

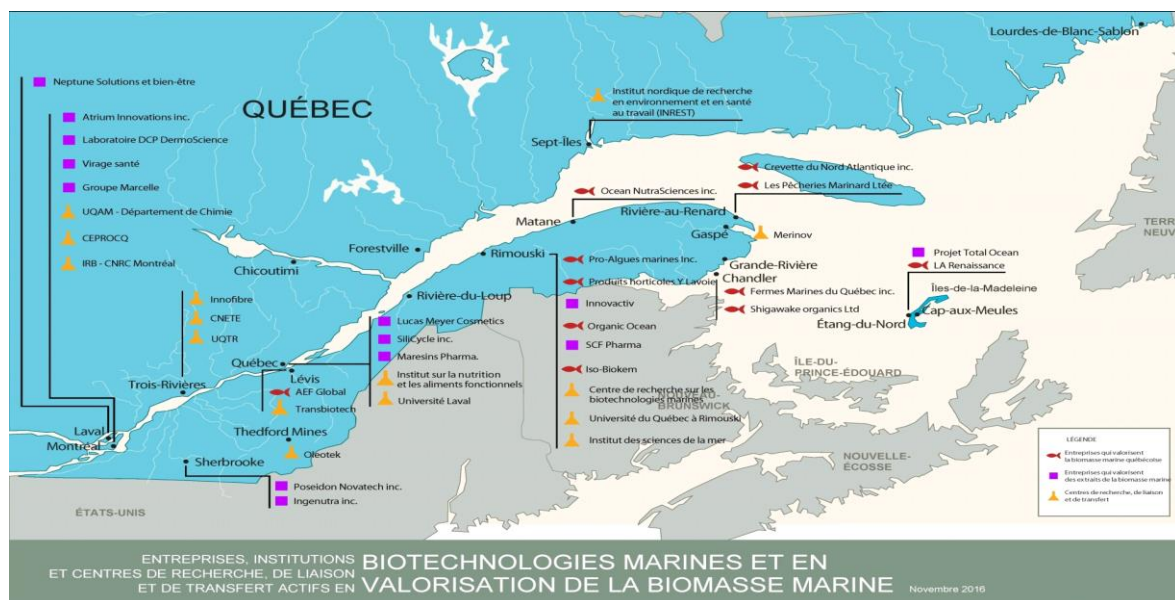
# Title: The Marine Biotechnology industry in Quebec: an Emerging Sector

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## Introduction

The fishing and seafood processing industry in Quebec has a long history and was for years a pillar of the economy like mining and forestry because of the cod. Today, snow crab, shrimp, lobster, and other marine life, unique sources of a biomass rich in value-added products, have replaced cod. This is fueling a significant emerging marine biotechnology industry across the province (see map).



Central to the marine biology of Quebec is the Saint-Lawrence River, which connects the Great Lakes with the Atlantic Ocean and runs over 1,200 km from Lake Ontario to the mouth where it becomes the Gulf of St-Lawrence. The estuary is one of the largest in the world being 370 km long and 48 km wide. The basin is 1.6 million km<sup>2</sup> large and represents 25% of the world's fresh water resources.

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## **A vast reservoir of marine biomass**

Not surprisingly, this is an exceptional reservoir of marine life and biomass. To know more about that biomass, we have to start with the resources that are commercially exploited on an industrial scale. Fisheries and Oceans Canada regulate the size of catch by a complex system of quotas by zone, which they revise annually based on the status of the stocks. Commercial fishing in the Atlantic and Arctic regions is classified in three main categories: Groundfish (11 species), Pelagics (10 species) and Shellfish (11 species). As an example, for the Snow crab in the Southern Gulf of St-Lawrence in 2019, the Total Allowable Catch (TAC) is 33,025 tonnes; for Lobster, the landings in 2015 were 27,462 tonnes in the southern Gulf of St-Lawrence. For shrimp, the zone for fishing is larger than the Gulf and reaches along the Labrador coast. The quota for Nordic Shrimp in the regions of Atlantic, Quebec and the Arctic was 50,085 tonnes for 2018.

Globally, the landings for 2017 for the four provinces of Atlantic Canada: Nova Scotia, New Brunswick, Prince-Edward-Island, Newfoundland and Quebec were 641,392 tonnes. Shellfish is the largest category with 394,292 tonnes mainly lobster, shrimp and crab. Quebec is but a small player with 8.6 % of these landings. These landings are going to processing plants, which generate important quantities of residues that form the supply for biotechnology intervention which bring various new products to the market.

The next big volume of marine biomass is that of the non-conventional species not exploited commercially for various reasons. Preliminary research has identified some 90 species.

The third group is the algae. In Quebec, a preliminary evaluation estimates that there are 240 species in the St-Lawrence of which 83 are brown algae and 85 red algae. This group is largely under-exploited at the moment.

Quebec is geographically well positioned in this vast and highly diversified reservoir of marine biomass, which is the raw material for an increasingly significant marine biotechnology sector.

## **A strong network of R&D expertise in marine biotechnology**

There are three principal research centres in Quebec:

- The [Centre de recherche sur les biotechnologies marine](#) (CRBM). Created in 2004, it is the principal link totally dedicated to this domain with a team of about 40 persons. Its scope for research covers 5 areas:
  - Valorization of aquatic biomass including marine coproducts;
  - Exploitation of macroalgae and marine plants;
  - Exploitation of microorganisms including microalgae;
  - Development and validation of analytical methods;
  - Development and validation of processes.
- [MERINOV](#) is one of the technology transfer centres attached to the Quebec community college network. It is Canada's largest integrated center for applied research in fishing, aquaculture, and the processing and development of aquatic products. MERINOV helps companies to become more competitive through technological innovation and sustainable, high-performance strategies. It provides technology transfer services in fishing and aquaculture, and it is dedicated to optimizing processing methods, developing food products, and developing industrial applications for marine biotechnology. MERINOV is a not-for-profit organisation composed of more than 100 employees posted at four centres located on the Gaspé Peninsula, the Magdalen Islands and the North Shore of the Saint-Lawrence.
- [Institute of Nutrition and Functional Foods](#) (INAF) is the largest group of researchers in Canada dedicated entirely to foods and the complex interactions between food components, nutrition and health. It is part of Laval University, and is active in marine biotechnology with a research group in marine products and by-products focusing on preclinical and clinical trials with the scientific and technical expertise of marine biotechnology research groups from Eastern Québec.

Around these three poles, there are eleven research centres, of which some are technology transfer centres:

- CRIQ (Industrial research Centre of Quebec)

- The National Electrochemical and Environmental Technology Centre (CNETE)
- CEPROQ
- Innofibre
- The Nordic Institute of environmental research and health at the workplace.
- Oleotek
- Transbiotech

Three research groups are in universities:

- UQAM - Chemistry Department
- UQAR - Aquatic Resources in Quebec
- UQTR - Industrial research chair in environment and biotechnology.

The National Research Council of Canada with its biotechnology research unit in Montreal also plays a significant role in funding and otherwise supporting the foregoing entities.

All together, these centres represent a large basin of scientific resources including about 90 people with PhD degrees of whom about a dozen are principally involved in biotechnology and the rest in related disciplines, for a total workforce of over 750 people. Their activities cover all the aspects of possible applications in marine biotechnology like:

- Natural health products and nutraceuticals
- Cosmetics and cosmeceuticals
- Biomedical and biopharmaceutical products
- Processing of marine products
- Phyto-sanitary products
- Horticultural products
- Animal feed
- Industrial bio products
- Alimentary products and ingredients
- Aquaculture

This puts Quebec as a major pool of expertise in marine biotechnology in Eastern Canada.

In addition to this research network, the education system provides a large selection of programs to train people interested in a career in every aspect of marine biotechnology. Four universities are offering undergraduate and master programs and one doctorate program in food sciences.

### Profile of the industry

There are 28 companies in Quebec for which marine biotechnology is their main activity and that are classified in two categories: those producing extracts and those processing extracts into other products. The first group of 11 companies is processing the biomass for seven (7) major markets mainly food and Environment/agriculture.

**Table 1: Companies processing the marine biomass in Quebec**

Companies	Markets						
	Feed	Food	Aquaculture	Cosmetics	Enviro. / Ag	Pharma	NHP
AF Global					X		
Bio Nord					X		
Crevette du Nord-Atlantique (La)		X					
Fermes Marines du Québec Inc.		X					
Iso-Biokem						X	
Ocean NutraSciences Inc.*		X					
Organic Ocean	X	X	X	X	X		X
Pêcherie Marinard Ltée		X					
Pro-Algue Marine					X		
Produits horticoles Y. Lavoie					X		
Shigawake organics Ltd					X		
<b>Total</b>	<b>1</b>	<b>5</b>	<b>1</b>	<b>1</b>	<b>6</b>	<b>1</b>	<b>1</b>

Source: Expansion Strategies Inc. Survey

In Quebec only, the volume of biomass presently available from all the seafood processors is more the 20 000 tonnes and it is mainly from three (3) sources: Shrimp (12 000 t), crab (4 000t) and lobster (3 000t). The current environmental legislation states that by 2020 the disposal in landfill sites will be banned. This a critical issue that the industry is facing and for which various solutions are being investigated.

More by-products will add to this volume. Redfish will soon be harvested on a large scale and will bring additional biomass. The sea cucumber is harvested on a much smaller scale but its list of ingredients rich in amino acids, lipids, etc. will attract biotechnology companies.

The Gulf of St-Lawrence is characterized by a combination of extreme temperature and special light conditions which has led to the evolution of organisms with unique properties and potentially valuable bioactive compounds.

The second category of 17 companies is targeting eight (8) major markets, mainly in food and natural health products.

**Table 2: Companies processing extracts of marine biomass into value-added products in Quebec**

Companies	Markets						
	Feed	Food	Biomaterials	Cosmetics	Enviro. / Ag.	Pharma	NHP
Atrium Innovations Inc.							X
Groupe International							X
Groupe Marcelle				X			
Ingenutra Inc.	X	X				X	X
Inova Source							X
Innovactiv				X			X
Lab. DCP DermoScience				X			
Laboratoire Innodal		X					
LNS Bio Coop Solidarité		X	X	X	X		X
Lucas Meyer Cosmetics				X			
Maresins Pharma		X					
Mérianche collagène				X			
Neptune Wellness Solutions							X
Poseidon Novatech Inc.		X					
SCF Pharma		X				X	X
SiliCycle Inc. (Total Océan)	X	X				X	X
Virage Santé							X
<b>TOTAL :</b>	<b>2</b>	<b>7</b>	<b>1</b>	<b>6</b>	<b>1</b>	<b>3</b>	<b>10</b>

Source: Expansion Strategies Inc. Survey

### Government support

In 2018, the Quebec Government recognized the marine biotechnology and the valorization of the marine biomass sectors as drivers of economic development with a specific strategy and action plan. The action plan 2018-2020 has identified two major issues:

- The valorization, in a sustainable manner, of marine resources and their by-products and marine processes.

- The development of an international profile.

On the first issue, the action plan prioritizes three orientations: Creation of a cluster; Maximizing the access to the resources and their development and Support business development aimed at the best markets.

On the second issue, the plan is to increase strategic partnerships with other countries and jurisdictions.

The implementation of the action is supported by a wide array of funding programs ranging from R&D to market access, by a network of Business Support Organizations such as *Technopole Maritime du Québec* (TMQ), a non-profit organization dedicated to the promotion and development of Quebec's innovative maritime sectors including marine biotechnologies and by a number of Regional Development Corporations.

In this context, foreign direct investment or partnerships have a window of opportunity supported by a diverse network of companies, a strong R&D expertise and infrastructure and a clear commitment of the government to enhance this emerging sector.