GenomeCanada

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BACKGROUNDER

2015 LARGE-SCALE APPLIED RESEARCH PROJECT COMPETITION

NATURAL RESOURCES AND THE ENVIRONMENT: SECTOR CHALLENGES – GENOMIC SOLUTIONS

Genome Canada's 2015 Large-Scale Applied Research Project Competition aims to support applied research projects focused on using genomic approaches to address challenges and opportunities of importance to Canada's natural resources and environmental sectors, including interactions between natural resources and the environment, thereby contributing to the Canadian bioeconomy and wellbeing of Canadians. Genome Canada and co-funding partners are investing $110 million over four years in the following 13 projects.

BRITISH COLUMBIA

CoAdapTree: Healthy trees for future climates

Project Leaders: Sally Aitken, University of British Columbia; Samuel Yeaman, University of Calgary and Richard Hamelin, Université Laval
Lead Genome Centre: Genome British Columbia
Co-Lead Genome Centres: Genome Alberta, Génome Québec
Total funding: $5.9 million

Drs. Sally Aitken of the University of British Columbia, Samuel Yeaman of the University of Calgary and Richard Hamelin of Université Laval will lead a team to develop better reforestation options for high-value tree species such as Douglas fir and lodgepole pine, as well as western larch and jack pine trees. The team's work will result in up to 30 per cent greater timber yields, with a proportional impact on the economy and employment, as well as sustain the ecological and environmental benefits of our forests.

Spruce-Up: Advanced spruce genomics for productive and resilient forests

Project Leaders: Joerg Bohlmann, University of British Columbia and Jean Bousquet, Université Laval
Lead Genome Centre: Genome British Columbia
Co-Lead Genome Centre: Génome Québec
Total Funding: $10.5 million

Spruce trees are Canada's most significant forest resource. The Spruce-Up project, led by Dr. Joerg Bohlmann of the University of British Columbia and Dr. Jean Bousquet of Université Laval, will accelerate the development and deployment of genomics-improved spruce stock that is more resistant to insects and drought, uses nutrients efficiently and results in improved wood quality and productivity. Spruce-Up is estimated to more than double the net economic output value of spruce forests, increasing the value of new trees and reducing losses due to environmental disturbances.

BioSurveillance of Alien Forest Enemies (BioSAFE)

Project leaders: Richard Hamelin, University of British Columbia; Cameron Duff, Canadian Food Inspection Agency and Ilga Porth, Université Laval
Lead Genome Centre: Genome British Columbia
Co-Lead Genome Centre: Génome Québec
Total funding: $8.6 million

Drs. Richard Hamelin of the University of British Columbia, Cameron Duff at the Canadian Food Inspection Agency and Ilga Porth of Université Laval are using genome sequencing and bioinformatics analysis to develop a suite of tools to rapidly and accurately detect alien invasive species and diseases in our forests. Their work will enable forest health professionals to track and determine the source of these threats and develop measures to prevent further invasions. The team's work will generate economic impacts of at least $3 billion annually.

Sustaining freshwater recreational fisheries in a changing environment

Project leader: Patricia M. Schulte, University of British Columbia; Ben Koop, University of Victoria and Anthony Farrell, University of British Columbia
Lead Genome Centre: Genome British Columbia
Total funding: $4.8 million

Recreational fishing is a treasured pastime, contributing more than $8 billion to the Canadian economy. Rainbow trout are a cornerstone of recreational fishing, but wild populations are in danger due to climate change and human impacts. The University of British Columbia's Dr. Patricia M. Schulte, along with Drs. Ben Koop of the University of Victoria and Anthony Farrell of UBC, is using conservation genomics to provide the tools, information and policy recommendations needed to stock fish that are resilient to the effects of climate change, monitor their genetic health and manage and preserve rainbow trout. The team's work will help preserve recreational fishing for generations to come.

ALBERTA

GENICE: Microbial Genomics for Oil Spill Preparedness in Canada's Arctic Marine Environment

Project Leaders: Casey Hubert, University of Calgary and Gary Stern, University of Manitoba
Lead Genome Centre: Genome Alberta
Co-Lead Genome Centre: Genome Prairie
Total funding: $10.7 million

Thanks to reduced sea ice cover and ice-free summers, the Northwest Passage has never been so busy, leading to greater risk of accidental releases of diesel or bunker fuel or other transportation-related contaminants. In addition, Arctic oil exploration is leading to fears of an oil spill in the Arctic Ocean. Marine microbial communities can help clean up, or bioremediate, oil spills in the south, where it is warmer. Drs. Casey Hubert of the University of Calgary and Gary Stern of the University of Manitoba are leading a team that will use microbial genomics to generate credible, science-based evidence on the role and potential of bioremediation to deal with oil spills in the cold, ice-laden Arctic Ocean.

Managing Microbial Corrosion in Canadian Offshore and Onshore Oil Production

Project leaders: Lisa Gieg, University of Calgary, John Wolodko, University of Alberta, Faisal Khan, Memorial University
Lead Genome Centre: Genome Alberta
Co-Lead Genome Centre: Genome Atlantic
Total funding: $7.9 million

Microbiologically Influenced Corrosion (MIC) is costly to the oil and gas industry, but not enough is known about how it occurs. Drs. Lisa Gieg of the University of Calgary, John Wolodko of University of Alberta and Faisal Khan of Memorial University are leading a team to provide a more multidisciplinary understanding of MIC and allow corrosion managers to better predict when, where and why MIC occurs and how to mitigate it. The result will be reduced oil spills and improved asset integrity, worker safety and environmental compliance, while extending the productive life of Canada's oil and gas infrastructure, reducing operating costs and allowing potential capital savings of some $300-500 million.

Systems Biology and Molecular Ecology of Chronic Wasting Disease

Project Leader: Debbie McKenzie and David Wishart, University of Alberta
Lead Genome Centre: Genome Alberta
Total funding: $11.5 million

Chronic wasting disease (CWD) is spreading into Canada, where it could infect and kill many of Canada's approximately two million deer, elk, moose and caribou (cervids). Little is known about how CWD spreads among cervids, as well as the risk of transmission to humans and other mammals. Drs. Debbie McKenzie and David Wishart of the University of Alberta are leading a

team that will use genomics and metabolomics to develop tools to model risk and predict spread of the disease. The team will also assemble kits to help identify disease and prevent its spread, allowing early detection and reducing disease spread.

Resilient Forests (RES-FOR): Climate Pests & Policy – Genomic Applications

Project Leaders: Barb Thomas and Nadir Erbilgin, University of Alberta and Yousry El-Kassaby, University of British Columbia
Lead Genome Centre: Genome Alberta
Co-Lead Genome Centre: Genome British Columbia
Total funding: $5.7 million

Climate change and the insect outbreaks and drought it brings, as well as the time it takes to create seedlings adapted to these conditions, are threatening both our forests and the communities that depend on the forest industry. Drs. Barb Thomas of the University of Alberta, Nadir Erbilgin of the University of Alberta and Yousry El-Kassaby of UBC are integrating genomics, metabolic profiling and mathematical modeling into existing tree breeding programs to generate pest- and drought-resistant trees with improved wood quality while shortening the time it takes for a complete tree-breeding cycle from ~30 years to ~10.

ONTARIO

SYNBIOMICS: Functional genomics and techno-economic models for advanced biopolymer synthesis

Project leaders: Emma Master, University of Toronto, Harry Brumer, University of British Columbia
Lead Genome Centres: Ontario Genomics
Co-Lead Genome Centre: Genome British Columbia
Project funding: $9.5 million

SYNBIOMICS, a project led by Drs. Emma Master of the University of Toronto and Harry Brumer of UBC, is focused on harnessing the genetic potential of microorganisms to identify and develop new biocatalysts that can be used to create materials from trees, such as resins, coatings, bioplastics and adhesives. The project will also foster small and medium-sized enterprises that will work together synergistically with nearby pulp mills, creating lasting knowledge-based economic opportunities for Canada's forest sector and rural communities.

Mine Wastewater Solutions: Next Generation Biological Treatment through Functional Genomics

Project Leader: Lesley A. Warren, University of Toronto, Jill Banfield, UC Berkeley
Lead Genome Centre: Ontario Genomics
Total funding: $3.7 million

The Canadian mining sector contributes 3% of Canada's GDP and employs more than 375,000 people. Mining wastewaters, however, contain sulphur compounds, which can cause acidification and toxicity in receiving waters. Dr. Lesley A. Warren of the University of Toronto, along with Dr. Jillian Banfield of University of California, Berkeley, is using genomics to develop innovative biological tools to allow the industry to better monitor, manage and reduce sulphur compounds in their wastewaters. The project's findings will lead to lower management costs, decreased risk of environmental damage, reduced liabilities for the industry and better safeguards for Canada's vital freshwater supplies.

BEARWATCH: Monitoring Impacts of Arctic Climate Change using Polar Bears, Genomics and Traditional Ecological Knowledge
Project Leaders: Stephen C. Lougheed, Peter van Coeverden de Groot and Graham Whitelaw (Queen's University), Markus Dyck (Government of Nunavut)
Lead Genome Centre: Ontario Genomics
Total funding: $9.5 million

Polar bears are the canary in the Arctic coalmine. Polar bear conservation both ensures polar bears' persistence and provides insight into the state of Arctic ecosystems. BEARWATCH, led by Dr. Stephen C. Lougheed in collaboration with Drs. Peter van Coeverden de Groot and Graham Whitelaw, all from Queen's University, and Markus Dyck, with the Government of Nunavut, will combine cutting-edge genomics with Inuit traditional knowledge to develop a non-invasive, fecal-based biomarker toolkit and a community-based monitoring program. Together they will permit assessment of bear health and track changes to polar bear populations.

QUÉBEC

ATRAPP – Algal Blooms, Treatment, Risk Assessment, Prediction and Prevention Through Genomics

Project leaders: Sébastien Sauvé, Université de Montréal, Jesse Shapiro, Université de Montréal, Sarah Dorner, Polytechnique Montréal
Lead Genome Centre: Génome Québec
Total funding: $12.1 million

In Canada, a growing number of drinking water treatment facilities, including those fed by the Great Lakes, the source of water for 8.5 million Canadians, are now considered at risk for blue-green algae "blooms." These blooms produce cyanotoxins that can make ill or kill humans and animals. Drs. Sébastien Sauvé and Jesse Shapiro of the Université de Montréal, along with Sarah Dorner of Polytechnique Montréal, are developing a chemical-genomic diagnostic toolkit to assess the risk of toxicity in water sources and to guide municipalities and water quality authorities in prevention and treatment strategies.

EcoToxChip: A toxicogenomics tool for chemical prioritization and environmental management

Project leaders: Niladri Basu, McGill University, Markus Hecker, University of Saskatchewan, Doug Crump, Environment and Climate Change Canada
Lead Genome Centre: Génome Québec
Co-Lead Genome Centre: Genome Prairie
Total funding: $9.6 million

Drs. Niladri Basu of McGill University, Markus Hecker of University of Saskatchewan, and Doug Crump at Environment and Climate Change Canada are leading a team to develop, test, validate and commercialize EcoToxChip, a technology that provides an accessible, affordable, consistent, and reliable platform for chemical evaluation. A user-friendly bioinformatics portal (EcoToxXplorer.ca) and an end user-validated technical guidance document will help ensure its uptake. The EcoToxChip will speed testing activities by seven-fold, and reduce the number of animals used for testing by 90 per cent. Together, the EcoToxChip and EcoToxXplorer.ca will make ecological and chemical risk assessment more cost-effective, timely, informative, and ethical.