have been spent to date?

[X] Yes [ ] Remediable Concerns [ ] No

Please provide comments to justify your response. Include comments on the following:

- whether explanations for budget variances are reasonable in the context of research progress to date;
- the level of success in securing co-funding from other sources;
- if there is a co-funding shortfall, suggest alternate sources of co-funding and comment on how the shortfall will impact the research.

I did not see glaring red flags. A project of this scope will necessarily have some adjustments. To the extent that I can evaluate the report, the variances that do exist seem to be explained sufficiently, although I did not quite understand the complications with the international contributions. I trust that Genome Canada will follow up with anything that seems out of the ordinary.

11. Progress towards addressing the issues raised at the time of the initial ICI review

[X] Excellent [ ] Good [ ] Satisfactory [ ] Not Satisfactory

Please comment specifically on the progress towards addressing the issues that were raised by the Expert Committee at the initial review listed below: • the resolution of outstanding management, budget and co-funding issues; • the revision of the GE^{3}LS component of the proposal; • the establishment of a Technology Development Advisory Group (TDAG) and a Science Advisory Board (SAB); • the implementation of a quality control/quality assurance monitoring system; and, • the resolution of outstanding issues with the public release of data in the ***International Nucleotide Sequence Database Collaboration (INSDC);***
All of these issues have been addressed satisfactorily in my opinion.

OVERALL RECOMMENDATION

[X] Further funding for the ICI is recommended

[ ] Further funding for the ICI is recommended with modifications

[ ] Further funding for the ICI is not recommended

Please provide a brief summary of the status of the project and a justification for your recommendation. Where issues have been identified, state whether these are major or minor, what actions should be taken (e.g., activities that should be reduced, abandoned or strengthened), alternate approaches to be considered and avenues to strengthen the project.
I am very enthusiastic about the progress that has been achieved. iBOL is producing barcodes at the targeted rate, within budget, and are making them available to the international community. This is what matters, and this is the main metric on which progress should be evaluated. Benefits to science and society will materialize in future.