RAPPORT FINAL (EXTRAIT)

Effects of climate change on Quebec biodiversity

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au nom de l'équipe de recherche:

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Au
Conseil de recherches en sciences naturelles et en génie du Canada

et
Ouranos inc.

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Public Summary of Outcomes and Benefits to Canada

The goal of the project was to draw an overall picture of the impacts of climate change on Quebec biodiversity (past, current, future). Its main challenge was to bring together experts from various disciplines, backgrounds, and professional traditions. This included naturalists, climatologists, biologists, modelers, academic researchers, graduate students, researchers from provincial ministries, and members from non-governmental organizations. Another challenge was to gather large datasets that had never been analyzed jointly, especially data on climate and on the distribution of species from several taxonomic groups.

From the perspective of the non-government and government partners, the key achievements of the project have been:

- To establish the first working group in Quebec about the effects of climate change on Quebec biodiversity. Many collaborators to the project are now considered experts on the ecological impacts of climate change and have become a strong source of knowledge and expertise within their organization.

- To establish a cohort of highly qualified personnel (ten graduate students) specialized into the effects of climate change on biodiversity. This is a strong benefit to partners, as shown by the fact that the first graduates of the project have been hired by the partners.

- To generate an overall view of the likely effects of climate change on Quebec biodiversity. Although many unknowns remain, this overall view holds that a strong reorganization of biodiversity in now underway in the province of Quebec due to climate change. One key element of this general picture is that climate change is inducing a shift in the range of many species. This now questions some basic principles of biodiversity conservation in Quebec and calls for adaptation strategies and more detailed research in some areas such as biodiversity monitoring, invasive species, and protected areas.

The achievements have translated into benefits for Canadians:

- The project provided a first assessment of the potential impacts of climate change on Quebec biodiversity, and this knowledge is now used by the Quebec government to work on the design of adaptation strategies to climate change in the field of biodiversity conservation (e.g. network of provincial parks). Results from the project were also disseminated directly to the public (magazine articles, radio interviews, Tv documentaries) so that Canadians are now better informed on this important subject.

REPORT ON PROGRESS

Brief description of the overall objectives of the grant as awarded

The overall objective of the project was to predict the potential effects of climate change on the distribution and abundance of a large range of plant and animal species from Quebec. We had three specific objectives:

(1) to evaluate how phenology (the timing of biological events) and species distributions have been affected by recent climate change;

(2) to construct ecological niche models for a wide array of plant and animal species including trees, other vascular plants, amphibians, beaver, and birds;

(3) based on the output from the first and second steps, to zoom in on the species and regions within Quebec that are expected to be most heavily impacted by climate change, and to develop regional strategies of biodiversity conservation that incorporate potential climatic threats.

We had planned to reach these objectives through recruitment of eight graduate students and a research assistant, and through intense exchanges of information (meetings, reports, and website) between researchers and supporting organizations.

Description of the progress made towards these objectives as a result of the grant (30 September 2007 to 30 September 2011)

The table below presents the milestones indicated in our proposal for the period covered by this report, together with their current status. Numbers in the status column refer to details that appear below the table.

Milestone	Description of activities	Starting date	Completion date	Status
Recruitment of grad students	Announcement of projects to recruit graduate students; selection of the candidates to start 1 January 2008	2007-10-01	2007-12-20	Done (**1**)
Updating methodological details before kick-off workshop	Review of scientific progress since application was written; planning of logistic details regarding access to databases	2007-10-15	2007-10-31	Done (**2**)
First (kick-off) workshop	Preparation of kick-off workshop to review project objectives, discuss logistic details, and confirm partners main needs	2007-10-15	2007-11-30	Done (**3**)
Web site published	Preparation of the web site describing the background and goals of	2008-01-05	2008-04-30	Done (**4**)

	the project			
Building plant database	Collection of the data from herbaria	2007-10-01	2008-04-30	Done (**5)**
First projections available	Modeling of the beaver dataset using BIOMOD and Bayesian statistics	2007-10-01	2008-02-20	Done (**6)**
First annual workshop	Preparation and hosting of the first annual project workshop to discuss first results, first applications	2008-08-01	2008-10-01	Done (**3)**
Web site updated	Updating the web site with first results of the project	2009-01-05	2009-04-30	In progress (**4)**
Graduation of PhD 4	Writing up of thesis by PhD 4 student and graduation	2008-06-01	2009-04-30	Done (**7)**
Climate envelope models generated	Modeling species distribution and abundance	2009-01-01	2009-12-10	Done (**8)**
Projections generated	Projecting species distribution and abundance	2010-01-01	2010-07-01	Done (**9)**
Reporting to NSERC in second year of the project	Preparation of the mid-term report of the project	2009-04-01	2009-06-20	Done **(10)**
Graduation of MSc 1 and 2	Writing up of theses by MSc 1 and 2 students and graduation of these students	2009-10-01	2010-04-30	Done **(11)**
Second annual workshop	Preparation of second annual project workshop to discuss results, main applications, and plan activities of year 3	2009-08-01	2009-10-01	Done **(3)**
Web site updated	Updating the web site with results of the project	2010-01-05	2010-04-30	In progress **(4)**
Final reporting	Preparation of the report for the final year of the project	2010-11-01	2011-03-31	Done **(12)**
Graduation of MSc3 and PhD1, 2, and 3	Writing up of theses by MSc 3 and all PhD students of the project and graduation of these students	2010-11-01	2011-05-30	In progress **(13)**
Web site updated with final results	Updating the web site with final results of the project	2010-11-01	2011-03-01	In progress **(4)**
Atlas of climate change effects distributed	Preparation of Atlas of climate change effects	2010-11-01	2011-04-01	In progress **(14)**

Final project conference	Preparation and hosting of a conference to present/discuss results of the project and consequences for strategies of adaptation to climate change regarding biodiversity conservation. Naturalists from a larger public invited.	2010-11-05	2011-04-30	In progress **(15)**
Researchers give seminars to partners' staff	Co-applicants and graduate students visit staff from the supporting organizations to give seminars and help interpreting results	2010-11-05	2010-12-20	Done

(1) We have been very successful at recruiting Highly Qualified Personnel (n = 2 research assistants, 1 postdoc, 4 PhD, 7 MSc, 2 BSc), as shown in the following table (italics indicate university, supervisor, and co-supervisor when applicable).

Name	**Short project description**	**Starting date**	**Completion date**
• Jason Samson (PhD) *McGill*, Humphries-Berteaux	Determinants of beaver abundance across spatial scales and in a warmer climate	2004-09	2011-05
• Blache Paul Akpoue (PhD) *U de M*, Angers	Bayesian modeling of changes in the ecological niche induced by the global warming	2007-09	2011-09
• Volker Bahn (Postdoc) *McGill*, McGill	Building climate envelope models for Quebec birds	2007-10	2008-09
• Laura Boisvert-March (BSc) *McGill*, DeBlois	Construction and management of a plant database	2008-05	2008-12
• Dominic Chambers (MSc) *McGill*, DeBlois, McGill	Projecting the response of tree species in Quebec to climate change at regional scale	2008-05	2011-11
• Chantal Gagnon (BSc) *McGill*, DeBlois	Construction of a plant database	2008-05	2008-08
• Richard Feldman (PhD) *McGill*, McGill	Modeling future changes in bird abundances due to climate change	2009-10	2010-11
• Beatriz Osorio Rodriguez (MSc) *McGill*, DeBlois, Vescovi	Environmental assessment and biodiversity in a changing climate: perspectives and challenges	2008-05	2009-04
• Frieda Beauregard (PhD) *McGill*,	Predictions of habitat shifts induced by climate change in	2008-09	2012-12

DeBlois	Quebec plants		
• Chantal Gagnon (BSc) *McGill*, DeBlois	Contributions of abiotic and climatic variables to explain the distribution of 25 forest herbs	2008-09	2009-04
• Benoît Laliberté (MSc) *Sherbrooke+UQAR*, Berteaux, Larivée	Effects of past climate change on Quebec birds – 1	2008-09	2009-05
• Nicolas Casajus (Research assistant) *UQAR*, Berteaux	Modeling of species distributions	2008-11	2010-12
• Laura Boisvert-March (Research assistant) *McGill*, DeBlois	Construction and management of a plant database	2009-01	2009-08
• Yanick Gendreau (PhD) *UQAR*, Berteaux, Nantel	Effects of climate change on the species at risk in Quebec	2009-01	2013-04
• Natalie James (MSc) *McGill*, DeBlois, Darveau	Effects of climate change on wetland plant biodiversity in Quebec	2009-01	2012-02
• Alexandra Liston (MSc) *McGill*, DeBlois	Forest herb species dispersal	2009-01	2010-12
• Xavier Francoeur (MSc) *UQAR*, Berteaux, Larivée	Effects of past climate change on Quebec birds – 2	2009-05	2011-12
• Laura Boisvert-March (MSc) *McGill*, DeBlois	Detecting recent distribution changes in trees	2009-09	2012-05

(2) We have surveyed and summarized the different techniques used in the literature to model the current and future distributions of species in relation to a changing climate, and have summarized this information in a 34-page report to one of our partners (Canadian Wildlife Service; first version of the report delivered March 2009). We also produced for Ouranos a 26-page research report outlining scientific concepts and needs to help develop a scientific framework for a biodiversity and climate change program (final report delivered August 2008). A summary of the available databases was produced, conditions of access to each database was verified, and fees were paid to QuébecOiseaux (ÉPOQ database) and Société d'Histoire Naturelle de la Vallée du St-Laurent (Atlas des amphibiens et reptiles du Québec). We also wrote for the Canadian Wildlife Service (March 2010) a 24-page report and a 650-page Atlas that summarized our results about birds and amphibians projections.

(3) Nine formal meetings have taken place to coordinate the team work of our project, named CC-Bio (for effects of **C**limate **C**hange on Quebec **Bio**diversity):

Meeting	**Location**	**Date**	**Objectives**	**Participants**
1st annual meeting	Montreal	12-13 November 2007	Kick-off workshop Review of project goal with partners	25

			and agreement on first steps to be taken	
1st technical workshop	Montreal	21-22 February 2008	Methodological discussions Review of methods and agreement on general methodological approaches	15
2nd annual meeting	Montreal	17-18 November 2008	Progress update Presentation of preliminary results and discussion of path forward	31
2nd technical workshop	Ile Verte	17-19 June 2009	Methodological discussions	20
3rd annual meeting	Montreal	10-11 November 2009	Progress update	30
3rd technical workshop	Montreal	12-13 November 2009	Methodological and publications discussions	19
4th technical workshop	Forêt Montmorency	22-24 March 2010	Atlas and publications discussions	23
4th annual meeting	Montreal	2-4 November 2010	Presentation of final results	23
1st synthesis meeting	Québec city	24 October 2011	Discussions of final products of the project (book and electronic atlas)	12

Many informal meetings between team members have also occurred to exchange specific information and coordinate CC-Bio.

(4) We have published in 2008 a French-English-Spanish website (http://cc-bio.uqar.ca/) describing the project. In the winter of 2009, an Intranet was added to the website in order to facilitate exchanges of confidential information among project members. In the summer of 2009, a Spanish version of the website was also added to respond to some interest from hispanophone countries. During the spring of 2012, final results will be added to the website in the form of an electronic Atlas giving visitors the opportunity to interact and visualize the most relevant information.

(5) Modeling the responses of plants to climate change first required acquiring data on the current distribution of species (woody and herbaceous) in North East America as well as on abiotic and climatic variables. As there was no atlas or database readily available for our purpose, we did in the first year of the project an extensive effort in gathering, validating, integrating, and mapping species and abiotic variables from diverse sources (herbarium records, forest surveys, Canadian and US databases, etc.). We were successful in constructing an extensive plant database, called ACTEAE,

currently containing more than 2,000,000 entries. Since one of our concerns was to ensure that species names were consistent with current taxonomy, a strong focus of this effort was on data quality. In the summer of 2009 we also conducted a similar effort to integrate spatial information about important abiotic (edaphic, etc.) and climatic variables across jurisdictions.

(6) Beaver density across Quebec was modeled with two statistical tools: 1) species' distribution models (SDM) and 2) Geographically Weighted Regression (GWR). A total of 700 SDMs were built, which resulted in 2,100 distribution maps that were summarized into three averaged maps (one for the present, one for 2050 and one for 2080) using an ensemble forecasting framework. Theses maps were compared to the ones obtained by the GWR models. We showed that considering the non-stationarity of the effects of climatic predictors improves the accuracy of the modeling process.

(7) The PhD 4 identified in our proposal (modeling of beaver distribution) has graduated on April 2011.

(8) and **(9)** Modeling and projection of species distributions have been done for beaver, for 190 bird species, for 113 amphibian species, for 120 tree species, and for 280 other plant species. This has allowed us to identify some methodological challenges (e.g. merging data from USA and Canada) and to standardize methods across sub-projects (e.g., size of study area and cells, choice of climatic variables, etc.). Our extensive sampling effort across international boundaries makes our contribution fairly unique in North America in biodiversity/climate change research. All students got trained in modeling using BIOMOD or the R language. They are now interpreting results and writing their theses (some students have already submitted their thesis and have graduated).

We summarize here the work done for birds to illustrate the modeling that was performed. Environmental layers were derived for the grid used by the OURANOS climate model. Breeding Bird Survey data were downloaded and interpolated to this grid (alternative data on bird abundance was obtained from EPOQ and we have begun exploring methods to appropriately integrate the two data sources for improved estimation). Models using random forest regression were fit for 5 species of birds. These models were then applied to projected climate from OURANOS. Projected changes in species range for the five species were produced. These maps, suggesting extensive northward migration of distribution areas, were heavily used as a demonstration for the project.

(10) A progress report has been written and send to NSERC on 30 June 2009.

(11) MSc 1 and 2 have successfully graduated on November 2011 and March 2009, respectively.

(12) The final report is now submitted.

(13) MSc 3 has written her thesis and will submit it during the winter of 2012. PhD 1 has graduated on November 2011. PhD 2 was on maternity leave for one year and is now interpreting her results. She will submit her thesis on December 2012. PhD 3 is also interpreting his results and has a chapter of his thesis accepted for publication. He will submit his thesis on April 2013.

(14) The writing of a book that synthesizes the results of the project and the acquired knowledge during these 4 last years has started on October 2011. This book will be published by the Presses de l'Université du Québec during the winter of 2013. This book will be 300 pages-long and aimed at biologists.

(15) The final conference of the project is postponed until the book summarizing the results becomes available.

The description of research contributions by members of the research team (see section *Research Team*) gives additional information on research progress performed during the period covered by this report.

Justification for any deviations from the original objectives

Deviations: The work that has been performed to date is in direct line with our original objectives and there is no major deviation that has occurred. However, we have experienced some delays in recruiting students. Some HQP entered the project at the very beginning (fall 2007), but because of the timing of the NSERC announcement in October 2007, active recruitment was only possible in the fall of 2007 and winter of 2008, with the bulk of the students entering the project in the summer or fall 2008 (see above table on HQP). In addition, we have chosen not to rush student recruitment because we needed to be highly selective given that the research involves the acquisition of sophisticated numerical skills. This strategy has allowed us to recruit students of high calibre (as shown by the fact that some of them got scholarships from NSERC or FQRNT). Moreover, we had anticipated in the original proposal that the gathering of data for some parts of the project (e.g., plants, abiotic variables) would require several months and we wanted this step to be done mostly by undergraduate students or research assistants to lead the way for graduate students who would be able to concentrate on modeling and data interpretation. Since PhD projects require three years to be completed and since it was not possible to hire all PhD students on the first day of the 3-year project, NSERC authorized us to change the end date of the project to 29 September 2011.

Description of the scientific significance of the results achieved

The results produced by this project give a first approximation of the impacts of climate change on Quebec biodiversity. The bioclimatic envelop of more than 700 species (190 bird species, 280 plant species, 120 tree species, 113 amphibian species, and the beaver) was modelled and projected under future climate change scenarios. The statistical approach used in this project incorporated the latest developments of the discipline, conferring robustness to the results generated. We also developed a new method to select an appropriate subset of climate change scenarios. This method is new and innovating in the climate change impact studies and will be submitted in a peer-review journal. Thousands of georeferenced maps were produced, providing a high quality support for decision makers in terms of management of biodiversity under climate change. All of these maps will soon be freely available on the project website.

Globally, our results suggest an extensive northward migration of distribution areas for a high number of species under a future warmer climate. These projected northward shifts reinforce the hypothesis of the northern biodiversity paradox (i.e. a potential increase of biodiversity in northern ecosystems due to climate change) and raise many questions on conservation of biodiversity. We also identified species and regions that would experience the highest negative effects of climate change (northern species, mountainous regions, etc.).

The knowledge acquired during the project are being summarized in a book that will be published during the winter of 2013. An intensive effort of scientific popularization is currently being undertaken to disseminate all this knowledge to a wide range of readers. Finally we gathered thousands of checklists of plant localizations in Quebec and created a database (ACTEAE). This database will be useful for new research projects and for other scientists.

Dissemination of Research Results

Refereed Journal Articles Submitted :	7
Refereed Journal Articles Accepted or Published:	5
Conference Presentations/ Posters:	76
Other (Technical Reports, Non-Refereed Articles, etc.):	17
How many of the publications, conference presentations, etc. identified above were co-authored with a non-academic partner?	33

DISSEMINATION OF RESEARCH RESULTS ATTACHMENT

Refereed journal articles, submitted (n=7)

Casajus N., C. Périé, T. Logan, M.-C. Lambert, S. de Blois, D. Berteaux (submitted in Methods in Ecology and Evolution) Projecting species distribution under climate change: an objective approach to select climate scenarios.

Chambers D., C.Périé, N. Casajus, S. de Blois (submitted to Ecology) Challenges in modeling the abundance of 105 tree species in eastern North America for climate change research.

Francoeur X., D. Berteaux, N. Casajus, J. Larivée (submitted in Ecology) Patterns and correlates of change in bird spring phenology in southern Quebec, Canada.

Feldman R.E., V. Bahn, N. Casajus, D. Berteaux, B. J. McGill, J. Larivee (submitted in Global Ecology and Biogeography) Climate cannot be used to predict bird abundances in eastern North America.

Samson J., D. Berteaux, M.M. Humphries (submitted in Ecography) Application of geographically weighted regression to ecological niche modelling of beaver density.

Samson J., D. Berteaux, B. McGill, M. M. Humphries (submitted in PLOS one) Persistent climate-correlated demographics and the warming climate niche of the contiguous United States population during the 20th century.

Samson J., N. Casajus, D. Berteaux, M. M. Humphries (submitted in Global Change Biology) Alternative niche dimensions, niche models, and climate simulations as contributors to uncertainty in beaver responses to climate change.

Refereed journal articles, accepted or published (n=5)

Bahn, V., B. J. McGill (2007) Can niche-based distribution models outperform spatial interpolation? Global Ecology and Biogeography, **16**, 733-742.

Berteaux, D., S. de Blois, J.-F. Angers, J. Bonin, N. Casajus, M. Darveau, F. Fournier, M.M. Humphries, B. McGill, J. Larivée, T. Logan, P. Nantel, C. Périé, F. Poisson, D. Rodrigue, S. Rouleau, R. Siron, W. Thuiller, L. Vescovi (2010) The CC-Bio project: Studying the effects of climate change on Quebec biodiversity. Diversity, **2**,1181-1204.

Gendreau, Y., C. A. Gagnon, D. Berteaux, F. Pelletier (2011) Cogestion adaptative des parcs du Nunavik dans un contexte de changements climatiques. In Un nouveau modèle de gouvernance: Parcs Nunavik. 23pp.

Jarema, S. I., J. Samson, B. J. McGill, M. M. Humphries (2009) Variation in abundance across a species' range predicts climate change responses in the range interior will exceed those at the edge: a case study with North American beaver. Global Change Biology, **15**, 508-522.

Samson J., D. Berteaux, B. J. McGill, M. M. Humphries (2011) Geographic disparities and moral hazards in the predicted impacts of climate change on human populations. Global Ecology and Biogeography, **20**, 532–544.

Conferences presentations and posters (n=76)

Akpoué B. P., J.-F. Angers (June 2009) Loi multidimensionnelle de Skellam-Poisson. Société Statistique du Canada. Vancouver, British Columbia, Canada.

Akpoué B. P., J.-F. Angers (June 2010) Modélisation de données discrètes: une généralisation de la distribution multivariée de Poisson. Société Statistique du Canada. Quebec City, Quebec, Canada.

Akpoué B. P., J.-F. Angers (April 2011) Modelisation of negatively correlated multivariate discrete data. Optimization days in HEC. Montreal, Quebec, Canada.

Akpoué B. P., J.-F. Angers (July 2011) Modeling Overdispersed Multivariate Poisson data. Statistics 2011 Canada. Montreal, Quebec, Canada.

Bahn V., B. McGill (August 2008) Finding constraints on the abundance of species: A path forward in large-scale distribution modeling. Ecological Society of America. Milwaukee, USA.

Beauregard F., S. de Blois (October 2009) Range patterns help predict plant species' response to climate change. International Society of Ecological Modelling. Quebec City, Quebec, Canada.

Beauregard F., S. de Blois (August 2010) Edaphic variables are as important as climatic variables in regional plant species distribution models. 95th Annual Ecological Society of America Meeting. Pittsburgh, Pennsylvania, USA.

Berteaux D. (January 2008) Effets des changements climatiques sur la biodiversité au Canada. Muséum National d'Histoire Naturelle. Paris, France.

Berteaux D. (January 2008) Effets des changements climatiques sur la biodiversité au Canada. Université Joseph Fourier de Grenoble, France.

Berteaux D. (March 2008) Effets des changements climatiques sur la biodiversité au Canada. Centre National de la Recherche Scientifique (CNRS). Chizé, France.

Berteaux D. (April 2008) Effets des changements climatiques sur la biodiversité au Québec. Workshop on migratory birds of Office National de la Chasse et de la Faune Sauvage. Chizé, France.

Berteaux D. (April 2008) Effets des changements climatiques sur la biodiversité au Canada. Université Jussieu. Paris, France.

Berteaux D. (May 2008) Effets des changements climatiques sur la biodiversité au Canada. Université Claude Bernard de Lyon, France.

Berteaux D. (September 2008) Effets des changements climatiques sur la biodiversité au Québec : Une collaboration s'établit entre chercheurs, naturalistes et gestionnaires. Les Midis des Sciences Naturelles. Rimouski, Quebec Canada.

Berteaux D. (November 2008) La protection des écosystèmes nordiques contre les changements climatiques. 33rd Annual Congress, Association des Biologistes du Québec (ABQ). Montreal, Quebec, Canada.

Berteaux D. (March 2009) Les effets des changements climatiques sur la biodiversité du Québec. Colloque La Biologie dans Tous ses États. Rimouski, Quebec, Canada.

Berteaux D. (April 2009) Biodiversité, écosystèmes, changements climatiques. Two-hour lecture given at Ouranos Consortium Inc. Montréal, Quebec, Canada.

Berteaux D. (April 2009) Effets des changements climatiques sur la biodiversité au Canada. Sherbrooke, Quebec, Canada.

Berteaux D. (August 2009) Les changements climatiques et la biodiversité. Parc national du Bic, Quebec, Canada.

Berteaux D. (November 2009) Les changements climatiques… sont partout autour de nous! Journées Savoir de l'Université du Québec à Rimouski. Rimouski Quebec, Canada.

Berteaux D. (March 2010) Effets des changements climatiques sur la biodiversité du Québec: Le projet CC-Bio. Consortium Ouranos sur la climatologie régionale et l'adaptation aux changements climatiques. Montréal, Quebec, Canada.

Berteaux D. (May 2010) Effets des changements climatiques sur la biodiversité du Québec: Le projet CC-Bio. Colloque *Écosystèmes, biodiversité et changements climatiques: « Prévoir » aujourd'hui ce que sera demain*, ACFAS. Montréal, Quebec, Canada.

Berteaux D. (May 2010) Effets des changements climatiques sur la biodiversité du Québec. Assemblée annuelle du Conseil régional de l'environnement. Rimouski, Quebec, Canada.

Berteaux D. (August 2010) Les changements climatiques et la biodiversité. Parc national du Bic, Quebec, Canada.

Berteaux D. (September 2010) Organisation et résultats préliminaires du projet CC-Bio au Québec.

Cycle du séminaire *Adaptation au changement climatique: forêts, espaces naturels et biodiversité*. Paris, France.

Berteaux D. (November 2010) Une analyse globale des effets des changements climatiques sur la biodiversité du Québec. 4ème Symposium scientifique sur la climatologie régionale et l'adaptation aux changements climatiques. Quebec City, Quebec, Canada.

Berteaux D. (November 2010) Changements climatiques et biodiversité. Colloque *La nature a-t-elle sa place en éducation? Pour une pédagogie de la biodiversité!* de l'Association québécoise pour la promotion de l'éducation relative à l'environnement. Conférencier invité à la soirée d'ouverture. École Père Marquette, Montréal, Quebec, Canada.

Berteaux D. (December 2010) Effets des changements climatiques sur la biodiversité du Québec: Le projet CC-Bio. Colloque annuel du Centre de la science de la biodiversité du Québec. Montreal, Quebec, Canada.

Berteaux D. (Juillet 2011) Changements climatiques et biodiversité. Parc national du Bic, Quebec, Canada.

Berteaux D. (August 2011) Changements climatiques et biodiversité. Parc national du Bic, Quebec, Canada.

Berteaux D. (October 2011) Effets des changements climatiques sur la biodiversité du Québec: Le projet CC-Bio. Colloque La recherche sur la faune au Québec en 2011 : vers de nouveaux enjeux, Carrefour Forêt Innovations. Quebec city, Quebec, Canada.

Berteaux D., J.-F. Angers, S. de Blois, M. Humphries, B. McGill, W. Thuiller, J. Bonin, M. Darveau, F. Fournier, J. Larivée, G. Lavoie, S. McCanny, P. Nantel, D. Rodrigue, L. Vescovi, D. Welch (November 2008) Le projet CC-Bio: Effets des changements climatiques sur la biodiversité du Québec. 3rd Symposium scientifique sur la climatologie régionale et l'adaptation aux changements climatiques. Montreal, Quebec, Canada.

Berteaux D., S. de Blois et al. (May 2010) Les effets des changements climatiques sur la biodiversité du Québec : le projet CC-Bio. Colloque Écosystèmes, biodiversité et changements climatiques : "prévoir" aujourd'hui ce que sera demain. 78e Congrès annuel de l'Association Francophone pour le Savoir (ACFAS). Montreal, Quebec, Canada.

Berteaux D., S. de Blois et al. (November 2010) Les effets des changements climatiques sur la biodiversité du Québec : le projet CC-Bio. Colloque Symposium Ouranos. Montreal, Quebec, Canada.

Boisvert-Marsh L. (March 2010) Spatiotemporal changes in northern limits of tree distribution in Québec since 1970. Plant Science Research Horizons Seminar. Ste-Anne-de-Bellevue, Quebec, Canada.

Boisvert-Marsh L. (May 2011) Detecting recent patterns of distribution change for northern tree species in response to climate change. Plant Science Research Horizons Seminar. Ste-Anne-de-Bellevue, Quebec, Canada.

Boisvert-Marsh L., S. de Blois, C. Périé (September 2010) Spatiotemporal changes at the northern limit of tree distribution in Quebec since 1970. International Union of Forest Research Organizations (IUFRO) Landscape Ecology International Conference. Braganca, Portugal.

Casajus N., D. Berteaux et al. (September 2009) Les effets des changements climatiques sur la biodiversité du Québec : le projet CC-Bio. Ecochange Summer School. Lausanne, Switzerland.

Casajus N., M.-C. Lambert, C. Périé, S. de Blois, D. Berteaux (October 2009) BIOMOD and S'AMP: Two platforms for ensemble forecasting of species distributions and abundances used in CC-Bio project. International Society of Ecological Modelling. Quebec City, Quebec, Canada.

Chambers D., C. Périé, N. Casajus, S. de Blois (October 2009) Modelling tree distribution and abundance in eastern North America in response to climate change. International Society of Ecological Modelling. Quebec City, Quebec, Canada.

Chambers D., C. Périé, N. Casajus, S. de Blois (December 2010) Potenital impact of climate change on tree abundance in eastern North America. 23th International Union of Forest Research Organizations (IUFRO) World Congress. Forests for the Future: Sustaining Society and the Environment. Seoul, Republic of Korea.

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