



Synthesis Plan

May 2008

- **Broad overarching synthesis themes/outcome**

GoMA's goal is to describe marine biodiversity in the Gulf of Maine region, including estimates of the unknown, and describe the ways that patterns of biodiversity affect attributes and functioning of the ecosystem. Although the Gulf of Maine is a comparatively well-studied region, our focus on biodiversity and function at the regional system level will be unique. Our collaboration with senior scientists at US and Canadian federal fisheries agencies and key conservation-oriented NGO's will help ensure another goal: that our accomplishments and communications prove useful in the broader conservation and ocean management realm.

In considering patterns and functioning, we will incorporate historical views of the system (through collaboration with HMAP and HNS), as well as observed and predicted impacts of biodiversity alterations (through collaboration with FMAP). Other CoML field programs have tremendous expertise, insight and data in environments where we have comparatively little new information specific to our region; we plan to involve these valuable and exciting sources of information at every appropriate step to make ours a truly synthetic and integrative product.

For our final project phase we have defined four theme areas to provide rallying points for the program and our regional research community:

- Biodiversity in the Gulf of Maine Area
- Bioinformatics and Visualization
- Biodiversity Attributes in Relation to Ecosystem Approaches to Management (EAM)
- GoMA Lessons Learned and Ecosystem Comparisons

We hope to capture public attention at a large scale via magazine and newspaper articles, engaging websites, a student video contest, and several proposed film productions. These outreach products, as well as our contributions to data systems and ocean observing, will stand as legacies of GoMA contributions to global society.

- **Synthesis management structure**
 - a. **Primary synthesis coordinator:**

Sara Ellis

b. Synthesis themes and leads

Synthesis Themes	Lead	Outputs
Biodiversity in the GoM Area	Lew Incze, Peter Lawton	Writing meetings, multiple scientific publications, new web content
Bioinformatics / Visualizations	Nicholas Wolff	Online data and mapping application, including development and hand-off Web based visualizations
Biodiversity Attributes in Relation to EAM	Peter Lawton	Joint paper with DFO-NMFS-GOMA; ICES paper
GoMA Lessons Learned / Comparisons of Regional Ecosystem Studies	Sara Ellis	Presentations, scientific publications, web content
Education and Outreach (to promote outputs from each of the four themes)	Susan Ryan	Workshops, presentations, lecture series, teacher placements, regional marine education initiatives, brochures, press releases, media interviews

Our ambitious synthesis plan will require close coordination between, and support from, the core GoMA project scientific support team that is now located at two principal sites – University of Southern Maine (USM) and the DFO Biological Station (SABS), Saint Andrews (funded through the Canadian Centre for Marine Biodiversity). At USM we have GIS specialist A. Adamek, and database specialist Nick Wolff. At SABS we are bringing on M Greenlaw (who has a Masters in applied geomatics) full time from July 2008, and Lawton will hire a postdoctoral candidate for another full time position in July or August 2008. Upon hiring and orientation to the GoMA program, we expect these two new staff members to complement the existing team at USM, as well as provide us with additional qualified marine specialists to work on specific synthesis outputs outlined in this plan.

- **Outline of chapter for Contributed Synthesis Volume**

The GoMA project management team of Ellis, Incze, and Lawton will be jointly responsible for GoMA's chapter in CoML's synthesis volume. Content will follow the general outline below.

1. *The Known (Status of discipline prior to Census)*

- Historical perspective
- A wealth of knowledge, a dearth of integration
- Driving factors for research
- Emerging need for integrated assessments and EAM

2. *From Unknown to Known (Evolution of GoMA)*

- What were the major gaps (geographic, taxonomic, technical etc.)?
- Approaches taken to closing gaps (including new tools and opportunities)
- Findings (including major discoveries, surprises, new research directions)
- Ramifications (scientific, governmental, policy, health, political, others?)
- New questions (emerging issues over the life of GoMA)

1. *The Currently Unknown (Remaining gaps)*

- Describe the unknowns in broad but useful ways
- From the above, what seem to be the most interesting and important questions (i.e., scientific and societal)?
- How can we conserve those elements of biodiversity that probably will remain unknown far into the future? What is the rationale for doing this (e.g., ecosystem function, applications to EAM)?

4. *How Can we Move From Unknowable to Knowable (Novel approaches to resolve the currently "impossible")*

- What limits our knowledge?
- Why do we need to push the limits?
- Ideas to move the goalposts (dream cruises, technology, modeling, ocean observing, etc.)
- Blueprint for the future (beyond 2010)

5. *Conclusions*

- Summary and practical suggestions on how knowledge/understanding might be moved forward from here.

- **Within-project synthesis plans (what product and who?)**

Within-project synthesis outputs	Lead	Target journal, venue or audience
For Scientific Audiences		
<u>Theme: Biodiversity in the Gulf of Maine</u>		
1. Spatial patterns of biodiversity at GoM and medium scales (basins, slope, banks, coastal zone, sea mounts, etc.), including estimate of total biodiversity, functionality of that diversity, and impacts of anthropogenic and climate forcing.	Incze & Lawton coordinate, and where appropriate lead, writing teams that include original working group chairs, PIs from GoMA-funded projects, Discovery Corridor and other Canadian research; additional experts	<i>Can. J. Fish. Aquat. Sci., ICES J Mar Sci; Bull. Mar. Sci.</i> , new web content
2. Zoogeography and changes in macro-invertebrate community diversity of rocky intertidal habitats	T Trott	<i>J. Coastal Geology</i>
3. Migration/feeding/space usage by whales in the Gulf of Maine	S Kraus, K Smedbol	<i>Marine Mammal Science</i>
4. “20-years-after” survey of life on Cashes Ledge	J Witman	TBD
5. Comparison of biodiversity in Cobscook Bay versus other locations on the East Coast of the US and Canada	T Trott	TBD
6. Statistical analyses of diversity measures extracted from the NMFS trawl survey database	AB Cooper, A Solow	TBD
7. Meta-analysis of US (e.g Cooper/Solow) and Canadian studies on fish diversity within GoMA and adjacent areas	K Frank, JA Cooper (DFO)	TBD
8. Genetic evaluation of southward spread of green crabs from a secondary invasion	J Byers	TBD

Within-project synthesis outputs	Lead	Target journal, venue or audience
9. Relationship between cod distribution and benthic habitat on an offshore ledge	J Grabowski	TBD
10. Diversity, distribution and abundance of deepsea corals found on New England seamounts and northeast continental margin	P Auster	Proceedings of 4 th International Symposium on Deepsea Corals
<u>Theme: Bioinformatics</u>		
1. Dynamic Approach to Integrating Oceanographic and Biogeographical Data in the Gulf of Maine	Wolff, R Franks, D Briggs, B MacLeod, Incze	ICES Annual Science Conf., Sept. 2008
2. Web-based data and mapping application	Wolff, J Black	Website (DFO and/or GoMODP)
3. Gulf of Maine Register of Marine Species (GoMRMS)	L Van Guelpen, G Pohle, M Kennedy	Website to be maintained by DFO
4. Increase GoMRMS functionality: flexible searching, links to content pulled from the Encyclopedia of Life, ITIS, Tree of Life web project, and Interactive Tree of Life	Wolff, L Van Guelpen, G Pohle	Web
5. Hand-off of GoMA bioinformatics achievements to OOS	Incze, Wolff, Lawton	TBD
<u>Theme: Biodiversity Attributes in Relation to EAM</u>		
1. Joint paper with DFO-NMFS after publication of Ecosystem Overview	M Fogarty, R Stephenson, Lawton, Incze	TBD
2. Approaches to modeling ecosystem functions as a function of oceanography and benthic spatial structures	P Auster and Incze	TBD
3. Ecosystem-based management and marine habitat mapping	C Cogan, B Todd, T Noji, Lawton, D Connor	ICES Annual Science Conf., Sept. 2008; <i>ICES J. Mar. Sci.</i>

Within-project synthesis outputs	Lead	Target journal, venue or audience
<u>Theme: GoMA Lessons Learned</u>		
1. GoMA Lessons Learned	Ellis	GoM Science Symposium, Oct 2009; presentation and publication in proceedings
For the General Public		
1. National Geographic Wild Chronicles: Discovery Corridor	URI Outreach Team, National Geographic, Lawton, Ryan	Television CoML and GoMA websites
2. 15-minute documentary film on GoMA research and discovery	Lawton, Ryan	DVD distribution; web download
3. CBC “Land and Sea” episode featuring GoMA and NaGISA	Lawton, Ryan	Canadian television viewers
4. Bilingual brochures on biodiversity in the Gulf of Maine (in French and English)	Lawton, CMB, DFO Communications	Canadian public
5. Web content	Ellis w multiple authors (USM, CMB, collaborators)	General public
6. Brochures	Ryan	General public
7. Press releases	Ryan	General public via media
For Teachers and Students		
1. “Telling your Story” workshop for scientists and teachers	Ryan	K-12 teachers, regional scientists
2. Placements of ARMADA teachers with summer field research -Platts Bank cruise -Intertidal sites	S Hickox, Ryan Incze T Trott	Selected US master teachers
3. Video contest for high-school students (ocean literacy theme)	Ryan	Regional & national ocean science bowls, YouTube

Within-project synthesis outputs	Lead	Target journal, venue or audience
4. Marine science essay contest	Lawton (CMB)	Senior high school students in Atlantic Canada
5. GMBIS-based curriculum	M Bampton (USM)	Colleges and universities in northeastern US
6. Special sections of web site	Multiple (USM and CMB)	Web
7. Educational posters on marine fauna	Lawton, CMB	K-12 students
For Managers		
1. Policy briefings in US and Canada	Ellis, Lawton	Marine resource managers
2. Brochures	Ryan	Marine resource managers

- **Cross-project synthesis plans (what product and who?)**

Cross-project synthesis outputs	Lead	Target journal, venue or audience
1. Comparison of several ecosystem-scale studies of biodiversity	Ellis with synthesis writing team including T Shirley and R McLaughlin (GoMEX), B MacKenzie (Baltic Sea), R Pitcher (Great Barrier Reef), Incze, Lawton (GoMA)	Presentation(s) at GoM Science Symposium, Oct 2009 Peer-reviewed symposium proceedings, or <i>Frontiers Ecol Environ</i>
2. Meta-analysis of bio-physical relationships between seabed species/assemblages and their environment	Lawton (GoMA) Pitcher (Great Barrier Reef)	TBD (awaiting final funding decision from CoML Synthesis Comm.)

Cross-project synthesis outputs	Lead	Target journal, venue or audience
3. Ecological context and implications of large herring shoals	Makris, Ratilal, (OAWRS), Jech (NEFSC), Incze (GoMA), G Melvin (DFO)	TBD
4. Changes in biodiversity along the intertidal and near-shore zones in the lower Bay of Fundy	Trott, Lawton (GoMA), Van Guelpen, Pohle (NaGISA)	TBD
5. GoMA methodologies for CoML methodologies handbook. Includes directed biota collection approaches in deep realms (<i>e.g.</i> ROPOS), acoustic-based methods (<i>e.g.</i> Makris), optical-based methods (ROV, towed platforms and other <i>in situ</i>), ocean observatories (NEBO), habitat classification schemes, data fusion between sampling techniques/addressing scale mismatch, etc.	Ellis (solicit US technical sources); Lawton (solicit Canadian technical sources)	CoML Methods Handbook
6. Create an inventory of marine barcoding initiatives underway in GoM region. Review existing links and develop recommendations for improvement and greater awareness within the regional community.	Incze (GoMA) D Steinke (BCOL)	GoMA and BCOL websites
7. Gruppe5Film documentary on CoML, with opening section on GoMA	Stefan Schneider (Gruppe5Film) Incze (GoMA), URI Outreach Team	
8. Popular article on “Three Gulfs” (Gulfs of Maine, Mexico, and Alaska)	Ellis (GoMA), URI Outreach team, author TBD	<i>National Geographic</i> or <i>Discover</i>

- **Visualization outputs**

In November 2007 GoMA launched a powerful version of a data and mapping application (aka Gulf of Maine Biogeographic Information System, [GMBIS](#)) which allows users to create interactive maps of layered biological and geophysical data and to download selected data. We are currently conducting public beta-testing. We will continue development through mid-2009 and plan to hand-off the application in 2010 to a new host organization, yet to be determined, which will maintain it as part of IOOS. We are now working with Canada’s DFO to

evaluate technology sharing of code with their ACON program package (developer J. Black, DFO) which has desirable features that we have not yet implemented.

We will create new visualizations of GoM data for our website in two classes of products: (1) Google Earth plots of tracking data for large migratory taxa (whales and tunas: Halpin, Block and Kraus) and “power-of-ten” scale-ins to some of the better-studied sites (Platts Bank, Discovery Corridor); and (2) other selected products, including fly-throughs, photos and/or other illustrative materials from GoMA field projects.

Dates	Visualization Items	Leaders or Contacts
Beta version currently online; to be handed off in 2010	Data and mapping application	Wolff
Nov 2008	Power of 10: Humpback whale migrations, use of feeding hotspots in GoM, e.g. , Platts Bank	Incze, Halpin, Adamek
June 2009	Discovery Corridor fly through, combined with text and images	Lawton, Greenlaw, Adamek, Halpin

- **Timelines/milestones for deliverables**

Dates	Milestones	Leaders or Contacts
Feb 2008	Proposal to NSF on ecological context of herring shoals (submitted)	Makris, Ratilal, Incze
April 2008	Submit letters of intent to CoML Synthesis Group for: -ecosystem comparisons (submitted, not selected for funding) -species assemblages in relation to habitat (submitted, in final review)	Ellis Lawton, R Pitcher
	GoMA presentation at GeoHAB meeting (Sitka, AK, USA) (completed)	Lawton
April-Nov 2008	Help organize NEOSEC’s Ocean Literacy Summit II (Boston, MA, USA)	Ryan
May 2008	CoML/GoMA presentation to GLOBEC SSC	Incze

Dates	Milestones	Leaders or Contacts
May 2008	Co-host COSEE-NE “Telling your Story” workshop for scientists and teachers (scheduled for May 29)	Ryan
June 2008	First meeting of steering group for ecosystem comparison (Harte Institute, Corpus Christi, TX, USA) (scheduled for June 9-10)	Ellis, T Shirley
	Documentary film group develops GoMA film concept	Lawton, Ryan, Incze, Ellis
	US and Canadian informatics experts begin collaboration on interoperability and functionality of GMBIS and ACON	Wolff, J Black
Aug 2008	Platts Bank Cruise (ONR funded)	Incze
	Host two ARMADA teachers -Platts Bank cruise -NaGISA field study	S Hickox, Ryan Incze T Trott
	Work with Gruppe5Film documentary team	Incze, Lawton, Ryan
	Presentation on NaGISA protocols at annual meeting of National Marine Educators’ Association (Savannah, GA, USA)	Ryan, JB Kavaliauskas
Fall 2008	Convene writing meetings of working group chairs and other invited experts, re GOM biodiversity (Portland, ME, USA)	Incze, Lawton
	Assemble HMAP/FMAP team for synthesis geared to Oct ‘09 GoM Science Symposium	Ellis
	Contact BCOL to review and track sample agreements in GoM region	Incze
Sept 2008	Presentations at ICES Annual Science Conference (Halifax, NS, Canada): -GoM data and mapping application -Marine habitat mapping and EAM	Wolff, R Franks Lawton (co-author with others from Marine Habitat Mapping Working Group)

Dates	Milestones	Leaders or Contacts
Oct 2008	Mapping & visualization workshop (Durham, NC, USA)	Wolff, Adamek (USM) M Greenlaw, R Benjamin (DFO)
Nov 2008	Presentation at NEOSEC's Ocean Literacy Summit II (Boston, MA USA)	Ellis
	World Marine Biodiversity Conference, (Valencia, Spain)	Incze, Lawton, Ellis
Dec 2008	Presentation at 4th International Symposium on Deepsea Corals (Wellington, NZ)	P Auster
	All data from GoMA projects submitted to OBIS	Wolff
Jan 2009	Launch lecture series w GMRI	Ryan
Feb 2009	CoML synthesis workshop (Long Beach, CA, USA)	Incze, Lawton, Ellis, Ryan, Wolff
Mar 2009	Complete review of BCOL-GoMA research community interaction and provide dynamic links to online resources from GoMA website	Incze, Lawton, Steinke
April-July 2009	R Pitcher's proposed sabbatical period (funded by CSIRO) to the Biological Station, St. Andrews, NB Canada. Facilitates work on cross-program syntheses in addition to his own planned work during sabbatical on deliverables for Great Barrier Reef project	Lawton, Pitcher
Summer 2009	Updates to GoMRMS completed	Pohle, Van Guelpen
	GoMRMS hyper-linked to EOL, ITIS, Tree of Life web project, and iTOL	Wolff
	Discovery Corridor cruise (NSERC and DFO-funded as part of the new Canadian Healthy Oceans Network, led by Snelgrove)	Lawton

Dates	Milestones	Leaders or Contacts
Aug 1, 2009	Draft Cross-Project synthesis paper for review by Synthesis Group: -Ecosystem comparison -Seabed species/assemblages and habitat	Ellis Lawton, R Pitcher
TBD 2009	Provide information and graphics for CoML National Geographic maps	Wolff, A Adamek, M Greenlaw
Oct 2009	GoMA co-sponsors GoM Science Symposium (St. Andrews, NB Canada) Presentations at GoM Science Symposium, St. Andrews, NB Canada -GoMA lessons learned -Ecosystem studies comparisons -Historical biomass /population estimates -Impacts of possible biodiversity changes	Incze, M Greenlaw (on Organizing Committee) Ellis Ellis Incze, Rosenberg (HMAP) Ellis, TBN (FMAP)
Dec 1, 2009	GoMA project chapter submitted to McIntyre Final draft to Synthesis Group: -Ecosystem comparison publication(s) -Seabed species/assemblages and habitat	Ellis Ellis Lawton and Pitcher
Early 2010	GoMA 15-min documentary file released “Three Gulfs” popular article published	Lawton Ellis
Jul 2010	Discovery Corridor cruise (NSERC and DFO-funded)	Lawton
Jul-Dec 2010	Intensive media campaign	Ryan
Fall 2010	ICES annual meeting (Poland) Policy briefings in US and Canada	Incze, Lawton, Ellis Ellis, Lawton
Oct 2010	Census “Grand Finale” events, London	Incze, Lawton, Ellis, Ryan, Wolff
Dec 2010	GMBIS application handed off to IOOS GOMA website handed off to inheritor site	Wolff Wolff