Where the City Meets the Sea: Studies in Coastal Urban Environments

Syllabus – Spring 2012

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Office Hours: By appointment

Course Description:
Over half of the human population lives within 100 km of a coast and coastlines contain more than two-thirds of the world’s largest cities. As a result, the world’s natural coastal environments have been substantially modified to suit human needs. This course will use the built and natural environments of coastal cities as laboratories to examine the environmental and ecological implications of urban development in coastal areas. Using data from multiple coastal cities, student teams will use field-based studies and Geographic Information System (GIS) data to examine patterns and processes operating in coastal cities. This course uses the local terrestrial, marine, and built environments as a laboratory to address these issues, and team projects requiring field work form a core component of the learning experience. As part of the NYU Global Network University initiative this course is being offered simultaneously in New York and Abu Dhabi and students will be collaborating extensively with students from their sister campus through the duration of this course.

Global Network University Connection:
Students in this course will collaborate with students attending an identical course being offered simultaneously in New York. Most collaboration will be asynchronous via email, but there are four common classes (see schedule) throughout the course where students on both campuses will attend a simulcast lesson by John Burt (Abu Dhabi) or Mary Killilea (New York) or student-led discussion sessions. This course is being operated with the collaboration and support of Peter Schilling of the GNU Unit at NYU-NY.

Course Purpose:
This course is designed as a non-majors science course for the purpose of introducing students to the scientific process of inquiry, field methods used in environmental research, and the acquisition, storage, analyses, and communication of data both within and among groups operating across large geographic scales. These processes will be introduced through content relating to the marine, terrestrial, and built environments of coastal urban areas. Note that all activities will be conducted in the class or the field; no laboratory space is required.
Prerequisites: None

Schedule: January – May 2012 (14 weeks, 2 days per week)
- Tuesday 8:00 am – 10:45 am (includes a 75 min. lesson then a field/lab activity)
- Thursday 8:00 am – 10:45 am (field or lab activity only)

Learning Outcomes:
Upon completion of this course, students will be able to:
• Apply appropriate techniques to design and implement a field-based study of environmental/ecological parameters related to urban ecology (Process)
• Select, analyze, and interpret data for spatial and/or statistical comparisons of quantitative environmental data (Process)
• Communicate scientific findings using appropriate style and format both orally and in writing (Process)
• Use technology to collate, analyze, exchange, and communicate data (Process)
• Describe the impacts of urbanization on coastal ecosystems at both a local and global scale (Content)

Software Required:
• ArcGIS; SPSS; Excel (No experience is required)

Textbook: None; Readings will be provided.

Attendance Policy:
Students are expected to attend all classes and field activities, including the day-long weekend field trip scheduled for March (specifics to be determined before registration).

Tardiness Policy:
Students are expected to arrive on-time for class and to submit all activities/homework at the time and date expected. Late assignments (even those submitted late on the same day) will incur a 20% deduction per day, with assignments more than 48 hours late assessed as a non-submission (zero grade).

Field-trips:
Students are required to complete several outdoor field trips during the course of the semester. These will include activities being conducted for several hours at cold air temperatures. Students are expected to wear field appropriate clothing and closed-toed, flat-heeled shoes during these activities. Students are responsible to ensure that they are physically capable to conduct
extended field work in these conditions and that they do not have medical conditions which would endanger their personal health before engaging in this course or its field trips.

Tentative field trips (provisional contingent on funding):
• Indoor and Outdoor air quality
• Biodiversity assessment (requires transport to natural and urban areas around NYC to deploy and collect insect pan traps)
• Day-long marine water quality sampling trip on board a boat; Life vests required.

*Grade Breakdown:*

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<thead>
<tr>
<th>Assessment Tool</th>
<th>Percent Contribution</th>
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<tbody>
<tr>
<td>Weekly Assignments</td>
<td>30</td>
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<tr>
<td>Midterm Exam</td>
<td>20</td>
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<tr>
<td>Final Project</td>
<td>25</td>
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<td>Final Exam</td>
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*Total* 100%
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<tr>
<th>Week</th>
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<th>Lab Topic</th>
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<tr>
<td>1</td>
<td>Where the City Meets the Sea: A Historical perspective&lt;br&gt;Lesson will begin with a presentation/discussion using Easter Island as a case study on the environmental impacts of human population growth in coastal areas. This reading will provide a historical context that will serve as the springboard into describing the purpose of this course and what is coming up in the semester via delivery of the syllabus. Generic information on the extent of urbanization in coastal areas and projections for future (mainly based on UN estimates) will be provided. Tue Jan 24, 2012</td>
<td>Surveying our Urban Environment:&lt;br&gt;Students will use cameras to catalogue the urban environment in NY and AD and use GPS units to geo-reference various points in photos. Will include terrestrial, marine, and built environments. Individual, pair or group focused (TBD) with specific geographic/environmental (and potentially socio-economic) targets assigned by faculty (40%) as well as self-generated by students (60%). Geographic limits of sampling must be prescribed. To be done in session and through week. Thu Jan 26, 2012</td>
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<td>2</td>
<td>Our Coastal Context (Common Class)&lt;br&gt;This will be a student-led class where each class will give a visual-based presentation to introduce counterparts from the other campus to their city. Sequence: Large-scale map of the area with general geographic areas delineated and described with images, some historical context on the city at large (where has it come from and where is it going?), perhaps including brief population introduction for context. Description of major environmental issues facing the coastal city, perhaps highlighting areas of potential interest for future research. Presentations to be mainly based off of images collected in previous lab. 75 minutes – 25 for each class, with remainder for general introduction and general discussion. Tue Jan 31, 2012</td>
<td>Human Demographics-The Challenge of Change:&lt;br&gt;In this activity students will research and collate information on demographics for their specific city in order to develop an understanding of the role that past, current, and projected human population growth is likely to affect coastal socioeconomics and ecology. Will include an introduction to measuring population growth and the major factors affecting it (birth, death, immigration, emigration, reproductive rates, etc.), using past population data to model future population growth, understanding the implications of exponential versus logistic growth that recognizes carrying capacity and its implications for coastal cities, an introduction to constructing and interpreting population pyramids, the use of population pyramids to infer probable socioeconomic and environmental issues. Thu Feb 2, 2012</td>
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<td>3</td>
<td>Using GIS to Monitor Development (Common Class)&lt;br&gt;Using the context another NYU global network city or NYC, students will be exposed to how GIS can be used to track and analyze temporal changes in coastal environments (using 2D analyses only; area, perimeter, etc). This lesson will start with a general presentation of historical maps/images with discussion and then go into the mechanics of using GIS software to catalogue and analyze these images using a pre-designed set of images. Tue Feb 7, 2012</td>
<td>Coastal Changes in NY and Abu Dhabi (Poster)&lt;br&gt;Using images of the coastline of the Abu Dhabi from various points in time, students will use the skills and processes from the previous lesson to track and analyze temporal changes in the natural Vs man-made components of their coastline through time using GIS software. Thu Feb 9, 2012</td>
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| 4    | **Shoring up Cities: Urbanization and Oceanography**  
*Common class*  
The construction of breakwaters, groynes, sea-walls, and other infrastructure can have significant impacts on the physical processes occurring in waters surrounding coastal cities. This lesson will explore how changes in the physical layout of natural coastlines can cause important oceanographic changes that can have impacts that extend well beyond the initial construction both in both space and time.  
Tue Feb 14, 2012 | **Coastline Dynamics Under Development**  
In this practical session students will use GIS software to model how shorelines change (in terms of shape and area) in response to the addition of groynes or breakwaters which impede long-shore drift.  
Thu Feb 16, 2012 |
| 5    | **Developing for Disaster: Risks Associated with Coastal Urbanization**  
Coastal cities are uniquely exposed to risks associated with the marine system that surround them. In this lesson, we will use case studies to examine disasters associated with storm surge and tsunamis that have impacted coastal cities in the past decade, as well as discuss the IPCCs projections on climate-change induced sea level rise and how this is likely to impact urban areas along coasts.  
The latter third of this lesson will summarize the environmental and critical human-infrastructure impacts of such disasters on cities, and examine how such disasters can be averted using appropriate urban planning, coastal engineering, and other techniques.  
Tue Feb 21, 2012 | **Modeling Disasters in Coastal Cities**  
In this activity, students would use georeferenced maps and images of their city to model the potential impact areas from projected 100 yr sea-level change (according to various IPCC model estimates), from storm surge, and from the potential impact of a tsunami (water level only) assuming similar to that experienced in SE Asia in 2008 as well as predicted height from fault models near city.  
Thu Feb 23, 2012 |
| 6    | **Heat Islands: The Climate of Coastal Cities**  
This lesson will focus on the concept of cities as ‘heat islands’: how to high-density urban areas affect the temperature of the surrounding environment through (a) physical changes in air movement and (b) input of anthropogenic heat (retention in built materials, A/C, cars, power plant effluent, storm-water runoff from paved streets, etc). Should include both terrestrial data and aquatic data if possible. To include information on ecological/health impacts and mitigation measures.  
Tue Feb 28, 2012 | **Temperature Patterns of our City**  
This exercise would derive from analysis of satellite based imagery of temperature patterns around NY/AD during the coolest month and the hottest month of the year, including comparable non- or less built up coastal habitats nearby (using data from night, when effects are most dramatic).  
Thu Mar 1, 2012 |
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| 7    | *Sick in the City: Air Quality in Coastal Cities*  
In this lesson students will explore air quality issues in the built environment. Here we will explore the often mythical perception that outdoor air quality in cities is worse than inside the home or office, and explore specific air pollutants of importance and their health effects. Case studies of specific environmental pollutants common to the indoor and outdoor built environments will be explored, and the specific health and environmental effects associated with each will be examined. Strategies for minimizing these stressors will be explored. Tue Mar 6, 2012 | *The Air We Breathe*  
In this activity, separate groups of students will be deployed to various indoor (NYU property) and outdoor environments where they will use meters to measure the concentration of a number of pollutants. These data will be loaded into the common on-line database and comparisons made amongst sampling habitats and against WHO standards for air quality. Parameters of interest (may) include: temp, RH%, VOCs, particulates (mold), SO2, NO2, NO, CO, CO2 NH3, H2S, HCN HCl, H2, O2, O3, EtO, CI2 SiH4 F2 AsH3 PH3, CI02, CCl2O, HF) Thu Mar 8, 2012 | |
| 8    | Spring Break Tue Mar 13, 2012 | Spring Break Thu Mar 15, 2012 | |
| 9    | *Exam Review*  
Tue Mar 20, 2012 | *Midterm*  
Thu Mar 22, 2012 | |
| 10   | *The Dead Zone: The Ecology of Urban Effluents*  
This lesson will explore how chemical output from cities in the form of point- and non-point discharge from industry, agriculture, and runoff affect the ecology of aquatic ecosystems surrounding cities. Discussions will be based around several case studies, potentially including: The Gulf of Mexico (or Chesapeake Bay or Baltic) dead zone for eutrophication, the Cuyohoga River and/or Lake Erie for aquatic pollution (or perhaps Lake Peipsi for a non-American point). Case studies will be followed by a global summary/outlook for coastal areas. Basic ecotoxicological foundations will be examined with reference to pollutants, and nutrient cycling and the processes leading to anoxia will be explored with eutrophication. Tue Mar 27, 2012 | *Water Quality Around Our City*  
This is a day-long field-based activity where students would conduct water quality sampling around the island of Abu Dhabi and compare results with international standards (e.g. WHO). Students will sample a series of points around the city by boat using hand-held meters and probes. Sampling will include standard physico-chemical parameters that can be measured with a hand-held probe, but it will be highly appealing to also have samples sent to an external lab for chlorophyll, TDS, and coliform analyses. Standard parameters: temp, DO, conductivity, pH, ammonium, nitrate. Sat Mar 31, 2012 (Note: Weekend Field Trip) |
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| 11   | *Water, water everywhere…: Collection, treatment, and disposal in coastal urban areas*  
This lesson will examine the how drinking water is collected, treated following use, and disposed of in coastal areas, and the inherent environmental issues associated with each. Special attention will be paid to saltwater intrusion and groundwater pollution in coastal aquifers, the growing role of desalination facilities (and their consequences) in supplying freshwater from the sea, as well as a city-specific description of water use, recycling, and disposal.  
Tue Apr 3, 2012 | *Data Management and Metadata*  
In this lab, students will learn about appropriate data management and archival techniques and the importance of meta-data for categorizing data-points. Using data from the previous weekend, students will upload and archive data from their meters into the online database and access the larger dataset for import into GIS.  
Thu Apr 5, 2012 |
| 12   | *Urbanization & Exploitation: Coastal Cities and Marine Resources*  
This lesson will explore the influence of coastal cities on marine resources that are exploited for human consumption. Topics will include the concept of the tragedy of the commons, global and local fisheries data case studies, direct and indirect ecosystem impacts, management and restoration techniques, and the double-edged swords of marine reserves, aquaculture, and artificial reefs.  
Tue Apr 10, 2012 | *Analyzing the Effectiveness of Coastal Marine Reserves*  
In this laboratory, students will be provided data on the composition and abundance of coral reef fish communities from both protected and unprotected areas around Abu Dhabi. Their task will be to determine whether marine protected areas (MPAs) are effective. Are their differences in abundance, size, species richness, etc. between MPAs and fished areas? Faculty will also demonstrate multivariate ordinations as a technique that illustrates whether or not communities are similar.  
Thu Apr 12, 2012 |
| 13   | *Simplified Systems: How Human-built Environments Affect Biodiversity*  
This lesson will explore how the homogenization of the natural environment through construction of cities affects biodiversity in both the terrestrial and marine systems. Topics will include loss and fragmentation of natural habitat, creation of artificial habitats and resulting species shifts, urban-rural gradients in impacts, greenways as habitat refugia and centers for biodiversity, and conservation and restoration efforts.  
Tue Apr 17, 2012 | *Biodiversity Sampling Issues and Experimental Design*  
This activity will lead to a cross-campus comparison of arthropod diversity in several habitats: built-urban area, urban green area, natural area (each replicated at various locations). Students will make collections using pan traps and identify insects to order (or class for spiders), with deployments for 24 hrs. Students will focus the report on their own study site, but include a component which compares their result to their sister campus. Collection areas will be documented photographically, including descriptions of associated plant cover, moisture, etc. and data will be associated with a GPS coordinate.  
Thu Apr 19, 2012 |
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<td>14</td>
<td><strong>Urban Invasions: Coastal Cities as Hubs for Alien Introduction</strong>&lt;br&gt;This lesson will explore how coastal urban areas serve as portals for the introduction and spread of non-native species. Students will be introduced to the ecology of invasion, including the conditions that foster invasion, characteristics of successful invaders, and a discussion on the vectors that are primarily important in coastal areas. This will be followed by a series of case studies of invasion of terrestrial and marine environments in coastal cities worldwide, along with a discussion of the importance of impacts caused by non-native species. Tue Apr 24, 2012</td>
<td><strong>Biodiversity Sampling Issues and Experimental Design (continued)</strong>&lt;br&gt;This will be a continuation of last week’s lab on sampling arthropod biodiversity. Here, students will sort insects in class using microscopes, identify to order using a key, and enter the data into Excel (or similar) for upload to the database. Students will then analyze differences statistically as an out-of-class assignment. Thu Apr 26, 2012</td>
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<td>15</td>
<td><strong>Summary Session - Student Group Work (Skype)</strong>&lt;br&gt;This will be a cross-campus class (virtual) in which students meet with their counterparts in New York to finalize discussions and analyses in preparation for presentation of their final projects in the following session. Students will be expected to exchange data and come to agreement on topics of importance across campuses and to construct a comparative analysis of these topics. Tue May 1, 2012</td>
<td><strong>Synthesis Session on Our Shared Coastal Environments (Common Class)</strong>&lt;br&gt;Students will here present the results of their joint analysis of data from both Abu Dhabi in New York, with groups focusing on topics that have been examined earlier in the course. Presentions will include reference to reviews of the relevant literature as well as original data collected during this course, making synthetic comparisons of processes likely structuring similarities or differences between Abu Dhabi and New York. Thu May 3, 2012</td>
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<td>16</td>
<td><strong>Final Exam Review Session&lt;br&gt;Tue May 8, 2012</strong></td>
<td><strong>Final Exams&lt;br&gt;TBD</strong></td>
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