



NF-UBC Nereus Annual Report

September 2011 to February 2012



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FOREWORD FROM THE PRESIDENT AND VICE-CHANCELLOR OF THE UNIVERSITY OF BRITISH COLUMBIA

I am pleased to have observed the growth and success of the NF-UBC Nereus Program – an integrated endeavour addressing many complex issues facing our oceans as well as planning for the future.

The Nippon Foundation continues its integral role in these collaborative efforts, demonstrating the same values and principles that guide the university's strategic initiatives. UBC shares the conviction that the Nereus program represents a unique, interdisciplinary approach that offers strong potential for promoting and establishing a sustainable relationship with the world's oceans. I am inspired by the passion and innovation conveyed by those involved in the program.

The Nereus program is both pertinent and essential to meeting these pervasive challenges. With the Rio Earth Summit approaching, it is my hope that we will see the emergence of similar international and interdisciplinary initiatives to provide comprehensive responses and to prepare for the future.

I would like to thank Dr. Villy Christensen, Dr. Yoshitaka Ota, and Dr. Daniel Pauly for their academic and directional efforts towards the development of this valuable program, and wish all partners, principal investigators, and fellows the very best in their collective pursuit of a prosperous future for our oceans. I look forward to witnessing their future accomplishments.

Stephen J. Toope

President and Vice-Chancellor of The University of British Columbia

COMMENT FROM THE DIRECTOR OF THE NF-UBC NEREUS PROGRAM

The joint activity of the Nippon Foundation and UBC, Nereus – Predicting the Future Ocean Program has taken on a very ambitious task: to provide guidance for how we as a global society can ensure seafood and a healthy ocean for future generations to enjoy. To do so, entails not just capacity to analyze and evaluate the state of living resources in the world ocean and how these will develop in a future with increasing demand for seafood under the impact of climate change. It also includes evaluating how we can develop alternative management strategies that are resilient to such impact. Taken on this task is indeed very ambitious and calls for long-term commitment from all sides – what makes me optimistic of the success of the endeavor is, however, that we have gathered a truly outstanding cohort of Nippon Foundation Nereus’ Fellows that are demonstrating a strong commitment to working together across disciplinary boundaries to provide not just world-class research but also solutions.

While the work of the Nippon Foundation – UBC Nereus has only just started, we are very pleased to report to the Nippon Foundation and UBC that the recruitment of Fellows for the activity has been completed, and that the work by now is well underway. The present report provides an overview of the activities of the Program with focus on the work of the Fellows. Their work is fundamental to ensure that the research is independent and of the highest caliber possible, and thereby for the ultimate success of the activity.

I am also very pleased to report that the reception of the Nippon Foundation – UBC Nereus Program has been exceptionally positive from all partner institutions, the broader scientific community, and from policy makers. There are strong expectations for the Program from all sides and a true sense that the activity is both timely and very important to support responsible use of our ocean resources in the future.

Let me finally express my gratitude to the Nippon Foundation for the visionary approach that led to the establishment of the Nereus Program and its joint focus on science, policy, capacity building, and outreach. I look forward to the coming years of cooperation with anticipation and interest.

Villy Christensen
Director, NF-UBC Nereus Program

EXECUTIVE SUMMARY

Executive Summary

The Nippon Foundation and the University of British Columbia have completed the one-year preparatory phase of their joint international marine program—the NF-UBC Nereus Program—and, in September 2011, began full-fledged activities based on the following three pillars:

1. Scientific Research: Predictions of the state of the ocean in 2050;
2. Capacity Building/Human Resource Development: Cultivation of marine scientists with a comprehensive outlook; and
3. Public Outreach: Helping politicians and the general public understand the state of marine resources.

Currently, researchers from the University of British Columbia, Princeton University, Duke University, the World Conservation Monitoring Centre, Cambridge University, and Stockholm University, as well as young researchers appointed as Nippon Foundation Nereus Fellows, are collaborating on research projects with the intent to acquire knowledge that will contribute towards “Predicting the Future of the Oceans in 2050.”

Actions to date include a conference held in January 2011, which was attended by all participating organizations, and both a request for official cooperation and a signed letter of intent by all organizations involved. Commencing in July 2011, the program began to accept applications for Nereus Fellowships, which represent the core of the next generation of researchers; the first Nereus Workshop was subsequently held at Princeton University for those selected. Funding has been issued to all organizations, and we have established a Nereus Website, which is updated regularly.

With respect to the cooperative system established with each participating organization, the Nippon Foundation and the University of British Columbia have exchanged letters of intent to cooperate, and the University of British Columbia has confirmed the division of research roles with each participating organization. Research at Princeton University is presently directed at determining changes in the marine environment arising from climate change, while researchers at Duke University are employing analytical methods such as spatial geography to evaluate marine habitat and the influence of climate change on fisheries. Further research is being done at the World Conservation Monitoring Centre and Cambridge University to employ geographic data in the evaluation of marine life distribution, while those at Stockholm University are endeavouring to increase our understanding of effective methods of international ocean governance.

The selection of 10 Nereus Fellows was carried out with fairness and transparency, and in accordance with the regulations of each research institution. The process followed the Nippon Foundation’s guidelines to nurture the growth of talented marine scientists, with the intent to promote the development of talented individuals possessing broad vision and

comprehensive multi-disciplinary knowledge. During the selection process, the principal researchers at each institution reviewed not only the accomplishments of the candidates in their own scientific fields, but also their experience in interdisciplinary research, the passion they displayed for research with practical applications in areas such as policy-making, and their potential for working as members of a team. Once completed, the Nereus Program intends to publish the Fellows' research results in prestigious international scientific journals.

In February 2012, participants presented an independent symposium at the American Association for the Advancement of Science, held in Vancouver, British Columbia. The symposium was titled "Nereus – Predicting the Future Ocean," and the event has been reviewed and reported in various forms (e.g., news articles, science podcasts, etc.) by international journalists who attended the convention.

An Annual Nereus Meeting was also scheduled for February 2012, during which the Nereus Fellows and senior researchers from each research institution gathered to engage in in-depth, cross-disciplinary discussions regarding the future of marine resources. Going forward, we plan to create an interdisciplinary field focusing on the oceans, while simultaneously facilitating more vigorous discussions among young researchers who are interested in integrating scientific research and governance strategies. The following three points are therefore of utmost importance in further developing our program:

- 1. Development of new fields through interdisciplinary interactions:** The potential exists to develop new research fields based on the collaborative research of the Fellows.
- 2. Promotion of integrated projects that connect the social and natural sciences (Nereus Diagram Construction):** Using simplified explanations and discussion, integrated projects can have a positive impact on bridging the gap between the social and natural sciences.
- 3. The necessity of new components (international laws, etc.)**
The strategic promotion of participation in other fields of study is necessary if we are to solve the problems facing marine resources. As we move forward, we will work with the Fellows and others to implement programs based on these three points.

Overall, the program has advanced according to schedule, and strategic development of research and capacity building activities has been observed. As we progress, we will require further efforts towards implementing an efficient outreach strategy; however, it is too early to comprehensively assess this requirement. Thus, the program has demonstrated satisfactory growth and preliminary achievement, and shows great promise for future success.

Yoshitaka Ota
Co-Director, NF-UBC Nereus Program

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1. INSTITUTE REPORTS

1.1 UNIVERSITY OF BRITISH COLUMBIA

1.1.1 INSTITUTIONAL PROGRESS

Having begun in September 2010, the Nereus Program commenced its first year with a focus on establishing networks and objectives. This notably involved negotiations with the suggested partner institutions regarding the work content and contracts. The initiation was completed without difficulty, and all partners were enthusiastic to join the program. Dr. Yoshitaka Ota joined the program as Co-Director in January 2011.

After a year of preparation, the first phase of the Nereus Program began in September 2011 with the appointment of Nereus fellows and the hiring of key Nereus staff at the University of British Columbia (UBC). We have been impressed with the level of cooperation from the partners: all have expressed that the work has inspired their respective institutions, and that they see the questions raised by the program as being of great importance for their research. This indicates a greater level of engagement from the partner institutions than originally expected.

Scientifically, the work has concentrated on defining the fellows' research goals and determining how these contribute to Nereus' overall objectives. The comparative advantage of the Nereus Program is that it represents the only research group that aims to analyze the impact of fisheries management on the global ocean based on predictive evaluations. To make it possible for the fellows to conduct their studies on a global scale, we have—through a very dedicated effort—developed the initial version of a Nereus data and modelling framework. We have thus developed the first holistic model of life in the global ocean and have made this framework available to the fellows. The implementation of the framework (the Nereus model) calls for capacity building—a goal that we are committed to support, and with which we hope to see initial results emerging in 2012.

We have also started the initial steps of defining Nereus' communication strategy, which involves (1) scientific communication, including cross-cutting papers involving fellows from different partner institutes, (2) communication with decision-makers, building on the OceanViz methodology, and (3) public communication, which involves supporting the fellows in preparing short stories about important fisheries management topics that relate to their research. We will develop the communication strategy in close cooperation with the partners, but have also taken the initiative to develop some preliminary products in order to stimulate the interest of the partners in scientific communication.

We recently hosted the first annual meetings of the Nereus fellows, PIs, and associates, along with the first steering committee meeting. In addition to its success, we were very impressed by the high scientific level of knowledge offered by the fellows, and even more so with the strong commitment to work across disciplines in order to address the questions and challenges faced within the scope of the Nereus program. Similar sentiments were expressed by the PIs. The scientifically stimulating dialogue that occurred during the meeting indicates that we are on track for addressing complex issues in a comprehensive and innovative manner.

This year, we also organized a session titled “Predicting the Future Ocean: the Nereus Program” at the recent 2012 AAAS Annual Meeting. During this session, all PIs from the Nereus Program presented their work and Dr. Villy Christensen provided an overview of the Nereus Program. Most of the fellows attended both AAAS and the session, the latter being one of the two best attended ocean sessions at AAAS. We were very fortunate to also hold a press briefing at AAAS in order to announce the Nereus Program, the development of the Nereus model, and some initial findings. The responses to our presentations have been very favorable, and more than 40 North American and European media outlets (primarily newspapers) have reported on the Nereus program. Furthermore, the Canadian Broadcast Corporation (CBC) used the Oracle as a feature in the CBC News coverage when commenting on the overall AAAS conference.

1.1.2 PROGRESS OF FELLOWS

AUDREY VALLS: NF NEREUS FELLOW

In August 2011, Audrey's supervisory committee approved her research proposal for her Ph.D. Afterwards, she successfully passed her comprehensive exam, including an oral qualifying exam given by the committee members. As of September 2011, she holds the title of Ph.D. Candidate, allowing her to fully focus on her research.

In September 2011, Audrey made significant progress on the second chapter of her thesis, focusing on species vulnerability to fishing. She worked on reviewing the parameters and methods that could be used to implement an index of extrinsic vulnerability to fishing, derived from Dr. William Cheung's index. She presented this preliminary work at the World Conference on Marine Biodiversity in Aberdeen in late September.

Since October 2011, Audrey has been focusing on the first chapter of her thesis, looking at species diet composition predictions for ecosystem models. She reviewed the literature in order to select potential predictors to be used for fish species. Thus, she defined a suite of predator types and predation behaviours to be considered. She also incrementally defined a predictive procedure to be implemented in an automated way in Ecopath with Ecosim models, based on a previously published algorithm. The scope of the feeding selectivity model she proposed was progressively redefined, considering data and modelling limitations. Dr. Villy Christensen and Audrey agreed to use the Mediterranean Sea as a case study to build and test the fish feeding selectivity model, which could then be applied on a global scale. She gave an overview of her first chapter during the Nereus meeting held in February. Her presentation was well received by the other Nereus fellows, who indicated a strong interest in collaborating on this particular topic. Audrey has also been working with Jeroen Steenbeek and Dr. Deng Palomares (UBC Fisheries Centre) on how to best extract and use the data available in the FishBase database to run her fish feeding selectivity model.

Meanwhile, Audrey has been collaborating with Dalai Felinto and Dr. Yoshitaka Ota on a video presentation of the fish feeding selectivity model to be delivered for the general public. This project aims at making her research work understandable to those without a scientific background. Working on the video has been very instructive for Audrey, allowing her to think about her model in visual terms and providing a good exercise for simplifying complicated scientific concepts.

Audrey recently attended the AAAS meeting in Vancouver and, in particular, the Nereus session.

1.1.3 DISSEMINATION RECORD

* = Nereus publication or presentation.

PRESENTATIONS

Dr. Villy Christensen

1. ***2012: AAAS Symposium, Predicting The Future Ocean – The Nereus Program. Vancouver, BC. Organizer and speaker (joint presentation with Dr Ota). Press briefing presenter.**
2. 2012: APEC-LME Workshop on Marine Ecosystem Assessment and Management, Seoul, Korea, Jan. 4-5.
3. 2011: University of Sao Paulo, Brazil, Dec. 1. Relationship between oceanography and fisheries research.
4. 2011: American Fisheries Society Meeting, Seattle WA. Session on global overfishing, keynote. September 7.
5. 2011: Using ecosystem modeling to evaluate impact of oil spills. NOAA Deepwater Communities Expert Workshop, St. Petersburg FL, April 21-22, 2011
6. 2011: Ocean visualizations and games. New tools for promoting sustainable fisheries. Role playing and other videogames. CIESM International Workshop. Gothenburg, 24 March.

7. 2011: NSERC Canadian Capture Fisheries Research Network, 1st AGM, Vancouver, 22-24 February. Hecate Strait Crab fisheries and their ecosystem
8. 2011: AAAS Symposium, 2050 – Will There be Fish? Washington DC, US, Feb. 18. Organizer and speaker. Press briefing presenter.
9. 2011: FARO/Safari Remote Sensing Workshop. Toronto, 6 Jan., Remote sensing and ecosystem impacts.

Dr. Yoshitaka Ota

1. ***2011: International Marine Conservation Congress, Introducing Satoumi. Victoria, Canada**
2. ***2011: Environmental Management of Enclosed Coastal Sea Meeting. Small place, large issues – Japanese coastal management. Baltimore, USA (Invited)**

Audrey Valls

1. Valls, A., Cheung, W., Christensen, V. Predicting future changes in marine biodiversity: An index of overall vulnerability to fishing for marine species. World Conference on Marine Biodiversity 2011, Aberdeen, Scotland (UK), September 26-30, 2011. Oral presentation.
2. Valls, A. Predicting future changes in marine biodiversity. FISH 500 Seminar, Fisheries Centre, University of British Columbia, Vancouver (CA), February 25, 2011. Oral presentation.

PUBLICATIONS

Dr. Villy Christensen

1. ***V Christensen, A Boustany, J Buszowski, WWL Cheung, DC Dunn, D Felinto, C Folke, PN Halpin, K Kearney, C McOwen, A Merrie, M Metian, H Österblom, Y Ota, RR Rykaczewski, JL Sarmiento, J Steenbeek, CA Stock, UR Sumaila, W Swartz, CJ Walters, R Watson, J Watson, A Valls, L Wood, and D Pauly. Life in the future ocean: the Nereus model. Manuscript presented at AAAS 2012, session “Predicting the Future Ocean: Nereus Program” in Vancouver BC, 18 February 2012.**
2. ***Christensen, V. 2012. The Oracle Meets Nereus: Predicting the Future Ocean. UBC Reports, 58(1). Jan. 3, 2012. Online Edition.**
3. ***Christensen, V., Piroddi, C., Coll, M., Steenbeek, J., Buszowski, J., & Pauly, D. (2011). Fish biomass in the world ocean: A century of decline (pp. 1–20). Fisheries Centre. Working Paper Series, Working paper #2011-06.**
4. Ahrens, R. N. M., Walters, C. J., & Christensen, V. (2012). Foraging arena theory. *Fish and Fisheries*, Foraging arena theory, 13, 41–59. doi:10.1111/j.1467-2979.2011.00432.x
5. Melnychuk, Michael C., Villy Christensen, and Carl J. Walters.. 2012. Meso-scale movement and mortality patterns of juvenile coho salmon and steelhead trout migrating through a coastal fjord. *Environmental Biology of Fishes*. (in press)
6. Morissette, L., Christensen, V. and Pauly, D., 2012. Marine mammal impacts in exploited ecosystems: would large-scale culling benefit the fishery. *PLoS* (in press)
7. Arias-González, J.E., González-Gándara, C.J., Cabrera, L., and Christensen, V. 2011. Predicted impact of the invasive lionfish *Pterois volitans* on the food web of a Caribbean coral reef. *Environmental Research* (in press).
8. Christensen, V., J. Steenbeek, P. Failler. 2011. A combined ecosystem modeling and value chain approach. *Ecological Modelling* 222:857-864.
9. Coll, M., Piroddi, C., Albouy, C., Ben Rais Lasram, F., Cheung, W. W. L., Christensen, V., Karpouzi, V. S., Guilhaumon, F., Mouillot, D., Paleczny, M., Palomares, M.L., Steenbeek, J., Trujillo, P., Watson, R., & Pauly, D. 2011. The Mediterranean Sea under siege: spatial overlap between marine biodiversity, cumulative threats and marine reserves. Submitted to *Global Ecology and Biogeography*, (in press)
10. Melnychuk, M.C., Walters, C.J., Christensen, V., Bothwell, M.L., and Welch, D.W. Effects of solar ultraviolet radiation exposure on early ocean survival and fry-to-smolt growth of juvenile salmon. *MEPS* (in press)
11. Piroddi, C., Giovanni, B., Christensen, V. Effects of local fishery and ocean productivity on the Northeastern Ionian Sea ecosystem. *Ecological Modelling*, (in press).
12. Piroddi, C., Giovanni, B., Christensen, V. Is marine open cage aquaculture a new trophic resource for common bottlenose dolphins? *Marine Ecology Progress Series* (in press)

13. Wabnitz, C., Christensen, V., Balazs, G., Bjørndal, K., Bolten, A., and Pauly, D. Baseline trophic relationships in Kaloko Honokōhau, Hawai'i. *Mar. Ecol. Prog. Ser.* (in press)
14. Piroddi, C., Bearzi, G., Gonzalvo, J., Christensen, V. From common to rare: the case of the Mediterranean common dolphin. *Biological Conservation*, (in press)
15. Espinosa-Romero, M.J., E.J. GREGG, V. Christensen, C. Walters, and K.M.A. Chan. 2011. Representing mediating effects and species reintroductions in Ecopath with Ecosim. *Ecological Modeling* 222: 1569-1579.
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17. Christensen, V., and A.W. Trites. 2011. Predation on Fraser River sockeye salmon. Cohen Commission Tech. Rept. 8: 120 p. www.cohencommission.ca
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21. UNEP. 2012. Global Environment Outlook 5 (GEO-5). Chapter 15: Scenarios and Sustainability Transformation. (Lead author).
22. PBL. 2012. GLIMP: Global integrated assessment to support the EU future environmental policies. The scarce resources issue study; Fisheries. DGEnv Service Contract No. 07.0307/2009/550636/SER/F1. (Lead author).
23. Christensen, V., Lai, S., Palomares, M.L.D., Zeller, D., Pauly, D. (eds.). 2011. *The State of Biodiversity and Fisheries in Regional Seas*, Fisheries Centre Research Reports 19(3). Fisheries Centre, University of British Columbia [ISSN 1198-6727]. 82 pp.
24. Christensen, V. and J.L. Maclean (Eds.) 2011. *Ecosystem Approaches to Fisheries: A Global Perspective*. Cambridge University Press, 342 p.
25. Heymans, J.J., Coll, M., Libralatto, S., and Christensen, V. Ecopath theory, modeling and application to coastal ecosystems. Chapter 9.5 in Bard, D., and Mehta, M. (Editors). "Estuarine and Coastal Ecosystems Modeling" of the Elsevier Science Series "Estuarine and Coastal Science", Elsevier Science Publishers, Amsterdam, (in press).
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27. Christensen, V. and Lai, S. 2011. Scenario development for decision making. Page 304-314 in Christensen, V. and J.L. Maclean (Eds.) *Ecosystem Approaches to Fisheries: A Global Perspective*. Cambridge University Press.
28. Christensen, V., and Maclean, J.L. 2011. Preface. Page xiii-xv in Christensen, V. and J.L. Maclean (Eds.) *Ecosystem Approaches to Fisheries: A Global Perspective*. Cambridge University Press.
29. Christensen, V. and Walters, C.J. 2011. Progress in the use of ecosystem modeling for fisheries management. Page 189-205 in Christensen, V. and J.L. Maclean (Eds.) *Ecosystem Approaches to Fisheries: A Global Perspective*. Cambridge University Press.
30. Stergiou, K.I., Christensen, V. 2011. Fishing down food webs. Page 72-88 in Christensen, V. and J.L. Maclean (Eds.) *Ecosystem Approaches to Fisheries: A Global Perspective*. Cambridge University Press.

Dr. Yoshitaka Ota

1. *Ota, Y. 2011. Nereus Program – an international initiative to save the future ocean. *Kannkyou Kannri*. Sep. 2011.
2. *Ota, Y. 2011. Nereus Program – Predicting Future Ocean. *OPRF News Letter*.

WORKSHOPS

Dr. Villy Christensen

1. 2011: Visiting Professor. Master of Fisheries Management Program. University of Las Palmas de Gran Canaria. 4-8 April: teaching ecosystem modeling course and developing model for strategic plan.
2. 2011: Ecopath modeling workshop. CINVESTAV, Unidad Mérida, Yucatan, Mexico. June 20-24. 13 participants from throughout Mexico. Course leader and lecturer.
3. 2011: Using Ecosystem Modeling for Fisheries Management. International Council for Exploration of the Sea (ICES), Copenhagen, Denmark, March 7-11, course leader and lecturer [24 participants from 14 countries]
4. 2011: Great Lakes Ecopath modeling workshop. Feb 28-Mar 1; Michigan State's Kellogg Biological Station. Resource person.

1.1.4 FUTURE PLANS

Our focus will be on guiding the research of the fellows, ensuring communication and coordination, developing our communication strategy, and further developing the data and modelling framework.

DR. VILLY CHRISTENSEN

Dr. Christensen will visit each partner institute at least once during 2012, with the first visit to Princeton on March 16th. At this meeting, topics to be discussed include coordination between the Nereus model and the new GFDL Topaz model output, as well as a follow-up on the fellows' work.

A number of dissemination activities are planned:

- Yale Climate and Energy Institute's Annual Conference: Managing species for regulating carbon cycling. Steering Committee Member. Yale University, April 12-14, 2012. Presentation about the Nereus model.
- World Fisheries Congress. Edinburgh, May 7-11. Nereus Program Presentation.
- Second International Symposium on the Impact of Climate Change on the World's Oceans. Yeosu, Korea. May 15-19. Invited Speaker.
- American Fisheries Society Annual Meeting. Minneapolis-St. Paul, August 18-23, 2012. Panel Speaker (audience of 4,000). Presentation about ecological networks.

DR. YOSHITAKA OTA

Dr. Ota will visit Stockholm to develop his collaborative study on governance with the fellows and PIs at the SRC. He will be stationed at the Centre from May 1st to July 15th.

AUDREY VALLS

Audrey has been selected to participate in the Oceans of Change Early Career Scientists Conference in Majorca, Spain, from April 24th to 27th in 2012. Her abstract on species vulnerability to fishing has been accepted for a poster presentation. Audrey is also participating in the 6th World Fisheries Congress in Edinburgh, from May 7th to 11th in 2012, where she will be giving a talk on her fish feeding selectivity model.

Subsequently, she hopes to visit our Nereus partners in Europe, and plans to be a visiting student at the Institute of Marine Science (ICM) in Spain for six weeks. There, she will collaborate with Dr. Marta Coll (an expert on ecosystem modelling in the Mediterranean Sea) on biodiversity issues in Mediterranean marine ecosystems, which is both relevant and useful for her own Ph.D. project. She will also be giving a talk about her project and the Nereus program while at the ICM. She has been invited by Dr. Coll to participate in a planned workshop on global approaches to promote Ecosystem Approaches to Fisheries in the Mediterranean Sea.

1.2 MARINE GEOSPATIAL ECOLOGY LAB, DUKE UNIVERSITY

1.2.1 INSTITUTIONAL PROGRESS

The Marine Geospatial Ecology Lab (MGEL) of Duke University has four members of the Nereus Program: Principal Investigator Dr. Patrick Halpin, Senior Nereus Fellow Dr. Andrew Boustany, Nereus Fellow Daniel Dunn, and web and database developer Ei Fujioka. All four Nereus team members have had extensive discussions and planning sessions to identify projects and create work plans. Additionally, several Master's students have expressed interest in contributing to smaller Nereus focused studies, further leveraging the resources available through Duke University.

Nereus PI Halpin and fellows have participated in several Nereus-specific meetings as well as a number of relevant meetings. Nereus PI Halpin attended PI meetings in Washington, D.C. (February 2011), a meeting with the Nippon Foundation in Tokyo (August 2011), and the Nereus Annual Meeting in Vancouver (February 2012). Nereus fellows Boustany and Dunn attended a meeting with the US and Canadian Nereus PIs and fellows at Princeton University in October of 2011. This working meeting was instrumental in coordinating project ideas with the Nereus team members from other laboratories. In addition, this meeting provided the opportunity for MGEL members to speak directly with scientists from Princeton and the Geophysical Fluids Dynamics Laboratory (GFDL) and to thereby gain a better understanding of the availability of, and methods of accessing, climate change data. MGEL members provided known fisheries and animal distribution datasets to other Nereus team members.

Halpin, Boustany, Dunn, and Fujioka also attended the Nereus Annual Meeting in Vancouver in February of 2012. This meeting afforded the opportunity to meet the full Nereus team and conduct more extensive planning on individual and collaborative projects. Boustany and Dunn presented project ideas, data requirements, and analysis techniques to the group and received extensive feedback on all topics. Nereus research analyst Fujioka participated in the meetings on data use and analysis. MGEL scientists were able to meet with University of British Columbia (UBC) and National Marine Fisheries Service scientists to discuss additional fisheries data needs and availability.

The American Association for the Advancement of Science (AAAS) annual conference, which was also held in Vancouver, followed the Nereus meeting. Halpin presented preliminary analyses examining the effects of climate change on ocean biodiversity and current marine protected areas. Climate change data used in this analysis was obtained from Nereus partners at Princeton and GFDL. Boustany and Halpin are continuing this line of research and are working on a manuscript to be submitted through Nereus.

MGEL is also planning a workshop on the predicted effects of climate change on marine mammal distributions with funding provided through the National Aeronautical and Space Administration (NASA). While this project falls outside of the full scope of the Nereus Program, much of the data and analysis techniques used will be applicable to Nereus projects currently underway.

MGEL is satisfied with the progress of the Nereus fellows as well as the overall progression of the Nereus Program. The collaborations cemented to date have been productive and further collaborations should prove advantageous.

1.2.2 PROGRESS OF FELLOWS

DR. ANDRE BOUSTANY: NF SENIOR NEREUS FELLOW

Dr. Boustany has acquired and begun working with general circulation model (GCM) output provided by collaborators at Princeton and GFDL. Thomas Froelicher, Jorge Sarmiento, and Charles Stock have provided guidance on working with model output data. Over 50 GB of 2D and 3D model data have been downloaded and analyses on these data in relation to marine animal distributions have begun. The first analysis has been to examine the predicted effects of climate change on marine protected areas and global marine biodiversity.

Data on marine protected areas was obtained from Nereus collaborators the Sea Around Us Project and UNEP-WCMC. Climate change data were obtained from Nereus partners GFDL and Princeton. Animal distribution and biodiversity data were obtained through the Ocean Biogeographic Information System (OBIS), a program on which MGEL is a longtime contributing and development partner.

This work has identified regions of predicted high relative climate stress. Relative climate stress was calculated by comparing past climate variability in a region to predicted future climate change. We feel this is a better indicator of climate stress than is absolute climate change as regions that have historically experienced small changes in oceanographic variables (temperature, productivity, PH, salinity) are likely to have less ability to tolerate future changes. Conversely, regions that commonly see large seasonal or inter-annual variability in oceanographic measures will be more likely to handle future changes with fewer disruptions to the ecosystem or the animals within it. Preliminary results from this study have found that regions that are predicted to see the highest relative climate stress are also the areas where marine biodiversity are the highest. The reason for this is that the regions with the highest biodiversity are found in areas where past oceanographic variability has been low. Under a changing ocean climate, these regions are more likely to see temperatures, etc. outside of the range experienced in the past.

Dr. Boustany has also begun working with fisheries datasets, primarily from pelagic and bottom longline fisheries in the Atlantic, to develop oceanographic linked fish habitat models. When these models are built using past observation data, it will be possible to then project predicted fish habitat into the future using output from GCM models. Predicted fish distribution and density data will then be examined in relation to fishery operation areas to gain insight into the potential effects on fishery yield. Similar fisheries datasets are also being obtained for the Pacific Ocean through a collaboration with the National Marine Fisheries Service and Dr. Jeffrey Polovina, a member of the Nereus Program Steering Committee.

In addition to these projects, Dr. Boustany has been in contact with members of the U.S. Coast Guard regarding the potential to apply similar habitat modeling techniques directly to fishing fleets to predict their distribution over time. This possibility was raised at the Nereus Annual Meeting and was met with interest by several Nereus collaborators. Work on this front will likely be led by a student at Duke and by Coast Guard personnel with Dr. Boustany and other MGEL members advising and providing technical expertise.

DANIEL DUNN: NF NEREUS FELLOW

Nereus Doctoral Fellow Daniel Dunn joined the Nereus program in September when he began his Ph. D. studies. As is expected of first year Ph. D. students, Dunn's focus has been on coursework. He has taken classes in physical oceanography, Bayesian and traditional statistics, fisheries ecology, and an interdisciplinary discussion seminar. He has also been working on independent studies looking at the history of fisheries management and fisheries oceanography.

While pursuing coursework, Dunn has also continued to participate in research, outreach and publications. Over the last year he organized a workshop on the identification of ecologically or biologically significant areas in the pelagic zone and participated in 2 other workshops: one on reconciling Fisheries management and conservation objectives in MPAs, and another on systematic conservation planning in the open ocean. He expects these to lead to publications in the next year. He was also invited to present on the integration of fisheries in Marine Spatial Planning at a Fisheries Leadership and Sustainability Forum. Lastly, he gave several presentations at the International Marine Conservation Congress in Victoria, B.C. and the World Conference on Marine Biodiversity in Aberdeen, Scotland.

Dunn's research over the last year has focused on autocorrelation in catch and bycatch, and oceanographic correlates of pelagic marine biodiversity. On the bycatch side, he has been working with Dr. Boustany to examine how to improve selectivity in gillnet fisheries using voluntary spatio-temporal management measures (i.e., closures). Initial results were presented at the Nereus Science Meeting in Vancouver. He plans to write this work up this summer and apply the techniques to other fisheries (possibly the US west coast rockfish fishery and, given recent discussions with Dr. Jeff Polovina, the Hawaii pelagic longline fishery) to

make regional and gear comparisons. Dunn has also begun a global literature search on oceanographic correlates of catch in pelagic fisheries.

1.2.3 DISSEMINATION RECORD

PRESENTATIONS

1. ***Halpin, P.N. and Boustany, A.B. Predicting Impact of Climate Change on Global Ocean Biodiversity. AAAS meeting Vancouver Feb 18, 2012**
2. Dunn, D.C., K.M. Gjerde, J. Ardron, P.N. Halpin. Utilizing the Convention on Biological Diversity's ecologically or biologically significant areas in need of protection to inform marine spatial planning in the open ocean. IMCC.
3. Dunn, D.C., P. Bernal, P.N. Halpin, A. Spadone. Identification of pelagic EBSAs – Workshop Findings. IMCC.
4. Dunn, D.C. Marine Spatial Planning & Fisheries. Fisheries Forum.
5. Dunn, D.C. A.M. Boustany, J.J. Roberts, P.N. Halpin. Spatio-temporal methods to reduce bycatch in the New England groundfish fishery. WCMB.
6. Fujioka, E, P. N. Halpin, A. J. Read, M. Soldevilla, K. Urian, C. Y. Kot, A. DiMatteo, B. D. Best, J. A. Cleary and B. Donnelly. 2011. Archiving and disseminating non-traditional marine mammal data for growing data needs in marine mammal conservation. 19th Biennial Conference on the Biology of Marine Mammals, Tampa, Florida, USA. November 27 – December 2, 2011.
7. Fujioka, E. 2011. Bio-logged data flow and data sharing. Biologged data management and sharing workshop, Biologging 4, Hobart, Tasmania, Australia. March 16, 2011.

PUBLICATIONS

1. Hsu, A; Boustany, AM; Roberts, J; Halpin, PN (submitted) Separating bluefin tuna and swordfish catch in the North Atlantic longline fishery: A mesoscale marine eddy perspective. Fisheries Oceanography.
2. Fujioka, E., Vanden Berghe, E., Donnelly, B., Castillo, J., Cleary, J., Holmes, C., McKnight, S., Halpin, P. (2012). Advancing global marine biogeography research with open source GIS software and cloud computing. Transactions in GIS 16(2): 143–160.
3. Dunn, DC; Boustany, AM; Halpin, PN (2011) Spatio-temporal management of fisheries to reduce bycatch and increase fishing selectivity. Fish and Fisheries 12: 110-119.
4. Boustany, A. (2011) *Bluefin Tuna: The State of the Science*. Ocean Science Division, Pew Environment Group, Washington, DC.
5. Collette, B.B., K.E. Carpenter, B.A. Polidoro, M.J. Juan-Jordá, A. Boustany, D.J. Die, C. Elfes, W. Fox, J. Graves, L.R. Harrison, R. McManus, C.V. Minte-Vera, R. Nelson, V. Restrepo, J. Schratwieser, C.L. Sun, A. Amorim, M. Brick Peres, C. Canales, G. Cardenas, S.K. Chang, W.C. Chiang, N. de Oliveira Leite, Jr., H. Harwell, R. Lessa, F.L. Fredou, H.A. Oxenford, R. Serra, K.T. Shao, R. Sumaila, S.P. Wang, R. Watson and E. Yáñez. (2011) High value and long-lived: A double jeopardy for threatened tunas and billfishes. Science 333(6040): 291–292.
6. Zydelis, R; Lewison, RL; Shaffer, SA; Moore, JE; Boustany, AM; Roberts, JJ; Sims, M; Dunn, DC; Best, BD; Tremblay, Y; Kappes, MA; Halpin, PN; Costa, DP; Crowder, LB (2011) Dynamic habitat models: Using telemetry data to project fisheries bycatch. Proceedings of the Royal Society B. Biological Sciences, doi:10.1098/rspb.2011.0330.
7. Garcia, S.M., J. Kolding, J. Rice, M-J Rochet, S. Zhou, T. Arimoto, J.E. Beyer, L. Borges, A. Bundy, D.C. Dunn, N. Graham, M. Hall, M. Heino, R. Law, M. Makino, A.D. Rijnsdorp, F. Simard, and A.D.M Smith (2012) Balanced harvesting: reconsidering the consequences of selective fisheries. Science 335:1045-1047
8. Curtice, C. D.C. Dunn, J.J. Roberts, P.N. Halpin. (in press) Ecosystem-Based Management May Fail Without Changes to Tool Development Financing. Bioscience.
9. Van Dover C.L., C. Smith, J. Ardron, D.C. Dunn, K. Gjerde, L. Levin et al. (2012) Designating networks of chemosynthetic ecosystem reserves in the deep sea. Marine Policy 36: 378–381
10. Curtice, C., R. S. Schick, D. C. Dunn, and P. N. Halpin. (2011) Home range analysis of Hawaiian Monk Seals (*Monachus schauinslandi*) based on colony, age and gender. Aquatic Mammals 37(3): 360-371.
11. Gilman, E., D.C. Dunn, A. Read, R. Warner, K.D. Hyrenbach. (2011) Designing criteria suites to identify sites and networks of high value across manifestations of biodiversity. Biodiversity and Conservation 20(14):3363-3383.

REPORTS

1. Dunn, D.C. (Ed.), J. Ardron, N.Ban, N.Bax, P. Bernal, S. Bograd, C. Corrigan, P. Dunstan, E. Game, K. Gjerde, H. Grantham, P. N. Halpin, A-L. Harrison, E. Hazen, E. Lagabriele, B. Lascelles, S. Maxwell, S. McKenna, S. Nicol, E. Norse, D. Palacios, L. Reeve, G. Shillinger, F. Simard, K. Sink, F. Smith, A. Spadone, M. Würtz. (2011) Ecologically or Biologically Significant Areas in the Open Ocean: Examples & Guidelines – Workshop Report. Gland, Switzerland: IUCN. 44pp.
2. International Seabed Authority. (2011) Environmental Management of Deep-Sea Chemosynthetic Ecosystems: Justification of and Considerations for a Spatially-Based Approach. ISA Technical Study No. 9. Kingstown, Jamaica: International Seabed Authority. 90pp.
3. Garcia, S.M. (Ed.), J. Kolding, J. Rice, M-J Rochet, S. Zhou, T. Arimoto, J. Beyer, L. Borges, A. Bundy, D.C. Dunn et al. (2011) Selective fishing and balanced harvest in relation to fisheries and ecosystem sustainability. Report of a scientific workshop organized by the IUCN-CEM Fisheries Expert Group (FEG) and the European Bureau for Conservation and Development (EBCD) in Nagoya (Japan), 14–16 October 2010. Gland, Switzerland and Brussels, Belgium: IUCN and EBCD. iv + 33pp.

PUBLIC OUTREACH

PI Halpin presented on the Nereus project at several United Nations sponsored meetings, including the Sustainable Oceans Initiative (SOI) meeting in Kanazawa, Japan in August 2011 and the FAO Fisheries Vulnerable Marine Ecosystems meeting in Rome in December 2011

1.2.4 FUTURE PLANS

MGEL scientists plan to continue work on future fish habitat modeling as well as continue modeling bycatch in these fisheries. We will also continue to collaborate on projects aimed at predicting the distribution of fisheries. Data and preliminary results from these projects will be shared with other Nereus Program collaborators to facilitate future collaborations incorporating model output. Of particular interest on this front is to begin to incorporate sociological and economic factors into the predicted fisheries distribution models.

Dunn and Boustany will participate in an upcoming workshop aimed at quantifying the effects of pelagic marine protected areas in Seté, France from March 25th to 31st. All members of MGEL will also be hosting a workshop on modeling marine mammal distribution under a changing climate. The dates for this workshop have not been determined as of yet.

Dunn will follow up with Dr. Daniel Pauly and Dr. Reg Watson regarding possible collaborations related to the Sea Around Us global fishing effort dataset. Dunn and Boustany plan to discuss continue discussion with Dr. Polovina surrounding analyses of the Hawaii pelagic longline dataset and Pacific-wide fisheries catch analyses.

1.1.5 COMMENTS

All MGEL members were impressed by the quality, enthusiasm, and knowledge of the members from the other Nereus Program groups. We look forward to collaborating with all the scientists under the Nereus Program over the next several years.

1.3 PRINCETON UNIVERSITY

1.3.1 INSTITUTIONAL PROGRESS

We are very satisfied with the Nereus Program and excited to be taking part in such an ambitious, groundbreaking project. Princeton's Nereus fellows have now been in place since fall of 2011 and have been doing excellent work thus far. All three have identified important facets to the challenge of projecting the future of global fisheries in 2050. Dr. Watson's work on large-scale fish and marine mammal migration and his incorporation of movement into a size-structured fisheries food web will elucidate the role of movement in the population dynamics of key species as well as broad-scale patterns in fisheries production. Rykaczewski's efforts to understand the response of the planktonic food web to climate and the linkages between planktonic food web dynamics will provide important insights into the sensitivity of fisheries productivity to climate variability and change. Kearney's work integrating physics, the planktonic ecosystem, and fisheries food web models will provide a means for improved dynamic linkages between these key modelling components within the Nereus program in addition to providing an invaluable tool for analyzing the response of the North Pacific ecosystem to a range of stressors.

We are also pleased that the Princeton Nereus fellows have been taking an active role in the endeavour to coordinate efforts between the various Nereus partners. The first annual Nereus Program meeting in Vancouver was very useful in this regard. We have encouraged our fellows to actively pursue the collaborations fostered during this meeting. We feel these are critical for ensuring that the innovative research being conducted at each institution also contributes to common modelling frameworks required to comprehensively address the future of global fisheries.

1.3.2 PROGRESS OF FELLOWS

DR. JAMES WATSON: NF SENIOR NEREUS FELLOW

Dr. Watson joined the Princeton Nereus group as a senior fellow in September 2011. His goal is to quantify the abundances and spatial dynamics of fisheries species at a global scale and to predict the global biomass of fisheries species in the future (e.g., 2050). He is developing a suite of models that use output from NOAA's Geophysical Fluid Dynamics Laboratory (GFDL) global circulation models (GCMs) and knowledge of the bioenergetics and movement rules governing the dynamics of species such as anchovy, sardines, and baleen whales. Watson's specific goals as a Nereus fellow are to: (1) develop an agent-based model of whale migration, (2) develop a size-based model of global marine fisheries production, and (3) develop a theory for coupled social-ecological systems.

He has made significant progress on his first and second goal, having built an agent-based model of whale migration and a size-based model for the dynamics of anchovy and sardines, and has started collaborating with Nereus fellows at the Stockholm Resilience Centre on his third goal.

DR. RYAN RYKACZEWSKI: NF SENIOR NEREUS FELLOW

Dr. Rykaczewski joined the Princeton Nereus group in November 2011. A large portion of his time has been since devoted to Nereus research, but he also receives a portion of his funding from fisheries-related research for projects specific to the Northeast Pacific and from teaching responsibilities at Princeton University.

Within the broad and comprehensive scope of Nereus, Rykaczewski's interests are focused on understanding the dynamics of lower-trophic levels (i.e., phytoplankton, zooplankton, and small pelagic fishes) and their responses to physical changes in the world's climate. Specifically, his goals are to improve our understanding of: (1) how physical changes in the atmosphere-ocean system influence the size structure and taxonomic composition of plankton; (2) how changes in this composition affect the transfer of organic matter and energy

to fishes; and (3) how physical changes alter the distribution of different types of marine food webs (i.e., marine biogeography).

Thus far, progress has been made in acquiring literature on methods by which these questions have been addressed in the past and forming a strategy through which to improve these past assessments. The most novel tool we now have at our disposal includes the Earth System Models developed at the NOAA Geophysical Fluid Dynamics Laboratory. These models will allow us to project future changes in ecosystem structure through the 21st century and beyond. Rykaczewski's previous work has highlighted the value of such models in identifying mechanisms of future ecosystem changes that differ from the mechanisms that we have observed in the past. He has begun a preliminary investigation of the relationship between different measures of modelled primary production and the fisheries landings compiled by the Sea Around Us project at the University of British Columbia. Enhancements to this comparison will be achieved through collaboration with other Nereus fellows, specifically:

James Watson, who is building a size-structured ecosystem model that will provide insight into the translation from planktonic size structure and fisheries production;

Kelly Kearney, who is completing a modelling case study of ecosystem structure in the subarctic Northeast Pacific; and

Chris Mcowen, who is interested in contrasting Rykaczewski's analysis of oceanic factors with his analysis of the coastal factors that may influence fish production.

KELLY KEARNEY: NF NEREUS FELLOW

Kearney's research over the past few months has concentrated on refining the end-to-end modelling framework that she has been developing as the focus of her Ph.D. thesis. The framework includes processes from traditional biogeochemical/lower trophic level models (e.g., light- and nutrient dependent primary production, nutrient cycling, etc.) along with predator-prey interactions between upper trophic level functional groups derived from network-style food web models (basically specifically on the Ecopath model). In creating this model, Kearney intends to create a tool capable of analyzing ecosystem response to environmental perturbations at both the bottom and top of the food chain.

Recent refinements include the introduction of new iron-related state variables and processes, including cycling between dissolved bioavailable iron and particulate iron, as well as simple ligand-binding of dissolved iron, and iron limitation on phytoplankton production. With the introduction of the explicit iron cycle, Kearney is now able to replicate observed seasonal cycles of nitrate and silicic acid drawdown, as well as overall community net primary production.

Kearney has just begun working on a bottom-up sensitivity study where she will analyze the propagation of increased primary production due to nutrient-replete conditions through the food web. She also plans to write a short paper detailing the food web clustering process she used for this sensitivity study and her model validation study, which will look at how average energy fluxes through the food web change as one moves from a finer to coarser resolution of functional groups.

1.3.3 DISSEMINATION RECORD

Since July of 2011, Dr. Sarmiento gave a presentation entitled, "Impact of climate change on ocean physical and biological processes of relevance to fisheries" at the Annual Meeting of the Italian Society of Limnology and Oceanography in Lecce, Italy; **attended the Nereus workshop in Vancouver during February 2012; and gave a presentation entitled, "Predicting the impact of climate change on global ocean physics and biology," at the Vancouver AAAS meeting, also held in February 2012.**

Watson has given a number of talks at Princeton University in the Atmospheric and Oceanic Sciences program and the Department of Ecology. **He attended the 2012 Nereus workshop at the University of British Columbia, and presented a poster at the American Association for the Advancement of Science 2012 meeting in Vancouver.**

Rykaczewski has highlighted the goals of the Nereus program and his role in the collaboration during a number of recent conferences and invited talks at universities, including the 2011 Annual Meeting of the North Pacific Marine Science Organization (Khabarovsk, Russia), the 2011 Annual Science Conference of the International Council for the Exploration of the Sea (Gdansk, Poland), St. Andrew's University, the University of South Carolina, the University of Hawaii, and the University of Southern California. He also attended and presented his progress at the Nereus Annual Meeting held at the University of British Columbia.

Kearney has presented her research at the Eastern Pacific Ocean Conference (October 11-14, South Lake Tahoe, CA, poster presentation), the ICES annual meeting (September 19-23, Gdansk, Poland, poster presentation), and **the Nereus meeting at the University of British Columbia. Kearney has also published under the Nereus program: Kearney, K.A., Stock, C.A., Aydin, K.Y. and Sarmiento, J.L. Coupling planktonic ecosystem and fisheries food web models for a pelagic ecosystem: description and validation for the subarctic Pacific. *Ecological Modelling (in press)*.**

1.3.4 FUTURE PLANS

Dr. Sarmiento will give a presentation on multiple stressors at the annual meeting of the US Ocean Carbon and Biogeochemistry Project at Woods Holes Oceanographic Institution in July 2012. He also plans to discuss his work on fisheries with Dr. William Cheung and Dr. Daniel Pauly at the University of British Columbia (UBC).

Watson will attend the 2nd International Symposium on the Effects of Climate Change on the World's Oceans in Yeosu, Korea (May 2012), where he will present his latest work. He will then present at the Ecological Society of America's (ESA) annual symposium in Portland, Oregon. He is also organizing a session at the American Fisheries Society's annual conference. His symposium is on climate change and fisheries production, and will include presentations from a number of Nereus principal investigators. Watson is also keen to follow up on collaborations initiated at the UBC meeting, and intends to visit the Stockholm Resilience Centre and Cambridge University.

Rykaczewski has two major conferences planned in the near future at which he will present his progress in topics related to Nereus. First, he will speak as an invited participant at the 2nd International Symposium on the Effects of Climate Change on the World's Oceans in Yeosu, Korea (May 2012). He will then be hosting a session (and presenting) on acidification and hypoxia in the Northeast Pacific at the Eastern Pacific Ocean Conference at Mount Hood, Oregon, in October 2012. He also anticipates working more closely with Nereus collaborators from the Stockholm Resilience Centre and UNEP-WCMC.

1.4 STOCKHOLM RESILIENCE CENTRE, UNIVERSITY OF STOCKHOLM

1.4.1 INSTITUTIONAL PROGRESS

The Stockholm Resilience Centre (SRC) has recruited two fellows who have quickly become integrated into the research at SRC. In addition to the two PIs, the involvement of several more senior researchers who have agreed to be actively engaged in the program as supervisors (Drs. Victor Galaz, Per Olsson, and Max Troell) has facilitated this transition. This represents a significant contribution and one that will ensure the SRC's success with fulfilling its ambitious goals within the Nereus Program.

The fellows and supervisors have thus far run a series of workshops aimed at contributing directly to Nereus, including:

- Overall brainstorming and the definition of objectives and studies to be carried out through the Nereus project (October 10, 2011 and November 7-8, 2011);
- Collaborative work on a first paper identified through brainstorming sessions (December 1 and January 16-17), as well as ongoing discussions in smaller groups; and
- Collaborative work on a second paper (ongoing in smaller groups).

The two PIs and two of the supervisors—Dr. Per Olsson and Dr. Max Troell—also hosted an international workshop for understanding governance shifts from August 22nd to 24th, 2011. The workshop, which involved a large group of international scholars, will directly contribute to the objectives of Nereus in both substance (through the development of a scientific paper) and in process (through the establishment of new scientific networks), each increasing the capacity of the SRC to contribute to Nereus.

The SRC and the Beijer Institute hosted a workshop from September 17th to 19th, 2011 addressing global food security, fisheries, and aquaculture issues. The workshop was lead by Dr. Carl Folke and Dr. Max Troell, with participation from Dr. Marc Metian and Henrik Österblom. A significant number of international scholars were in attendance, including one Nobel laureate. This workshop was also closely linked to the aims of Nereus.

Dr. Troell also participated in a closed roundtable meeting hosted by His Royal Highness The Prince of Wales, the founder of the International Sustainability Unit (ISU). The meeting was held in London during December of 2011, focusing on the sustainability of fishmeal supply from Asia. Troell also participated in the official ISU Marine Program Launch Event on the 3rd of February, 2012.

Currently, we at the SRC are very satisfied with the fellows' and Nereus' contribution to the research agenda at the SRC. Since there are many similar ongoing initiatives, Nereus provides an important link that is stimulating innovative collaboration at the SRC, benefiting all of those involved.

1.4.2 PROGRESS OF FELLOWS

ANDREW MERRIE: SRC NF NEREUS FELLOW

Progress thus far includes:

- Learning the field, gathering materials, and increasing familiarity with important literature;
- Learning theory and method;
- Seeking training in network methods, survey design, and qualitative interview study design and analysis;
- Undertaking mandatory courses;
- Developing think around research ideas and refining doctoral plan;
- Defended Master's thesis and working on publishing thesis article;
- Initiating data collection and review for a RFMO/Climate article;

- Beginning to map out the ‘Marine Resources Governance’ landscape, which will be incorporated into his doctoral essay;
- Working on Marine Science Discourse Review article with Marc Metian;
- Collaborating on a ‘Social Ecological Scenarios’ paper;
- Conducted a phone conference with Francois Bilet regarding global marine resources governance and the UNGA informal consultative processes in fisheries meetings to be held in 2013 and 2014;
- Brainstorming the suggested development of an ocean governance/fisheries management index that incorporates sociocultural components; and
- Assisting with SRC social media and internal high-level seminars.

DR. MARC METIAN: SRC NF SENIOR NEREUS FELLOW

Progress thus far includes:

- Brainstorming with SRC PI’s and Dr. Troell on the position and formulation of the work strategy for the two-year fellowship;
- Invited to participate in the Asko workshop in September 2011;
- Collaborating on a manuscript resulting from the Asko workshop, addressing global food security, fisheries, and aquaculture issues;
- Collaborating with Dr. Troell, Dr. Österblom, and Dr. Folke on a comment to a published paper, “Solution for a cultivated planet,” by Foley et al. (2011) *Nature* 478: 337-342;
- Collaborating on a manuscript from Dr. Villasante entitled “Using social-ecological indicators to evaluate global seafood markets changes”;
- Involvement with Dr. Troell in a talk that will be given by Dr. Beveridge (WorldFish Center) at the World Fisheries Conference in May 2012 at Edinburgh, Scotland. A manuscript should result from this talk, and will likely be entitled “Meeting the food and nutrition needs of the poor: the role of fish and the opportunities and constraints emerging from the rise of aquaculture”;
- Working on a Marine Science Discourse Review article with Andrew Merrie and the SRC Nereus team;
- Collaborating on a ‘Social Ecological Scenarios’ paper, with specific attention to the governance diagram;
- Elaborating with Dr. Troell on a Master student’s project on algae called, “Ocean seaweed farming – our next frontier for food?”; and
- A two-week visit to UBC’s Fisheries Centre in order to meet with scientists and discuss potential future collaborations.

1.4.3 DISSEMINATION RECORD

* = Nereus publication or presentation.

PRESENTATIONS

1. *Österblom, H. Predicting the future ocean: the Nereus program. AAAS Annual meeting 2012, Vancouver (discussant and presenter)
2. Österblom, H. One third for the birds. Stockholm Seminar.
<http://www.stockholmresilience.org/seminarandevents/stockholmseminars/previousseminars/2012/s2012/saveathirdforthebirds.5.4e1e1d1d13540440047138c.html>
3. Österblom, H. Opportunities and challenges for transformation in marine social-ecological systems in the Baltic Sea. Resilience 2011, Arizona, 2011 (session co-convenor together with Drs Per Olsson and Jack Kittinger).
4. Österblom, H. Reclaiming leadership in fisheries. European Parliament, 2012.

PUBLICATIONS

1. Cury, P.M., Boyd, I.L., Bonhommeau, S., Anker-Nilssen, T., Crawford, R.J.M., Furness, R.W., Mills, J.A., Murphy, E.J., Österblom, H., Paleczny, M., Piatt, J.F., Roux, J.-P., Shannon, L., Sydeman, W.J. (2011) Global seabird response to forage fish depletion – one-third for the birds. *Science*
2. Österblom H, Sissenwine M, Symes D, Kadin M, Daw T, Folke C (2011) Incentives, social-ecological feedbacks and European fisheries. *Marine Policy* 35:568-574
3. Galaz, V., Crona, B., Österblom, H., Olsson, P., Folke, C., Polycentric systems and interacting planetary boundaries — Emerging governance of climate change-ocean acidification-marine biodiversity, *Ecol. Econ.* (2011)
4. Nyström, M., Norström, A.V., Bleckner, T., de la Torre Castro, M., Eklöf, J., Folke C., Steneck, R.S., Osterblom, H., Thyresson, M. and Troell, M. and. (submitted) Braking feedbacks in degraded marine ecosystems (states). (Accepted Ecosystems)
5. Henriksson, P., N. Pelletier, M. Troell and P. Tyedmers (2012) Life cycle assessment and its application to aquaculture production systems. *Encyclopedia of Sustainability Science and Technology*. Meyers, Robert A. (Ed.) 1st Edition., 2012, 10500 p.
6. Troell, M., Hecht, T., Beveridge, M., Stead, S., Bryceson, I., Kautsky, N., Ollevier, F., Mmochi, A. (eds.) (2011) *Mariculture in the WIO region - Challenges and Prospects*. WIOMSA Book Series
7. Deutsch, L., Troell, M., Limburg, K. and M. Huitric (2011) Trade of Fisheries Products-implications for marine ecosystems and their services, in T. Köllner (ed.), *Ecosystem Services and Global Trade of Natural Resources Ecology, Economics and Policies*, 304 p, Routledge, London, UK. 304 pp.
8. Pelletier, N., Audsley, E., Brodt, S., Garnet, T., Henriksson, P., Kendall, A., Kramer, K., Murphy, D., Nemecek, T., Troell, M., Tyedmers, P. (2011) Energy Intensity of Agriculture and Food Systems. *Annual Review of Environment and Resources*, 36: 223-246.
9. Crépin, A.-S., Biggs, R., Polasky, S., Troell, M., de Zeeuw, A. (submitted). Consequences of regime shifts for human welfare and implications for management. In revision *Ecological Economics*.
10. Tacon, A.G.J., Hasan M.R., Metian, M. (2011) Demand and supply of feed ingredients for farmed fish and crustaceans: trends and prospects. *FAO Fisheries and Aquaculture Technical Paper No. 564*. FAO, 87 pp.
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PUBLIC OUTREACH

1. Österblom, H. 2011. Interviewed in national radio on findings in our Science paper (Cury et al. 2011)
2. Österblom, H. (2011) Blog post on seabird-forage fish interactions.
<http://rs.resalliance.org/2011/12/22/no-surprise-to-buzz-holling-non-linear-response-of-seabirds-to-forage-fish-depletion/>
3. Österblom, H. (2011) Seabird-forage fish interactions, white board seminar
http://www.youtube.com/watch?v=wTGshAcV9MU&feature=player_embedded

1.4.4 FUTURE PLANS

The SRC is currently deeply involved in developing our research agenda and expect a number of workshops to be conducted in the coming year. The planned visits of Dr. Yoshitaka Ota, Dr. Villy Christensen, Nereus Senior Fellow Dr. Wilf Swartz, and others during the spring will coincide with a number of collaborative efforts at the SRC.

Fellows, PIs, and supervisors will participate in the Planet Under Pressure conference to be held in London at the end of March (<http://www.planetunderpressure2012.net/>), and will be attending the World Fisheries Conference in Edinburgh this May (<http://www.6thwfc2012.com/>).

1.4.5 COMMENTS

Those at the SRC greatly appreciate the opportunity to be a part of the Nereus program, and recognize the program's value in adding substantially to the further development of research at the SRC. Several SRC

activities presented here do not directly relate to Nereus, but still constitute key activities that will contribute to the program. This initiative has enabled new and promising collaborations with a number of individuals who are not employed by Nereus, and we anticipate that the interest will continue to grow as additional colleagues are incorporated into our endeavour to further understand global marine governance.

1.5 UNEP-WCMC: UNIVERSITY OF CAMBRIDGE

1.5.1 INSTITUTIONAL PROGRESS

UNEP-WCMC and the Geography Department of the University of Cambridge have recruited one fellow whilst prospective PhD students have been shortlisted with interviews expected to take place soon.

There has been a project meeting between WCMC and Cambridge, with another projected in the near future. The structure of the meeting was as follows:

- Outlined the project to Dr. Mike Bithell and Dr. Tom Spencer (Cambridge);
- Discussed how the computational demands of large models could be met; and
- Discussed possible methods to classify habitats.

***WCMC and Cambridge have postponed fellow recruitment until 2013, at which point a full report will be submitted.**

1.5.2 PROGRESS OF FELLOWS

DR. CHRIS MCOWEN: NF SENIOR NEREUS FELLOW

Progress thus far:

- Reading relevant papers (ongoing);
- Developing thinking around research ideas (ongoing);
- Have gathered sample data from NOAA, FOA and OBIS;
- Registered and developed code for using the computer cluster at Cambridge;
- Developed code in R using sample data;
- Have contacted a variety of academics through email and Skype, e.g. Ben Halpern, and projects, i.e. GlobalNews and AquaMaps, regarding the use of data and potential collaborations;
- Submitted grant for additional funding through UNEP; and
- Developed a collaboration matrix outlining potential future collaborations with Nereus Fellows.

Public outreach:

- Attended the launch of the fisheries arm of The Prince's Charities' International Sustainability;
- Discussed the Nereus program at a lunchtime seminar at the Scottish Marine Mammal Institute (St Andrews); and
- Invited to talk about the Nereus project at a lunchtime seminar programme at the National History Museum London.

1.5.3 FUTURE PLANS

I have recently received code from Ben Halpern that assists in translating land-based processes into quantifiable coastal impacts; furthermore, I am expecting Sea Around Us Data for Large Marine Ecosystems and Exclusive Economic Zones to arrive shortly. I have made contact with a number of potential suppliers of Artisanal fisheries data and have already received some from Papa New Guinea and Kenya. I will therefore be running preliminary data analysis on these to test my methods and hopefully get some preliminary results. I will be attending the World Fisheries Conference in Edinburgh in May (<http://www.6thwfc2012.com/>) and hopefully visiting the Stockholm Resilience Centre afterwards to discuss a governance project and the methodology behind the Baltic Sea initiative.

Furthermore, I will be meeting with Dr. Yoshitaka Ota when he visits the UK. Together, we will travel to Kent and Dover to visit his colleagues, who are interested in coastal fisheries.

1.5.4 COMMENTS

The meeting at UBC and AAAS really outlined the potential of the project and clarified how we can all come together and utilize the strengths of each institution. Furthermore, at an individual level it helped to focus the methodology and outline the role that the WCMC and Cambridge can play within the project.

The arrival of the PhD student is eagerly anticipated as this will provide further scope for collaborative work, both internally with the post-doc but also externally with the partner institutions. The work of the PhD student will provide new geographical range maps and methodologies, thereby strengthening the project and the role of Cambridge / WCMC within Nereus.

2. NEREUS FELLOWS

2.1 WILF SWARTZ



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a place of mind

Born in Toronto, Wilf spent most of his youth in Tokyo, Japan before moving to Vancouver. He went to University of British Columbia where he studied Marine Biology and first became involved with the Sea Around Us Project as a research assistant. Wilf then spent two years in Fukuoka, Japan, as a Coordinator of International Relations before returning to UBC to do his MSc at the Fisheries Centre with Daniel Pauly. Following successful completion of his MSc., which focused on the transition of Japan

from a fishing nation to a fish buying nation, Wilf moved to London, UK, where he spent three years as an Analyst for Nomura International, a Japanese investment firm. He returned to UBC for the third time to begin his PhD with Rashid Sumaila.

Wilf's PhD will focus on the expansion of marine fisheries and seafood market. He recently completed a study on the growth of seafood consumption footprint (Seafood Print), which was featured in the October 2010 issue of the National Geographic.

ネレウスにおける研究内容

漁業再興へのコストを考える

- 水産業再編の政策オプションとその代償
- 誰が、どのような形でコストを補うのか？

持続可能な水産物消費への政策

- 消費者が資源への負担が少ない水産物を選ぶことを推進する政策とはなにか？

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2.2 AUDREY VALLS



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a place of mind

Maybe because I grew up in Marseille, on the Mediterranean Sea's edge, I have always been curious about anything related to the marine life. Later, learning about the serious threats to the oceans due to human activities, I decided to become a scientist to contribute to marine ecosystems conservation.

I completed my MSc in Fishing

Science and Aquaculture in 2009 at Agrocampus Ouest, in France, working with Drs. Didier Gascuel and Sylvie Guénette. We assessed the potential effects of a Marine Protected Area, the Port-Cros National Park, in the Mediterranean Sea. We used ecosystem modelling approaches (Ecopath and EcoTroph) as we intended to consider not only a few emblematic species but the whole marine food web.

As a PhD Candidate, I am currently working with Dr. Villy Christensen at the Fisheries Centre, UBC. My project intends to provide better predictions of global changes in marine biodiversity through the 21st Century, using a spatial ecosystem model (Ecospace) representing the world's oceans.

1st Nereus Annual Science Meeting - February 2012

PREDICTING GLOBAL CHANGES
IN MARINE BIODIVERSITY

Audrey Valls
PhD Candidate
Fisheries Centre - UBC

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Seeing their significant impacts on marine ecosystems worldwide, fishing and climate change are very likely to be the most decisive factors of future trends in marine biodiversity. Our predictions will thus be improved by a better consideration of fishing and climate change effects, but also trophic interactions between marine species.

Presentation: Predicting global changes in marine biodiversity by considering trophic interactions and human impacts at the species level

2.3 ANDRE BOUSTANY



NF SENIOR NEREUS FELLOW, DUKE UNIVERSITY

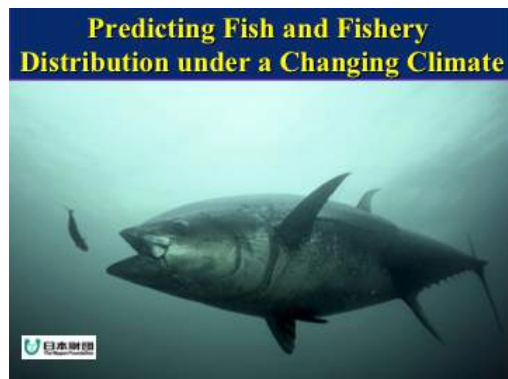
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Andre recently received his Ph.D. from Stanford University. He completed his thesis on population structure and habitat utilization of bluefin tunas. Andre is currently working in Dr. Pat Halpin's lab at Duke University where he is continuing his

research on bluefin tuna as well as performing bycatch research as part of the GLOBAL bycatch assessment project.

Presentation: Predicting shifts in pelagic fish and fisheries under a changing climate



2.4 DANIEL DUNN



NF NEREUS FELLOW, DUKE UNIVERSITY

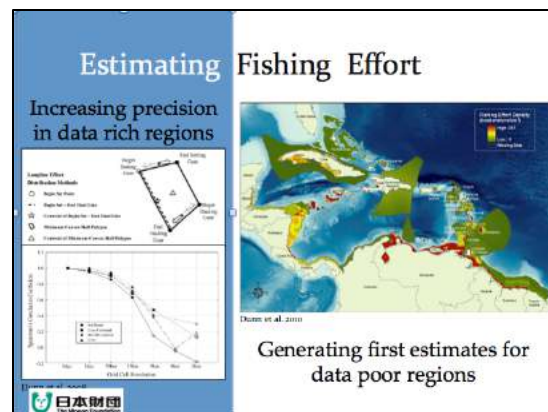
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Daniel is a Nippon Foundation Doctoral fellow and a James B. Duke fellow with the Marine Geospatial Ecology Lab at Duke University where he focuses on ecosystem-based fisheries management, pelagic conservation and marine spatial planning.

Daniel's current research centers on spatio-temporal management of fisheries to reduce bycatch, increase fishing selectivity, and objectively allow fisheries to participate in MSP. Specifically, he is investigating current and future spatio-temporal distribution of target species, fishing effort and marine biodiversity, and how these will affect (and be affected by) marine spatial planning and the use of marine protected areas. He is particularly interested in the development of dynamic pelagic fishery closures and MPAs. Daniel is a liaison for the Census of Marine Life to the Global Ocean Biodiversity Initiative (GOBI) and to the Secretariat to the Convention on Biological Diversity (CBD). In this capacity he has is the GOBI lead on the dynamic pelagic work group, and has been intimately involved in both the identification and cataloguing of Ecologically or Biologically Significant Areas (EBSAs) in areas beyond national jurisdiction and the development of EBSA information repositories for both GOBI and the CBD Secretariat.

Presentation: Spatio-temporal management of fisheries: Future directions



2.5 KELLY KEARNEY



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Presentation: Modelling the effects of decadal-scale climate variability across trophic levels

Linking biogeochemical models and fisheries models



2.6 RYAN RYKACZEWSKI



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Dr. Ryan Rykaczewski is a biological oceanographer interested in understanding how changes in the physical processes of the ocean and atmosphere influence the productivity of marine ecosystems. He was a student of Professor David M. Checkley, Jr. and received his Ph.D. in Oceanography from Scripps in 2009. Ryan's dissertation work examined the influence of atmospheric processes on the size structure of the plankton community and on small pelagic fishes of the California Current. Since 2009, Ryan has been working as a postdoc at NOAA's Geophysical Fluid Dynamics Laboratory in Princeton, NJ and at Oregon State University's Hatfield Marine Science Center where he has been investigating the response of northeast Pacific ecosystems to large-scale climate forcing of the past and future.

Presentation: Ecosystem responses to climate change: Connecting fisheries to physics



2.7 JAMES WATSON



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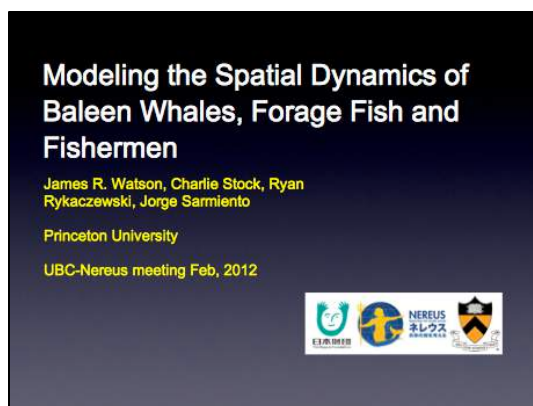
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Marine ecosystems are some of the most productive and diverse environments on Earth, maintaining a wide variety of organisms and providing essential food and services to the global population. Unfortunately, they are also under increasing stress from perturbations such as oil spills, climate change and over-fishing. The goal of my research is to improve our governance of marine systems and mitigate

the impact of these disturbances. My work focuses on understanding crucial feedbacks between physical, ecological and social processes. During my PhD I have investigated the role of ocean circulation in structuring the spatial dynamics of near-shore ecological communities. I have also explored ways in which marine protected areas can be designed to account for this spatial structure. The tools that I employed have their roots in physical oceanography, theoretical ecology and computer science. Looking forward, my aim is to expand the scope of my interdisciplinary research and, using a Complex Adaptive Systems perspective, address issues such as global ocean fisheries production and the evolution of social norms in response to ecological complexity.

Presentation: Modelling the spatial dynamics of baleen whales, forage fish, and fishermen



2.8 MARC METIAN



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Marc is working at the Stockholm Resilience Centre where he investigates the dynamics of markets and the social-ecological trade-offs that can exist between forage fish fisheries for fishmeal in aquaculture and direct human consumption. Social-ecological consequences from aquacultures increased dependence on high-grade inputs from agriculture are also part of his research topics. He is looking at links between sustainable use of marine resources, food security and governance, particularly in light of projected substantial increased demand for seafood due to both population growth and per capita consumption. He is closely collaborating with Dr Henrik Österblom (SRC), Dr Max Troell (Beijer Institute), Prof. Carl Folke (SRC) and the other SRC NF-fellow Andrew Merrie.

Marc received his Ph.D. degree in Biological Oceanology and Marine Environment from the University of La Rochelle (France) in 2007, realizing his researches at Marine Environment Laboratories - International Atomic Energy Agency (Monaco). He obtained his MSc in 2003 in Agronomy (applied zoology) from the Free University of Brussels (Belgium).

He is a multidisciplinary scientist with experience in environmental and sustainability-oriented research, focusing e.g., on food safety. Marc has worked on aquaculture nutrition and the role of aquaculture in food security, in particular from the perspective of the competition that exists between catch of forage fish for

fishmeal and human consumption. He has a keen interest in aquaculture globally and future challenges associated with this development, particularly the debate about “competition between feed and food resources.”

Presentation: Aquaculture: Crucial and increased component of seafood supply: Need for a resilient and responsible aquaculture



2.9 ANDREW MERRIE



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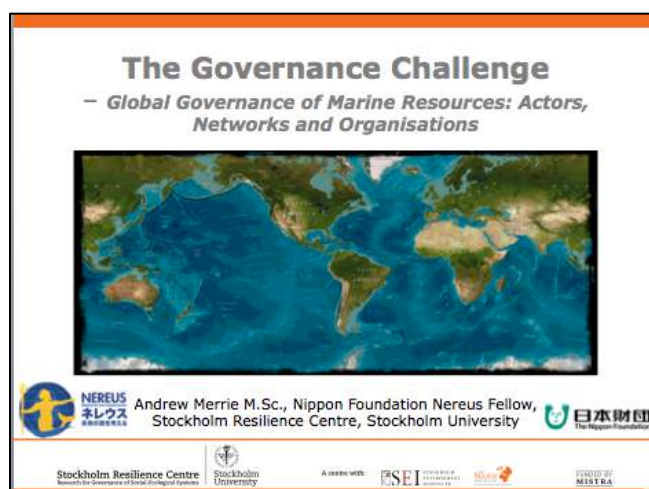
Andrew started his PhD in September 2011 after having completed his Master's in 'Ecosystems, Governance and Globalisation' at the Stockholm Resilience Centre. He comes from an educational background in Political Science and International Business. His focus in politics has been on transnational governance, International Relations and Policy Analysis. His Master's research focused on the emergence and spread of Marine Spatial Planning as a tool for ecosystem-based management. The thesis explored formal governance structures and informal governance networks, the role of individuals as institutional entrepreneurs, innovation in the context of social-ecological system dynamics and cross-scale interactions.

His PhD project is entitled 'Global Governance of Marine Resources – Actors, Networks and Organisations'. Over the course of the PhD, Andrew will use specific cases to highlight and assess; the interactions of formal and informal governance institutions, key actors involved in global governance of marine resources, the governability of marine resources embedded in the global economy and the feedbacks, relations, trajectories and nonlinearities that characterise the evolving marine resource governance landscape.

In addition to his PhD research, Andrew is a member of the SRC communications team where he indulges his passion for social media and helps to organise a range of seminars and dialogues.

Finally, Andrew is a New Zealander who has flown all the way across the world (17,016 kilometres no less!) to join the SRC in Sweden.

Presentation: Global challenge, global industry, global governance? Global governance of marine resources: Actors, networks, and organisations



2.10 CHRIS MCOWEN



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I have recently completed my Ph.D. at St Andrews. One of the primary goals of my thesis was to model the spatial distribution of the different facets of biodiversity in relation to climatic, physical and anthropogenic factors. This involved developing a variety of predictive and explanatory models in order to tease out the key drivers of species richness, functional diversity and genetic diversity.

Prior to this I completed a MSc at the Marine Biological Association of the United Kingdom, investigating the population structure of intertidal fish species.

I will start my postdoc at WCMC in Cambridge on the 21st of November, where I will be exploring the spatial distribution of species richness and productivity in a variety of coastal ecosystems.

Presentation: Modelling coastal fisheries:
Disentangling the web of variation



3. NEREUS ANNUAL MEETING, FEBRUARY 13-16, 2012

3.1 PROGRAM

Nereus Annual Meeting Program	
Monday, February 13th, 2012	
9:00 – 17:00	Nereus Fellows Workshop
Tuesday, February 14th, 2012	
9:00 – 9:30	Opening
9:30 – 10:00	Meet and Greet / Refreshment Break
10:00 – 12:00	Presentations from Nereus Fellows (Part 1)
12:00 – 13:00	Lunch
13:00 – 18:00	Presentations from Nereus Fellows (Part 2)
Wednesday, February 15th, 2012	
9:00 – 12:00	Nereus Technical Workshop: data and modelling framework, climate change, and socio-economic factors
12:00 – 13:00	Lunch
13:00 – 16:00	Nereus General Workshop (Part 1)
16:00 – 16:15	Meet with UBC President and Photo Session
16:15 – 18:30	Nereus General Workshop (Part 2)
18:30 – 21:00	Dinner
Thursday, February 16th, 2012	
9:00 – 11:00	Nippon Foundation meeting with Nereus Fellows / Technical Workshops for Nereus Fellows
12:00 – 13:00	Lunch
13:00 – 15:00	Steering Committee Meeting / Workshops for Nereus Fellows
15:00 – 18:00	Closing Discussion and Ending Remarks from the Nippon Foundation

3.2 PARTICIPANTS

Name	Affiliation	Title
Mitsuyuki Unno	Nippon Foundation	Executive Director
Yukiko Kuwata	Nippon Foundation	Translator (Project Coordinator, Maritime Affairs Department)
Villy Christensen	University of British Columbia	Nereus Program Director and Principal Investigator
Yoshitaka Ota	University of British Columbia	Nereus Program Co-Director and NF Senior Nereus Fellow
Daniel Pauly	University of British Columbia	NF-UBC Steering Committee Chair
Wilf Swartz	University of British Columbia	NF Senior Nereus Fellow
Audrey Valls	University of British Columbia	NF Nereus Fellow
Jeroen Steenbeek	University of British Columbia	Technical Consultant
Patrick Halpin	Duke University	Principal Investigator
Andre Boustany	Duke University	NF Senior Nereus Fellow
Daniel Dunn	Duke University	NF Nereus Fellow
Jorge Sarmiento	Princeton University	Principal Investigator
James Watson	Princeton University	NF Senior Nereus Fellow
Ryan Rykaczewski	Princeton University	NF Senior Nereus Fellow

Kelly Kearney	Princeton University	NF Nereus Fellow
Henrik Österblom	Stockholm Resilience Centre	Principal Investigator
Carl Folke	Stockholm Resilience Centre	Principal Investigator
Marc Metian	Stockholm Resilience Centre	NF Senior Nereus Fellow
Andrew Merrie	Stockholm Resilience Centre	NF Nereus Fellow
Louisa Wood	United Nations Environment Programme – World Conservation Monitoring Centre (UNEP-WCMC)	Principal Investigator
Chris Mcowen	United Nations Environment Programme – World Conservation Monitoring Centre (UNEP-WCMC)	NF Senior Nereus Fellow
Jeffrey Polovina	National Marine Fisheries Services (NOAA); Pacific Islands Fisheries Science Centre	NF-UBC Advisory Panel Member
Charles Stock	Princeton University	Guest
Ei Fujioka	Duke University	Guest

3.3 NEREUS FELLOWS WORKSHOP (MONDAY, 13th FEBRUARY 2012)

In a preliminary workshop, the fellows discussed the questions that would guide their research objectives and the overall scope of the Nereus program. Over the course of the workshop, stimulating discussions generated a variety of perspectives and approaches. Three main questions evolved regarding the quantity of fish and fishers as well as the contribution of fisheries to global food supply. The fellows further divided the topics into the state of the oceans, state of the fishing industry, socio-ecological processes, and governance. The final structure is represented in Figure 1. The importance of disseminating information to stakeholders and the general public was also emphasized, and the new Web interface facilitating communication and sharing between fellows was introduced. Finally, the fellows and PIs briefly discussed data availability and sharing.

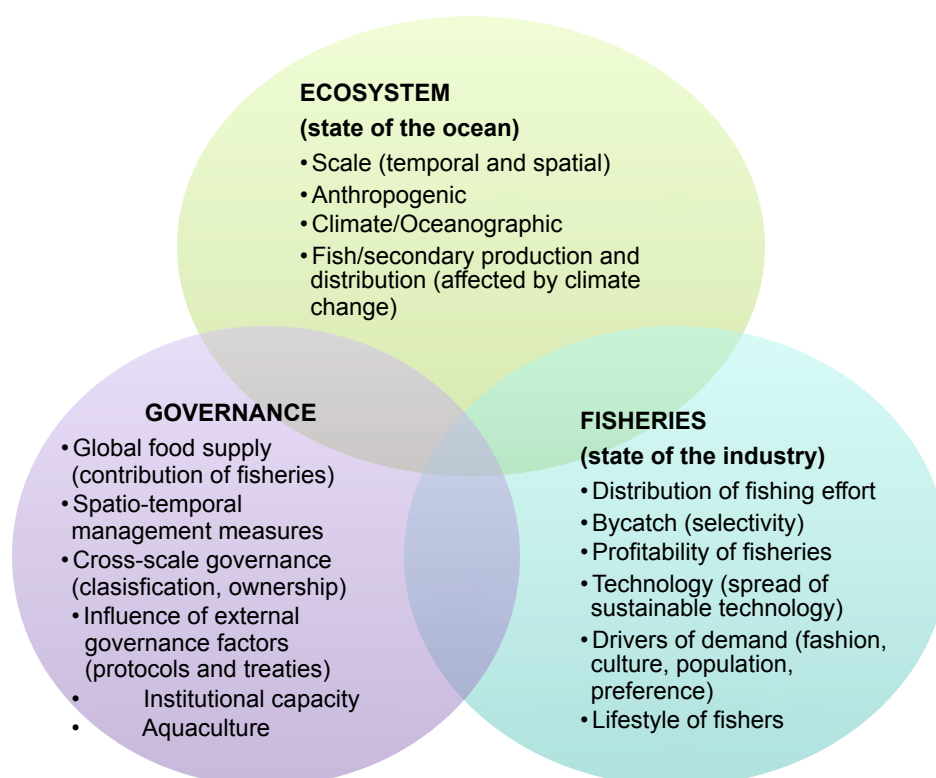


FIGURE 1 Three overarching research themes.

3.4 PRESENTATIONS (TUESDAY, 14 FEBRUARY 2012)

During the first formal meeting, the Nereus fellows were asked to give presentations outlining their progress and future plans towards their respective projects.

Kelly Kearney presented an end-to-end modelling framework for the North Pacific that captures the effects of decadal-scale climate variability across trophic levels (from zooplankton up to mammals and birds). The model was constructed using 23 functional groups, and is derived from three different models: a physical, 1-D mixed-layer model (forced at surface with winds, etc.); a biogeochemistry model (NEMURO); and a predator/prey model (EwE). The model provides a fully-coupled simulation of upper and lower trophic level species, nutrient cycles, and physics, and both maintains stability over decadal to centennial timescales and replicates observed seasonal dynamics in nutrients and productions.

Given our ability to project future changes in plankton production and distribution, Ryan Rykaczewski intends to explore how changes at the base of the food web affect fisheries productivity, and how we can use the former to determine the latter. Factors to be considered include phytoplankton taxa and relative rate of recycling; variable trophic transfer efficiency and trophic level of the catch; and zooplankton dynamics and mediation of transfer efficiency. He is presently investigating how the California Current is responding to global warming through increased stratification in the open ocean, increased nutrient supply along the coast, and increased wind stress.

James Watson provided an overview of three models he intends to create in order to capture the spatial dynamics of baleen whales, forage fish, and fishermen, including a(n):

- Agent-based model of whale migration (How do migration patterns evolve? How do migration patterns change with climate change/anthropogenic impacts?);
- Size-based model of marine communities, focusing on size, bioenergetics, and movements and simulating the spatial dynamics of forage fish; and a
- Socio-ecological model (e.g., ODEs, game theory, agent-based, etc.) to incorporate societal influences and patterns

Audrey Valls introduced the components of her research—diet composition, keystone species, and vulnerability to fishing—as tools for use in ecosystem modelling (EwE “plug-ins”) that will improve our capacity to predict changes in marine biodiversity. To evaluate vulnerability to fishing, she intends to use intrinsic factors (e.g., species characteristics) and extrinsic factors (e.g., fisheries attributes) to produce a comprehensive index.

Andre Boustany works on predicting marine animal habitat based on physiology, oceanography, and environmental conditions. He outlined current efforts to apply these techniques to predict distributions of fish and fisheries over longer time scales, and under different scenarios of climate change.

Daniel Dunn explained his research regarding future prospects for spatio-temporal management of fisheries, as well as current endeavours to map fishing effort with increased precision and availability of data. Other directions of interest include the distributions of artisanal and semi-industrial fisheries under climate change scenarios, as well as the use of pelagic fisheries closures, with specific attention to their utility under climate change scenarios.

Chris Mcowen proposed the creation of a predictive framework that incorporates oceanographic, anthropogenic, and climatic/biotic indicators in order to better understand the drivers of coastal fisheries productivity, and how factors such as urbanization and climate change will affect coastal fisheries in the future.

Marc Metian spoke of the potential for sustainable forms of aquaculture to function as part of the global solution, rather than the problem. To accomplish this, the dilemma arising from competing uses of

aquaculture resources must be reconciled and sustainable aquaculture techniques must be implemented globally.

Andrew Merrie identified governance as one of the major challenges in fisheries management—one that entails many conflicting scales and players. Amongst his research interests, Andrew discussed the dueling discourses in global marine resources governance, and his intention to evaluate the effectiveness of the UN General Assembly's open-ended informal consultative processes on oceans and coastal law. Moving forward, Andrew's key research themes include the following:

1. Who are the key agents that may shape changes in global marine governance?
2. Governance institutions and interactions
3. Governance of marine resources in a high-tech global marketplace
4. Transformation potential of global marine governance—the way forward

Presentations were then given by Dr. Yoshitaka Ota, fisheries anthropologist and Co-Director of the Nereus Program, Dr. Charles Stock, Research Oceanographer at the NOAA/Geophysical Fluid Dynamics Laboratory, and Dr. Henrik Österblom, Principal Investigator at the Stockholm Resilience Centre, speaking on behalf of Dr. Carl Folke. Dr. Ota introduced his work towards the establishment of a global indigenous fisheries assessment, Dr. Stock spoke of the use of IPCC-class models in the assessment of the impact of climate on living marine resources, and Dr. Österblom explained the importance of modelling complex socio-ecological systems.

3.5 SUMMARY: WEDNESDAY, 15th FEBRUARY 2012

The morning began with a brief introduction to the day's schedule, which consisted of a series of presentations as well as a visit from Mr. Mitsuyuki Unno, Executive Director of the Nippon Foundation and a group photo session with Mr. Unno and Professor Stephen J. Toope, President and Vice-Chancellor of the University of British Columbia. The day would conclude with a demonstration of Nereus' Oracle.

Presentation 1

To begin, Dr. Villy Christensen presented Nereus' newly developed model as a representation of anthropogenic impacts on the world's oceans. The model employs a scientific interface to communicate different scenarios through visualizations that are easily understood by those without scientific backgrounds.

Sea Around Us Project (SAUP) and Data Availability

Dr. Daniel Pauly and Reg Watson introduced the SAUP's commitment to manage and represent the worldwide fish catch data by using a layer methodology combined with a ½ degree cells base. Professor Pauly emphasized the difficulty of collecting data and reconstructing the information due to inaccurate reports. The objective is to make all reconstruction data available by next year through collaboration. The data sharing process would necessitate a basic understanding of logistics and transparency.

Presentation 2

Dr. Christensen presented a multilayer model encompassing the main mechanisms driving processes in the ocean. Each cell of the model integrates several attributes in order to determine habitat capacity using spatial and temporal data. To incorporate fisheries management, the model enables modification of biomass, gear, and habitat characteristics. Distinct models (e.g., governance) are also combined for different trophic levels and then linked through fluxes, nutrients, and organic matter transferred to higher trophic levels. Nereus members agreed on a missing link related to human activities and, in particular, on organic matter extraction.

Presentation 3

Dr. Jeffrey Polovina discussed major changes to the food web that have occurred over the past few decades, including the associated nutrient fluxes and the data used to observe these trends. In the four major oceans, significant trends related to ocean stratification and changes in size and structure of phytoplankton, as well as a decreasing catch rate of large pelagics, were observed during the last decade. This was contrasted with an increase in the mid-size pelagic catch rate, thereby demonstrating a trophic cascade and confirming the concept of "fishing down the food web," as described by Dr. Daniel Pauly.

Presentation 4

Jorge Sarmiento addressed the need to combine human dimensions with IPCC models, discussing the potential for a model combining population growth, technology, and IPCC emission scenarios in order to generate scenarios specifically focused on fisheries.

UBC President's Visit

Professor Toope was delighted to welcome the Nippon Foundation and congratulated the Nereus team on their meaningful contribution towards achieving a sustainable world.

"The Oracle meets Nereus" Presentation

Dr. Villy Christensen presented the Oracle to Mr. Mitsuyuki Unno and the members of Nereus as a preliminary announcement preceding the AAAS Annual Meeting. Two distinct programs were created: one addressing the general public, and the other addressing fisheries managers. Following the group photo session, the members discussed the potential for the Oracle to have a strong visual impact on the general public.

3.6 STEERING COMMITTEE MEETING (THURSDAY, 16th FEBRUARY 2012)

3.6.1 PARTICIPANTS

Name	Affiliation	Title
Mitsuyuki Unno	Nippon Foundation	Executive Director
Yukiko Kuwata	Nippon Foundation	Translator (Project Coordinator, Maritime Affairs Department)
Villy Christensen	University of British Columbia	Nereus Program Director and Principal Investigator
Yoshitaka Ota	University of British Columbia	Nereus Program Co-Director and NF Senior Nereus Fellow
Daniel Pauly	University of British Columbia	NF-UBC Steering Committee Chair
Patrick Halpin	Duke University	Principal Investigator
Jorge Sarmiento	Princeton University	Principal Investigator
Henrik Österblom	Stockholm Resilience Centre	Principal Investigator
Louisa Wood	United Nations Environment Programme – World Conservation Monitoring Centre (UNEP-WCMC)	Principal Investigator

3.6.2 DISCUSSION

The Steering Committee spoke to the preliminary accomplishments of the program, and of the need to maintain the momentum gained through collaboration. The members identified the project as unique due to its interdisciplinary and global nature, and expressed excitement at the prospect of the valuable contributions to science that could be achieved through this endeavour.

The meeting entailed discussions of data contribution and sharing, publications, and press release details. The members agreed that, for each publication, one institution would be allocated responsibility for conducting press releases and organizing the exchange of information between institutions. Due to the scope of the project, principal investigators and fellows were encouraged to maintain contact with Dr. Yoshitaka Ota, and to inform him of important details.

Mr. Mitsuyuki Unno concluded the annual general meeting with the following speech:

The scientific results are important for Nereus in many ways. I have had the chance to meet with six of the fellows and really appreciate such wonderful members who truly understand the philosophy behind the Nereus program. I have great hopes that such a team can overcome challenges. The principal investigators constitute the dream team. The program—as set at the University of British Columbia by Dr. Yoshitaka Ota, Professor Villy Christensen, and Professor Daniel Pauly—accommodates and operates within the Nereus philosophy. As we progress, we will begin to understand our requirements and establish methods for integrating our findings into international policies and laws. If there is anything unbalanced in the budget, I would be happy to discuss it with you. Over the past 50 years, the Nippon Foundation has worked to support people with passionate ideas; we fully support this group and are pleased to be collaborating with the young fellows. I would also like to inform you that I will not be able to fully assist during the next meeting since I will be focusing my support towards the victims of the tsunami in Japan. Finally, I would like to express my gratitude to all of those who contributed to make this meeting possible.

4. THE ORACLE MEETS NEREUS AT AAAS

By Audrey Valls

While many people today are able to enjoy the fruits of the oceans, there is widespread concern about over-exploitation of the world's fish resources, which has caused serious declines in fish populations. Will the global ocean be healthy enough to provide seafood for coming generations?

Based on a partnership between the Nippon Foundation (NF) and five academic institutions, including the University of British Columbia (UBC), an international research and outreach project was launched in 2010 to answer questions about the future ocean. Being the “protector of fishermen” and possessing the ability to predict the future, the ancient Greek god of the sea, Nereus, was chosen as the project's symbol. The NF-UBC Nereus Program aims to assist with modelling the future ocean and determining how we can ensure sufficient seafood and a healthy ocean for our children and grandchildren to enjoy. As well as simulating the future ocean, the project aims to enhance capacity building and raise public awareness.

During February, the NF-UBC Nereus Program held its first annual meeting in Vancouver culminating with a symposium at the Annual Meeting of the American Association for the Advancement of Science (AAAS). From the 16th to the 20th of February, the 178th Annual Meeting gathered thousands of scientists, engineers, educators, policy-makers, and journalists from some 50 nations to discuss ideas around the theme “Flattening the world: building a global knowledge society.” Attendees were offered a large choice of scientific symposia and plenary lectures, but also workshops, exhibitions, and poster presentations. A number of sessions emphasized the importance of communication in science and gave advice on how best to communicate science to other scientists, as well as the public.

The Nereus session at the AAAS, “Predicting the future ocean: the Nereus Program,” was organized by Dr. Villy Christensen, Director of the Nereus Program. He gave an overview of the use of 3D gaming technology to produce visualizations for communicating scientific results. Dr. Christensen's talk, entitled “The Oracle Meets Nereus,” introduced the Oracle, a 3D animated character who serves as an interactive and educational interface to make the science in Nereus accessible to the public and policy-makers. By using entertaining visuals, the interface provides scientific information based on the Nereus modelling framework, which is the first global model of life in the ocean. It aims to capture how marine life has developed in recent years, and projects possible future ocean states, which are partly dependent upon the actions of humans now and in the past. The 3D gaming approach employed by the Nereus Program was created by Dr. Christensen's team at the Fisheries Centre during the past three years and will be developed further with the aim of contributing to raising public awareness.

Following Dr. Christensen's presentation, all of the principal investigators from the Nereus Program's partner institutes – Dr. Jorge Sarmiento from Princeton University, Dr. Louisa Wood from Cambridge University, Dr. Patrick Halpin from Duke University, and Dr. Henrik Österblom from Stockholm University – introduced their research work and outlined their participation in the Nereus Program, thus emphasizing their collaborative roles in bridging the gap between their respective disciplines. Dr. William Cheung from UBC and Dr. Jeff Polovina from NOAA also participated in the session, which was well attended. The following day, a Live Chat with Dr. Christensen and Dr. Yoshitaka Ota, Co-Director of the Nereus Program, was hosted on the Science website.



FIGURE 2 Dr Henrik Österblom, Dr Louisa Wood, Dr William Cheung, and Dr Villy Christensen participating in the Nereus symposium at the AAAS Annual Meeting on 18 February 2012. (Photo: Yoshitaka Ota)

During the week prior to the AAAS conference, the Nereus Program held its first three-day Annual Meeting. All of the principal investigators and fellows gathered at St. John's College on the UBC campus. Dr. Daniel Pauly and other members of the steering committee, as well as representatives of the Nippon Foundation, attended the meeting.

On the first day, all of the fellows and a few of the professors presented their proposed contributions to the Nereus Program. At UBC, there are two Nereus Fellows, both from the Fisheries Centre: Wilf Swartz, a prospective postdoctoral fellow who will begin in Spring 2012, and myself, Audrey Valls, a PhD candidate under the supervision of Dr. Christensen. As a Nereus Fellow, I introduced my PhD work, focusing on predicting global changes in marine biodiversity by considering trophic interactions and human impacts at the species level. The remainder of the meeting was dedicated to discussions on how to foster and strengthen successful collaborations among partners.

Overall, the Nereus Annual Meeting proved a very promising first gathering, and the work presented at the AAAS symposium was well received. During the coming years of the program, the Nereus modelling framework and the Oracle interface will both be developed further to allow policy-makers to ask questions, and then display the consequences of different management scenarios visually. By predicting the future ocean, the Nereus Program hopes to shed light on what needs to be done to ensure a healthy ocean that can provide seafood for coming generations.



FIGURE 3 Nippon Foundation fellows and Nereus researchers met with Mr Mitsuyuki Unno, Nippon Foundation, and President Stephen Toope, UBC, during the first Nereus Annual Meeting from the 13th to the 16th of February 2012. (Photo: Martin Dee)

NEREUS REPORT IN JAPANESE (BY DR. YOSHITAKA OTA)

ネレウスプログラム

平成 23 年度中間報告 (2011 年 2～2012 年 2 月)

概要

日本財団とブリティッシュコロンビア大学の共同運営による国際海洋プログラム「ネレウスプログラム (NF-UBC Nereus Program)」は、一年の準備期間を経て、

調査研究: 2050 年の海の未来を予測

人材育成: 総合的な視野を持った海洋科学者の育成

周知啓発: 魚資源の現状について政策者・一般市民の理解の手助け

を活動内容の3本柱として、2011 年9月から本格的な事業活動を開始している。現在、ブリティッシュコロンビア大学・プリンストン大学・デューク大学・世界自然保護監視センター・ケンブリッジ大学・ストックホルム大学の研究者、および、若手研究者である日本財団ネレウスフェローによって“2050 年の海の未来”への知見獲得への共同研究が進められている。

これまでの活動としては、2011 年1月に参加機関との協議を開始し、各協力大学への正式な参加を要請し、参加機関とのプログラム協力同意書締結を進めた。7月に入ってから、中核となる次世代ネレウスフェローの募集を開始し、プリンストン大学にて選抜者による初めてのネレウスワークショップを開催した。この間に、ネレウスプログラム予算をすべての機関に交付が完了し、ネレウスプログラム・ホームページも設置され、現在も、適宜、更新中である。

各参加機関との連携体制については、日本財団を中心としてブリティッシュコロンビア大学と連携同意書が交わされ、ブリティッシュコロンビア大が各参加機関と研究役割分担を確認する内容となっている。プリンストン大学とは気候変動による海洋環境の変化の観点から、デューク大学とは地理空間的な分析手法において、また、世界自然保護監視センター・ケンブリッジ大学とは海洋生物の資源分布に関する地理的データのアセスメントの点で、ストックホルム大学とは現在の国際海洋ガバナンス研究について協力を得られることになっている。

10名のネレウスフェローの選抜については、日本財団・海洋人材育成プログラムの指針

である「広い視野を持った、総合的な人材育成の促進」を考慮に入れつつ、各研究機関の規定にのっとり、公平性と透明性を持って行われた。選抜にあたって、各研究機関の研究責任者は、応募者の専門的な学術能力だけに特化した選抜を行わず、学際的な研究の経験、政策等の実践的な指針を示すことを目的とした研究への情熱、チームワーカーとしてのポテンシャル等を考慮した。

学術発表については、若手研究者の成果がとりまとめられ次第、順次、評価の高い国際専門学術雑誌に発表されていく予定である。手始めに、来年2月にバンクーバーで開催されるアメリカ科学振興協会の年次大会において、「ネレウス-未来の海を予測する」と題して単独シンポジウムを主催し、大会参加の国際ジャーナリストへ情報発信を行った(サイエンスポッドキャスト出演等)。

今後の活動スケジュールとしては、来年2月にブリティッシュコロンビア大学での全体年次会議を開催し、ネレウスフェロー、各研究機関の主任研究者が一同に集い、魚資源の未来についての分野横断的な科学議論を深めた。今後より、統合的な研究視点と政策マインドを持った若手研究者同士のより活発な議論が発生するとともに、海に関する学際的新領域の構築が行われる。故に、これまでのプログラム進捗から、今後のプログラム発展において以下の3点の重要性が示唆される。

1. 学際的議論からの新領域の発生
各フェローの共同研究から新たな学問領域の発生が可能となる。
2. 社会・自然科学をつなげる統合的プロジェクトの推進(ネレウス・ダイアグラムの構築)
図式的な説明・議論により、社会・自然科学の壁を越える、統合的プロジェクト推進がはかれる。
3. 新たなコンポーネント(国際法等)の必要性
魚資源の問題解決の為に必要とされる他の学問領域の参加を戦略的に促進する。

今後は、この3点を重視し、プログラム推進をフェロー及び関係者とともに進めていく事とする。

太田義孝

日本財団—ブリティッシュコロンビア大学 ネレウスプログラム 副統括(Co-Director)

漁業センター(Fisheries Centre), ブリティッシュコロンビア大学

2012 年 2 月 29 日

ネレウスプログラム 中間活動報告 (2011 年 1 月～12 月)

報告内容

1. これまでの活動経緯
2. 各参加機関との連携体制について
3. ネレウスフェローの選抜について
4. ネレウスフェロー紹介
5. 学会発表および周知啓発活動について
6. 今後の活動スケジュール

これまでの活動経緯について:



日付	活動
2011. 1,2,3 月	各協力大学への正式な参加要請。 UBC による総合コーディネーターの選抜。公募により太田義孝氏を選定。 Nereus Program Start Meeting: 全参加機関出席による総合会議。各協力大学機関と UBC において東日本大震災支援基金への協力。
2011 4.5.6 月	ブリティッシュコロンビア大学とプリンストン大学・デューク大学間において、プログラム協力同意書を締結。 ネレウスプログラム事務局(予算、連絡システム等)および技術チーム(ソフトウェアプログラム、3D 映像)の設置 各大学において、ネレウスフェローの募集および選抜を開始
2011. 7.8.9.10 月	ブリティッシュコロンビア大学とケンブリッジ大学 (および World Conservation Monitoring Centre) 間において、プログラム協力同意書を締結。 ネレウスプログラム予算をすべての大学に送金。 ネレウスプログラム・ホームページを設置。 すべての日本財団ネレウスフェローの選抜が終了。

	北米ワークショップをプリンストン大学にて開催。 ストックホルム大学と、協力同意書を締結。
2011 11.12 月	ネレウスアドバイザーパネルの選考。 フェローによる Skype 会議。 第1回ネレウス全体会議(Science Meeting)準備。 アメリカ科学振興協会年次大会での単独シンポジウム準備。

各参加大学研究機関との連携体制について

日本財団－ブリティッシュコロンビア大学

連携同意 2010 年 12 月に笹川会長とトゥーブ学長の出席により東京、日本財団において連携同意がプレス発表とともに行われた。

ブリティッシュコロンビア大学－プリンストン大学

連携同意: 2011 年1月に UBC に提出。

連携内容(調査研究):

米国海洋大気圏局(NOAA)の海洋地理流動性研究機関(GFDL)が共同参加し、研究対象として気候変動による海洋環境の変化と今後の漁業活動および魚資源の動向の変化の調査を行う。プリンストン大学の生態進化学研究所(サイモン・レヴィン教授)との連携により、ネレウスフェローがより総合的な海洋教育を受ける事のできるサポートを行う。

ブリティッシュコロンビア大学－デューク大学

連携同意:2011年の5月にUBCに提出。

連携内容(調査研究):

デューク大学海洋地理空間生態系研究所は、他の研究機関の科学データを、地理空間的な分析手法によって変換、統合する役割を担う。また、海洋空間計画等、今後の海洋管理(漁業管理を含める)の世界的な傾向を考慮に入れた管理側の対応を含めたより現実的な魚資源の変化を考察する。

ブリティッシュコロンビア大学－国連環境計画・世界自然保護モニタリングセンター(UNEP-WCMC)・ケンブリッジ大学

連携同意:2011年7月にUBCに提出。

連携内容(調査研究):

ケンブリッジ大学との連携(この連携については、ケンブリッジ大学地理学科とUNEP-WCMC との間に日本財団奨学金制度についての同意が結ばれている)により、これまで行われた海洋生物の資源分布に関する地理的データのアセスメントを行うとともに魚資源に重要な沿岸域生息域への環境影響の分析、予測を行う。

ブリティッシュコロンビア大学－ストックホルム大学

連携同意: 2011 年 10 月に UBC に提出。

連携内容(調査研究):

ストックホルムレジリアンスセンターでは、社会経済学的視点から、現在の国際海洋ガバナンス、特に漁業資源に関する地域、国際管理機関間の連携と機能に関する考察を行う。また、養殖も含めた水産資源の流通システムの変化についても考察を行い、食料安全保障の面から今後の水産資源および流通の可能性を理解する。

*協力に関する同意

リティッシュコロンビア大学産学連携室のガイダンスのもと、UBC と各大学間において、合意書を結び、協力・連携における法的な取り決めを行った。この取り決めには、プログラム共同推進者としての日本財団の役割についても明示されている。連携取り決めについては、UBC と日本財団間の協力規定に沿いながら全関係大学の規定にのっとり、同様の内容でまとめられている。

ネレウスフェローの選考について

日本財団ネレウスフェローとシニアネレウスフェローの選考については各大学また研究機関の規定にのっとり、公平性と透明性を持って行われている。

選抜にあたって、各研究機関の研究責任者は、日本財団海洋人材育成プログラムの指針である「広い視野を持った、総合的な人材育成の促進」を考慮に入れ、個人的資質を選抜基準として勘案した。その結果として、各研究責任者は、応募者の専門的な学術能力だけに特化した選考を行わず、学際的な研究の経験、政策等の実践的な指針を示す事を目的とした社会貢献への情熱、チームワーカーとしての適正を考慮した上で、フェローの選考を行った。

研究機関名	募集方法	応募者数	選考経過
UBC	大学ホームページ、 Nature Online での広告 他研究機関への募集メール送付	Ph.D. 1名 (France) Post-doc. 4 名 (Canada, US)	Ph.D.: プリンストン大学の現博士課程を選考。 Post-doc.: 応募者から 4 名 (Canada, US) を書類選考し、1 名につき面接の上、最終選考を行った。
プリンストン	大学ホームページ、 Nature Online 多研究機関への募集メール送付	Ph.D. 3 名 (Brazil, US) Post-doc. 17 名 (Canada, US, UK, Australia, NZ, Japan)	Ph.D.: プリンストン大学の現博士課程を選抜。 Post-doc.: 応募者から 2 名を書類選考し(男性 2 人 (USA))、面接の上、最終選考を行った。

ニューク	大学ホームページ、他研究機関への募集メール送付	Ph.D. 5名 (US) Post-doc. 1名 (US)	PhD:応募者から2名を書類選考し、面接の上、最終選抜を行った。Post-Doc:募集選考トピックに関係する研究者に募集要項を送り、1名を面接の上、最終選考した。
WCMC-ケンブリッジ	大学ホームページ 他研究機関への募集メール送付	Post-doc. 5名 (US, UK, Australia)	Ph.D.: 応募者から3名を書類選考し、女性1人(イギリス)、男性2人(イギリス、オーストラリア)を面接の上、最終選抜を行った。
ストックホルム	大学ホームページ 他研究機関への募集メール送付	Ph.D. 42名 (Brazil, US) Post-doc. 3名 (Sweden, France)	Ph.D.: 応募者から3名を書類選考し、女性2人(ノルウェー、スイス)、男性1人(ニュージーランド)を面接の上、最終選抜を行った。Post-Doc:募集選考トピックに関係する研究者に募集要項を送り、1名を面接の上、選抜した。

ネレウスフェローの紹介

大学・研究機関	日本財団シニアネレウスフェロー (ポストドク) NF Senior Nereus Fellow (Post-Doc.)	日本財団ネレウスフェロー (博士課程) NF Nereus Fellow (Ph.D.)
ブリティッシュ コロンビア大学	Wilf Swartz (Canada) 漁業経済	Audrey Valls (France) 海洋生態系
プリンストン大学	James R Watson 海洋生態系、気候変動、	Kelly Kearney 海洋学、気候変動

	Ryan Rykaczewski 海洋生物、気候変動	
ケンブリッジ大学 世界自然保護モニタリングセンター	Chris Mcowen 沿岸域生息域、生物多様性	未定
デューク大学	Andre Boustany 大型魚類(マグロ)、海洋空間分析	Daniel Dunn 混獲、海洋空間分析
ストックホルム大学	Marc Metian 水産養殖、資源管理ガバナンス	Andrew Sean Merrie 資源管理ガバナンス、政策分析

ネレウス研究責任者 (Principal Investigators)

大学・研究機関	研究責任者名	研究責任者名
ブリティッシュ コロンビア大学	Villy Christensen 漁業資源管理、海洋生態系	太田義孝 海洋人類学、海洋政策
プリンストン大学	Jorge Sarmiento 海洋学、気候変動	Charles Stock 海洋学、気候変動
ケンブリッジ大学 世界自然保護モニタリングセンター	Louisa Wood 生物多様性、海洋保全	Tom Spencer 沿岸域環境、自然地理学
デューク大学	Patrick Halpin 海洋空間分析、生物多様性	
ストックホルム大学	Carl Folke 社会経済、持続可能社会	Henrik Österblom 資源管理ガバナンス、違法漁業

学会発表および周知啓発活動について

ネレウスプログラムの理念と活動内容に関する周知活動として、学会発表(アメリカ科学振興協会)やマスコミ取材(ドイツ ZDF)、国際機関(UNEP)、NGO(Pew 財団)での発表等を行っている。また、これらの活動では、コンピューターグラフィックを使ったメディア手法を用いて、一般および政策者との科学コミュニケーションの向上を図っている。さらに、来年2月には、バンクーバーで開催されるアメリカ科学振興協会(科学雑誌サイエンス発行、世界最大の学術科学団体)の年次大会において、「ネレウス-未来の海を予測する」と題して単独シンポジウムを行う。このシンポジウムは、すでに公式取材の申し込みを受けており、この機会を用いて年次大会に集まる約300名を超える国際ジャーナリストにネレウスプログラムの理念と内容を発信する。

ネレウス学会発表(国際のみ)、および他団体への周知活動一覧

学会および団体名	発表者	日時・場所
国際海洋保全学会 International Marine Conservation Congress	太田義孝 (UBC)	5 月 ヴィクトリア、カナダ
アメリカ漁業協会 American Fisheries Society	Villy Christensen (UBC)	8 月 シアトル、アメリカ
国連大学 United Nations University	Patrick Halpin (デューク大学)	8 月 東京、日本
Pew 財団 海洋環境グループ Pew Foundation, Marine Environment	太田義孝 (UBC)	9 月 ワシントン DC、アメリカ
世界閉鎖性海域環境保全会議 Environmental Management for Enclosed Coastal Sea	太田義孝 (UBC)	9 月 バルチモア、アメリカ
世界海洋生物多様性保全会議 World Conservation of Marine Biodiversity	Audrey Valls (UBC)	9 月 アバディーン、イギリス
国連環境計画会議 United Nations Environment Programme	Louisa Wood (世界自然保護モニタリングセンター)	10 月 ナイロビ、ケニヤ
ドイツ ZDF テレビ Zweites Deutsches Fernsehen	Villy Christensen (UBC)	12 月 ドイツ、アメリカ東部

*Ocean Visualisation 活動戦略

ネレウス UBC のプログラム活動の一つとして行われている Ocean Visualisation (コンピューターグラフィックを使った海洋映像)を活用し、Youtube 等を通して、活動内容の発信を行っている。