

DEPARTMENT OF INTEGRATIVE BIOLOGY

STRATEGIC PLAN: 2020-2025

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1 BACKGROUND ON THE DEPARTMENT

1.1 Who we are?

1.1.1 Departmental History and History of Strategic Plans

The Department was formed under the name Department of Organismal Biology, Ecology and Evolution in September 2004 as part of the reorganization of the College of Biological Science. The idea behind the merger was that faculty from the former Botany and Zoology Departments would be united by similar research approaches rather than their biological systems. The department name was changed to Integrative Biology (IB) after Senate approval in December 2004.

The first Academic Plan (research and teaching) was released in 2006 and expired in 2011. One major objective of this plan was to *integrate between the IB disciplines (Ecology, Evolution and Physiology)* and consequently faculty were recruited in the areas of Functional genomics, Theoretical evolutionary biology, Ecosystem ecology, Neurophysiology, and Coevolutionary ecology. In 2009 a new Plan was developed that focused on the *integration between levels of organization*. While this plan expired in 2014, two contractually limited (CL) positions were started in 2012 and 2013 and three regular faculty positions were filled to support the Biodiversity Institute of Ontario (BIO).

The spectrum of research in IB has changed significantly since 2009 due to several departures and retirements affecting all three disciplines. Integrative Biology hired four new faculty members since 2014. These include 2 positions with an emphasis on the scholarship of teaching and learning (SOTL), one position in the realm of Ecophysiology and one position in Bioinformatics and Computational Biology. Additionally, Dr. Georgia Mason (behavioural biologist and Director of the Campbell Centre for the Study of Animal Welfare) joined the IB faculty in May 2020. As of May 2020, job searches have been initiated for positions in plant ecology/evolution, environmental/comparative physiology and aquatic ecology and global change.

1.1.2 Departmental Membership and Operational framework

As of June 2020, the Department has 36 full-time faculty, 8 teaching staff, 3 administrative staff, 17 post-doctoral fellows (4 nil-salaried) and 115 graduate students. Through committee work and several department-wide discussions IB is in the process of developing handbooks for all major IB stakeholder groups (i.e. Faculty, Staff, Post-docs and Graduate Students). IB has also development a comprehensive framework on matters of Equity, Diversity and Inclusion. These documents are relevant for the IB Strategic Plan as they provide specific context for how strategic objectives will be implemented.

1.2 What we do?

1.2.1 Integration: Disciplines and Axes of Expertise

The name of the department references the fact that research and teaching in IB integrate among multiple axes of inquiry. These axes include the core IB disciplines (Ecology, Evolution and Physiology), levels of organization (Gene/Genome, Phenotype, Population, Community, Ecosystem, Biome), taxonomic group (protozoa, plants, fungi, invertebrates, vertebrates) and research activity (experimental, field, computational, lab, theory). The integration between research axes provide IB with a unique identity both in Ontario and in Canada, and the commitment to this integration is captured in the current departmental vision statement.

1.2.2 Instruction and Training

Our comprehensive undergraduate program prepares students for a wide range of career options, including opportunities in business, medicine and biotechnology, industry, environmental management and conservation, research and education. The department is responsible for seven majors, including two coop programs (Ecology and Marine and Freshwater Biology) and one minor in zoology. IB also shares responsibility for the major in plant science with the Departments of Plant Agriculture and Molecular and Cellular Biology. IB also contributes to ten other majors within CBS and 31 majors outside CBS in which students take either IB core courses or IB courses as restrictive electives (see supplement for details).

Faculty and staff are both involved in the instruction of undergraduate students with the support of graduate students through GTAs. The department also offers several field courses (Field Ecology in Algonquin Park, Marine Biology & Oceanography at the Huntsman Marine Science Centre in St. Andrews, New Brunswick, Arctic Ecology in Churchill, Manitoba, a second year

field course in Biodiversity at the Canadian High Arctic Research Station in Nunavut) and participates in the Ontario Universities Program in Field Biology (OUPFB).

While faculty and teaching staff generally teach a broad range of undergraduate courses that are core for IB majors, certain areas can be more difficult to assign based on the current composition of staff and faculty. Most notably, courses in botany, developmental biology, histology, wildlife biology, and aquatic ecosystems often have a limited number of potential instructors and in several cases have required the use of sessional lecturers. While some of these gaps will be addressed with the ongoing hires, others will have to be considered in future hires.

At the graduate level, faculty in the department instruct and train MSc and PhD students. Co-advising students is common and sometimes occurs with faculty in other departments on campus. Furthermore, faculty in IB participate in several interdepartmental programs including Bioinformatics, Neuroscience, Biophysics (MSc, PhD) and Toxicology (MSc, PhD). Three graduate courses offered through IB allow our graduate students an in-depth look at a current topic and three advanced courses allow independent research projects in a laboratory not affiliated with the Thesis advisor. All incoming MSc students must also take a Scientific Communications course that introduces them to philosophy of science and guides them through the development of a research proposal.

1.2.3 Research

Research expertise and activities in IB can be described along the three specific axes outlined above. Laboratories are funded through NSERC, CIHR, OMAFRA and several foundations. Total research funding (not charitable donations) to IB and Bio in 2018/2019 was at \$15 million. Larger funding sources, outside of NSERC Discovery program include NSERC Strategic Grants, Ontario Genome, Fisheries and Oceans. IB currently has one Canada Research Chair (Paul Hebert) and one Weston Senior Scientist (Ryan Norris).

A research survey of all IB faculty in 2018 (details in Supplement) revealed an overall high level of integration between IB research disciplines. However, in comparison to the integration between ecology and evolution, less integration exists between physiology and the other two disciplines. The strategic planning committee also analyzed the collaborative environment within IB from 2008 and 2018 by extracting co-authored publications during that time period from 1570

publications. The analysis revealed 10% of co-authorship among faculty and revealed a broad collaborative network between the departmental disciplines. While IB research generally features a broad range of taxa, a much smaller component of research is dedicated to plants, prokaryotes and protists in comparison to other taxa. Within animals, a significantly smaller proportion of research is dedicated to invertebrate taxa. IB faculty engage in both field and lab research approaches, but comparably less research is conducted in the theoretical and computational realms. In addition, IB has particular expertise in the aquatic sciences with research programs in trophic biology, ecotoxicology, evolutionary ecology, phycology, physiology, aquaculture related research and biomechanics. IB also features research in wild-life biology, terrestrial ecology, comparative and environmental physiology, endocrinology, plant physiology and ecology, biodiversity and computational biology. Note however that some of these areas are only represented by individual research groups.

The SP committee also conducted a more in-depth analysis of the axes of expertise in the department and how they may be affected by potential faculty retirements. Specifically, axes of expertise were split into contributions to 2 principal components and their contribution to the three disciplines. The following main conclusions emerged: 1) Potential retirements over the next 5 years will likely affect physiology and evolution more than ecology. 2) Research in invertebrates primarily occurs in the realm of field ecology and few labs take advantage of invertebrate model systems for other research. 3) Most theory work clusters within evolutionary ecology with little work in physiology. 4) Molecular and genetic work strongly clusters with physiology and evolution and less so with ecology. 5) Little research on protozoans, bacteria and fungi is conducted other than from a biodiversity perspective.

1.2.4 Facilities

Several research support facilities are important for the functioning of the department and delivery of undergraduate and graduate programs. The Hagen Aqualab, an integrated aquatics facility on campus permits experimental studies of aquatic organisms, is directly under the oversight of IB, while other University-level facilities such as the Phytotron, Limnotron, the Genomics facility, Advanced Analysis Center and several collections (Insects and Plants), are heavily used by IB faculty and students for both teaching and research, and represent significant administrative commitments from IB faculty.

1.3 Future areas of integration and growth

In addition to supporting core strengths and existing areas of integration in teaching and research as outlined above, the strategic planning process revealed several areas of potential growth in research over the next 5 years. These center around two themes that were developed based on feedback from the faculty research survey as well as workshop and focus group discussions: 1) Anthropogenic impacts on the environment and 2) Integration across levels of biological organization. IB should consider these themes as *research clusters* beyond disciplinary, taxonomic or other research activity axes. Faculty should be hired within these clusters based on their ability to contribute to the overarching theme and their ability to integrate across axes. Finally, due to the recent COVID-19 pandemic, Universities and funding institutions will make rapid adjustments to their priorities and funding allocations. While the direct consequences for IB were impossible to predict at the time when this document was finalized, the strategic planning committee agreed that this crisis touches on many areas in which IB is actively conducting research, such as, for example, the impacts of environmental degradation on wildlife biology and the development and spread of emerging diseases. Therefore, some relevant areas were included in the themes outlined below.

Theme 1 - Anthropogenic impacts on the environment: With global climate change on the rise and other anthropogenic activities on the environment having complex impacts on organisms and ecosystems, amalgamated IB expertise can provide critical and fundamental insights into the mechanisms underlying these processes across levels of organization, taxonomic diversity and disciplinary boundaries. Research in this realm also aligns strongly with University priorities in environmental stewardship and biodiversity as well as recently developed UoG Institutes around health and the environment (OneHealth) and environmental research (GIER). Recent hires focusing on ecophysiology, computational biology and bioinformatics make important contributions to this priority. Furthermore, recently approved proposals for future hires are an additional contribution to this priority (environmental/comparative physiology and aquatic ecology and global change). New directions that we develop through future hires can therefore build on this strength and integrate expertise around conservation and wildlife biology, socio-economic impacts of global change and the analysis of multiple stressors on the environment and animals in a well-defined physiological and ecological framework. Moreover, the risk of emerging diseases due to habitat degradation, wildlife trade and altered behavioral patterns due

to anthropogenic impacts as well as air and water pollution all require an integrative and interdisciplinary approach and new hires could complement existing expertise in these areas in IB. These topics are also of direct relevance to a proposed course-based masters program in Wildlife Biology that is currently in development.

Theme 2 – Integration across levels of biological organization: Complex multi-level questions ranging from genome to biomes require an effective integration of mechanistic thinking with evolutionary and ecological processes. This integration should be emphasized in future hires by enhancing expertise in 1) the rigorous and systematic application of OMICS sciences to biological problems and 2) the implementation of theoretical and experimental evolutionary approaches across temporal and spatial scales.

OMICS integration: Future hires will link molecular inquiries with ecosystem level questions using physiological, developmental, ecological or evolutionary approaches to address higher level (beyond specific disciplines, taxonomic groups or levels of organization) questions about the interconnectivity of life on earth, using genomics, transcriptomics, proteomics and metabolomics tools. These include but are not limited to prokaryotic and eukaryotic interactions, ecosystem nutrient cycling, biodiversity studies and trophic interactions. Additionally, there is a need to develop the computational resources to integrate datasets from different sources and levels of organization.

Evolutionary integration: Future hires will integrate evolutionary thinking with ecological and physiological mechanisms across temporal and spatial scales. Research within this cluster ranges from basic understanding of evolutionary dynamics within natural populations to applied questions of genetic diversity in agricultural or aquaculture systems. It also is relevant for studies of experimental evolution and studies of biodiversity and biogeography, both on a phenotypic and a genotypic level.

2 STRATEGIC PLANNING PROCESS

Two committees consisting of staff, students and faculty were tasked to develop new teaching and research plans for IB in F2018/W2019. These committees were joined to finalize the new

Academic plan for IB in F2019/W2020. Consultation with stakeholders was conducted on three separate occasions in order to develop a conceptual framework for strategic activities in IB. In the fall of 2018, a survey was sent out to all faculty in order to collect information on strengths and weaknesses in the department and develop priorities for future hires. In parallel, the teaching committee developed a detailed expectations and actions document in order to develop IB as an agent of improvement/change in the quality of instruction provided to undergraduate and graduate students, and PDFs. The 2019 Departmental Vision and Academic Planning Committee analyzed and discussed this information and developed specific strategic priorities and goals for IB. The overarching concept behind these priorities is to *integrate between the multiple axes of expertise* that exist in the department in both teaching and research. The committee recommends that a similar process be implemented every five years after the release of this strategic plan in order to revisit new developments and priorities.

3 VISION STATEMENT AND GUIDING PRINCIPLES

It is the vision of the Department of Integrative Biology to become an international leader in creating, translating, and applying our understanding of life to contemporary problems using physiological, ecological, and evolutionary perspectives. We are guided by the following principles:

- To *integrate* multiple axes of inquiry in research, instructing and training.
- To *identify* and *solve* existing and emerging multi-level, complex biological questions by challenging the status quo, pursue excellence in research and teaching and champion innovation that can be achieved by adopting an integrative and interdisciplinary approach.
- To *pursue* an integrative and interdisciplinary research approach through dynamic collaborations within and outside the department.
- To *educate*, *instruct* and *train* the next generation of scholars and biology-literate citizens at the undergraduate, graduate and postdoctoral levels using evidence-based high impact educational practices including active and experiential approaches and facilitate opportunities for national and international impact.
- To *foster* productivity and innovation through a working environment focused on wellness, equity, diversity, inclusivity and accessibility.
- To *communicate* with and *engage* society and decision makers in our research to assist with solving problems relevant to the sustainability and wellbeing of society and the environment.

4 STRATEGIC PRIORITIES

Priority 1: Strive for excellence in biology research and training by integrating across multiple axes of inquiry

Below are four specific goals that were developed during the strategic planning process, each with specific action items. Note that the examples following the action items serve the purpose of clarifying the intent of the action items and are supposed to be guiding tools when implementing actions.

Goal 1.1: Maintain our core strengths and enhance our research and teaching in areas of integration and future growth

- **Action:** Hire faculty and staff in identified areas of integration and growth
 - **For example:** Develop faculty hiring proposals within research and teaching clusters
 - **For example:** Actively engage in discussions about potential CRC positions with the College and University.
- **Action:** Find opportunities for seed money that supports novel and exploratory research outside the scope of regular funding opportunities
 - **For example:** Create working groups for the development of interdisciplinary proposals
 - **For example:** Integrate with institutes and initiatives across campus
- **Action:** Build partnerships across campus, industry partners and society
 - **For example:** Develop framework for existing and novel industry collaborations in IB and integrate with existing research (industry partnership grants) and teaching (Co-op programs)
- **Action:** Effectively communicate research findings across campus and beyond
 - **For example:** Develop a clear strategy for communicating departmental research activities, open positions, and collaborative opportunities through departmental website, twitter, SCRIBE, etc.
- **Action:** Incentivize and track societal impact
 - **For example:** Tracking career outcomes and societal outcomes from IB research and teaching activities

Goal 1.2: Build support for research activities

- **Action:** Develop a system that facilitates effective equipment sharing and repair/replacement
 - **For example:** Facilitate and support equipment sharing in IB by developing and maintaining shared and up to date system with list of departmental equipment

- **Action:** Provide enhanced administrative support for research to reduce and streamline paperwork
 - **For example:** Clearly outline processes for common research tasks in departmental handbooks (i.e. hiring, T&P, grant administration and reporting, reimbursement process etc.)
- **Action:** Develop strategies for HQP recruitment and funding
 - **For example:** Facilitate recruitment of international students in collaboration with University and College
- **Action:** Develop a system to support student travel fellowships
 - **For example:** Provide travel fellowships for graduate students on a competitive basis

Goal 1.3: Enhance integration of research and teaching activities

- **Action:** Develop an effective system for teaching assignments that balances teaching needs and the expertise and interests of faculty and staff
 - **For example:** Effective long-term planning of teaching and service commitments
- **Action:** Create opportunities for graduate students and post-docs involvement in teaching
 - **For example:** Opportunities for guest lectures and contributions to curriculum development through committee work
- **Action:** Develop clear criteria for teaching component with faculty DOE.
 - **For example:** Recognize that graduate teaching by faculty is an HQP training contribution

Priority 2: Enhance and improve the working environment in IB

Goal 2.1: Foster a diverse and inclusive environment by continuous and active engagement of all department members to remove barriers faced by equity-seeking groups (Specific examples for these action items will be regularly reviewed by this committee)

- **Action:** Establish and maintain EDI and Mental Health and Wellness committee in IB and making contributions to EDI/MHW an essential component of IB stakeholder activities
- **Action:** Promote work-life balance and social interactions among all IB stakeholders
- **Action:** Create, support and maintain a learning, research, and work environment that is free from discriminatory and intimidating behavior
- **Action:** Address issues related to equity-seeking groups that include, but are not limited to, those represented by race, sex, age, physical disabilities, sexual orientation, gender identity, neurodiversity, and socioeconomic status
- **Action:** Strive to develop and enhance existing Indigenous relationships

- **Action:** Maintaining Equity, Diversity and Inclusion in all IB activities, including committee work, teaching and training as well as research.

Goal 2.2: Strengthen (support) existing collaborations and develop new collaborative activities in research

- **Action:** Create and encourage a culture of sharing/communication in IB
 - **For example:** Develop departmental handbooks for all IB stakeholders that clearly outlines the governance structure of each group and provides examples on essential and relevant processes within the department
 - **For example:** Celebrate successes in IB publicly
- **Action:** Support co-advising of undergraduate and graduate students
 - **For example:** Develop framework for incentivizing co-supervisions of graduate students and undergraduates.
- **Action:** Develop a support system for collaborative grant applications
 - **For example:** Facilitate working groups for the development of interdisciplinary proposals
 - **For example:** Support integration of IB research with novel institutes and initiatives on campus as well as other colleges with well-funded research in areas relevant to IB (i.e. agricultural science, animal bioscience and environmental sustainability)

Goal 2.3: Strengthen (support) existing collaborations and develop new collaborative activities in teaching and training

- **Action:** Integration and coordination of faculty and staff activities with respect to course revisions, curriculum development, new initiatives and delivery
 - **For example:** Establish regular curriculum review by both faculty and teaching staff
 - **For example:** Identify courses where team teaching would enhance undergraduate learning outcomes and assign to faculty and staff willing to test team teaching strategies
- **Action:** Link faculty and staff teaching activities to cross campus activities
 - **For example:** Integrate with ICON course

Priority 3: Raising the quality of the IB training environment

Goal 3.1: Supporting and effectively evaluating MSc and PhD graduate programs

- **Action:** Create measurable outcomes and expectations for graduate students
 - **For example:** Develop a graduate student handbook with specific information of roles of advisor, committee and student expectations as well as learning outcomes
- **Action:** Improve graduate student working environment

- **For example:** Effectively match graduate student expertise with GTA assignments, Provide GTA opportunities that are accessible to graduate students with field work obligations,
- **Action:** Improve graduate student career development
 - **For example:** Support and facilitate graduate training off campus, involve graduate students in departmental service activity (co-chair model), Develop relationships with potential employers, Provide instructional skills workshop, IDPs
- **Action:** Develop support system for graduate students
 - **For example:** Develop framework for graduate student support (financial support, sick leave, parental leave etc.) complementary to existing college and University structures.

Goal 3.2: Enhance career development and learning opportunities for all IB stakeholders

- **Action:** Encourage and reward instructional improvement
 - **For example:** Discuss and develop plan to provide course offerings in the summer through coordinated proposal submissions to LEF (Learning enhancement fund)
 - **For example:** Encourage fellowships/time for change
 - **For example:** Develop and implement evidence-based teaching practices
 - **For example:** Strategic team teaching
 - **For example:** Foster a more inclusive work environment for staff
 - **For example:** Recognize the contribution of graduate students to undergraduate teaching. Provide graduate students with opportunities to get involved in the development of graduate courses (special topic, methodologies and skills).
- **Action:** Increase opportunities to involve postdoctoral researchers in departmental activities, including teaching, training, research and service
 - **For example:** Extend job fairs to postdocs, provide teaching opportunities, IDPs
- **Action:** Provide project management and leadership opportunities for all IB stakeholders

Priority 4: Enhance quality of undergraduate curriculum/experience

Goal 4.1: Enhance learning activities in IB undergraduate curriculum

- **Action:** Mapping of skills/threads across courses
 - **For example:** Organize regular curriculum retreats
- **Action:** Greater participation in interdisciplinary UNIV courses
 - **For example:** Create UNIV/ICON courses, Increase engagement in citizen science

Goal 4.2: Emphasize and develop skills in undergraduate curriculum

- **Action:** Review and develop active and experiential learning opportunities across undergraduate curriculum
 - **For example:** Maintain strong laboratory and field component of existing courses,
 - **For example:** Create UNIV/ICON courses, Increase engagement in citizen science
- **Action:** Enhance job readiness of students
 - **For example:** Coop programs, internships (BIOL 3660 courses), build relationships with potential employers
- **Action:** Course improvements with emphasis on professionalism, numeracy, critical thinking, group learning and scientific communication
 - **For example:** Expand public speaking and presentation opportunities in semester to include field course attendees, URA/USRAs/SRAs, encourage and support conference participation (policy, science)
 - **For example:** Continue to emphasize “hard” skills in curriculum such as using databases, statistical analysis and programming, lab and field techniques, animal identifications etc.

5 ASSOCIATED DOCUMENTS (chronological order)

- Strategic Planning Survey Summary (4/1/2019)
- Strategic Planning Workshop Summary (5/1/2019)
- Expectations_Actions Document May 2019 (5/10/2019)
- Focus Group Summary (12/17/2019)
- IB Responsibilities (2/20/2020)
- EDI Framework (1/29/2020)
- Survey of IBSP by Department (6/18/2020)