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Summer 2015 GIS Analyst Internship at the Connecticut Department of Energy & Environmental Protection, Old Lyme, Connecticut

Stuart R. DeLand
Clark University, sdeland@clarku.edu

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Summer 2015 GIS Analyst Internship at the Connecticut Department of Energy & Environmental Protection, Old Lyme, Connecticut

Stuart R. DeLand

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A Master's Project

Submitted to the faculty of Clark University, Worcester,
Massachusetts, in partial fulfillment of the requirements for the
degree of Masters of Science in the Geographic Information Science for Development and the
Environment

And accepted on the recommendation of

Jie Tian, academic advisor

Abstract

I worked as the Geographic Information Systems (GIS) Internee for the Connecticut Department of Energy & Environmental Protection (CT DEEP) from May 18, 2015 through August 14th of the same year. I was stationed at the Old Lyme Field office and worked under the direct supervision of Deb Pacileo, my boss and GIS analyst for CT DEEP. My function in the agency was similar to my supervisor's as I had no single project that dominated my time, but was given a multitude of projects to create, edit, oversee, and produce. Some of these project included editing python scripts of former interns', creating a database for trawl survey data input, and finalizing maps to be shown at a CT DEEP board meeting. The CT DEEP internship was important to my development as a GISDE student as it provided insight into how federal agencies might typically use geospatial software on a day to day basis. This report is a relation of my time at CT DEEP and my opinions on the strengths and weaknesses of the internship position.

Academic History

Name: Stuart Randolph DeLand

Baccalaureate Degree: B.S., Environmental Science

Source: Allegheny College, Pennsylvania   Date: May, 2013

Dedication

To my brother Owen. Veni, vidi, vici.

Acknowledgements

I would like to thank Professor Jie Tian for guiding me through my time as a graduate student in Clark University's GISDE program, without the knowledge gained in his Python Programming classes, I would not have been able to complete a majority of my work as an internee at CT DEEP. Secondly, I would thank my classmates in the GISDE class of 2016 for the late nights and long hours in the lab made enjoyable.

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Chapter 1. Introduction

The GISDE program of Clark University is the latest stepping stone in my pursuit if GIS competency and employment. Throughout the program, classes have been engaging and challenging, group projects forced me to consider alternatives to my traditional methods of problem solving, and the summer 2015 internship at the Connecticut Department of Energy & Environmental Protection (CT DEEP) gave me a glimpse of what future employment might entail. The opportunity came to me through the Director of Career Development and External Relations, Sharon E. Hanna by email and I applied online, and was interviewed in person. The application process took one month to complete while the internship lasted for three months. Being an intern at CT DEEP required many of the skills I learned at Clark University, but also forced me to learn several others, many of which I have incorporated into research and final projects this term. In its entirety, I would highly recommend this internship position to any 1st year student willing to learn GIS techniques outside of the classroom.

Chapter 2. Description of the Organization

2.1 Agency Overview

The Connecticut Department of Energy & Environmental Protection (CT DEEP) is a multi-branched federal organization based in the capital city of Connecticut, Hartford. Established on July 1, 2011, CT DEEP is charged with "conserving, improving, and protecting the natural resources and the environment of the state of Connecticut" (CT DEEP, 2015a).

2.2 Main Areas of Work & Expertise

CT DEEP's various interests around the state are divided into three Branches noted in the subsequent section and multiple Departments per section. However, all branches within CT DEEP are involved in projects that fall into three distinct categories: Legislation, Scientific Research, and Public Outreach. As CT DEEP is a federal agency, much of its work is tied to funding through taxes and governmental oversight; therefore a large number of projects are motivated by enacted laws, policy changes, or interest from Connecticut's representatives. CT DEEP also is heavily invested in scientific research because of its interest in conservation and the upkeep of Connecticut's ecosystems. Finally, every Department in CT DEEP attempts to maintain a degree of transparency by engaging the public during field work, online, and through federal representation.

2.3 Organizational Structure

CT DEEP is a consolidation of the Department of Environmental Protection and the Department of Public Utility Control and as such, is divided into three branches in addition to the Office of the Commissioner: The Energy Branch, The Environmental Quality Branch, and the Environmental Conservation Branch (CT DEEP, 2015a). The Energy Branch works on local, state and regional (interstate) energy policy issues by developing and implementing CT's Comprehensive Energy Strategy, and implementing energy efficiency programs in conjunction with the Energy Efficiency Board (CT DEEP, 2015b). The Environmental Quality Branch is responsible for protecting and enhancing the quality of Connecticut's air, water, and lands (CT DEEP, 2015c). Within The Energy Branch the bureaus of Air Management, Materials Management, Compliance Assurance, and Water Protection and Land Reuse monitor, enforce, and preform cleanups around the state (CT DEEP, 2015c). The Natural Resources Branch works

to preserve resources and the environment of Connecticut; its work is divided into six departments: Fisheries, Forestry, Wildlife, Insects and Invertebrates, Wetlands and Water Resources, and Geology (CT DEEP, 2015d). As the Seasonal GIS Intern, I worked within Fisheries Department of the Natural Resource Branch under my direct supervisor, Deb Pacileo.

2.4 GIS Application within the Organization

Geographic Information Systems (GIS) are used mainly within The Natural Resources Branch of CT DEEP; The Energy and Environmental Quality Branches may use GIS, but there is an apparent emphasis on the Branch to which I was employed. The six departments of The Natural Resources Branch have one GIS specialist (Deb Pacileo is the Fisheries' GIS Specialist) that reports to the GIS general manager of The Natural Resources Branch, Beth Doran, based in the Hartford Office. GIS projects are created primarily in a reactionary manner; most result from a change in law or policy. For example, between 2012 and 2014, several laws that placed restrictions on use of various types of fishing trawls were enacted, changing the geographic extent where fishermen could cast. Thus, the outdated maps (pre-2012), needed to be update to reflect the revised policy so the general public could see exactly the extent of the restrictions in place. Other common applications of GIS, at least within the Fisheries Department, include creating maps tailored to conferences or meeting about distribution or catch rates of target fish species. For example, I was required to create a map of the distribution of mean catch rates of Black Sea Bass from 2005-2014 along the Eastern Sea Board (Southern New Jersey to Northern Massachusetts in this case); this map was presented as an inter-state conference regarding the current status of the Black Sea Bass.

2.5 Organizational Strengths and Weaknesses

Assertions of CT DEEP's strengths and weaknesses are based on my observations within the Old Lyme field office of the Fisheries Department; this is by no mean a reflection of the entire agency's efficiency. The primary strength and weakness of CT DEEP are both tied to funding of the agency. Connecticut resident tax dollars are the source of many CT DEEP projects, giving the agency leeway in allotting monetary amounts to certain research, but limiting the extent and content of that research based on policy changes and governmental interest. Several projects within the Fisheries Department, such as the Seasonal Trawl Survey and the Seine Survey, have been funded and executed for more than 25 years because of constant support

from leaders of CT DEEP and the federal government. Other projects, such as the lobster survey, have been 'shelved' or entirely removed from the itinerary due to budget, major species die-offs, or reallocation of manpower. In this way, CT DEEP is limited in what it can research, protect, or investigate, but gains stable support in the projects that are sufficiently supported.

Pertaining specifically to the Fisheries Department, the process of approving GIS content, be it for public or inter-departmental access, needs special attention due to the time required for approval. If a GIS specialist completes a map through a program such as Arc GIS Online or ERDAS and wishes to make it visible to the public, he/she needs to send it not only to the GIS general manager of The Natural Resources Branch, but also that manager's boss for corrections and oversight on data usage. This process, while summarized in a single sentence, has taken my boss over a year to complete in some cases. This, coupled with the fact that many maps maintained by the Fisheries Department need to be updated every year to two years, makes approved content often out of date before it is even published to the general public.

2.6 How effectively does CT DEEP accomplish its mission?

CT DEEP's mission is largely an ongoing operation, be it energy conservation or environmental protection; the agency can never truly reach its goal because each year will bring new challenges or issues that must be addressed. However, based on my observations of the Fisheries Department, it appears that many within the agency are constantly struggling to keep up with the projects assigned to them. This is not to say that research and projects are never completed, however it appears that the agency may be understaffed (and potentially underfunded when compared to other federal agencies).

Chapter 3. Internship Responsibilities

Disclaimer: As noted in Chapter 2, data and maps must be approved in CT DEEP before their release to the public, a process that can sometimes take over a year to complete. As such, any content awaiting approval cannot be displayed for public viewing; unfortunately this means that the subsequent projects discussed in this section will not be accompanied by figures or tables detailing my body of work due to legal constraint. However, some projects I worked on in CT DEEP published versions of the particular map/program before my involvement, therefore figures of these projects are included in this report.

3.1a Projects: Saltwater Fishing Resources Map (SWFR) through Arc GIS Online

The Fisheries Department of the Natural Resource Branch of CT DEEP is involved in not only the conservation but the corresponding recreation of water bodies across the state; to this end, CT DEEP maintains the Saltwater Fishing Resource Map (http://www.depdata.ct.gov/maps/saltwaterfish/map.htm), a conglomerate of points of interest inland and on the coastline for resident and out-of-state fisherman (Figure 1). The SWFR divides recreation into six distinct categories: Sports Licensing Agents, Bait and Tackle Shops, Enhanced Opportunity Shore Fishing Sites, Car Top Boat Launches with LIS Access, Trailered Boat Launches with LIS Access, and Party and Charter Boat Locations. Sports Licensing Agents are offices across the state that issue official-recognized fishing licenses (dependent on type of fishing requested). Bait and Tackle Shops are outdoors store that sell and repair fishing gear and related supplies. Enhanced Opportunity Shore Fishing Sites are locations where the minimum size limits of Summer Flounder (*Paralichthys dentatus*) and Scup (*Stenotomus chrysops*) are reduced from 18 to 16 and 10.5 to 9 respectively in an effort to encourage shoreline fishing while regulating commercial (e.g. trawl) fishermen (CT DEEP, 2015e). Car Top Boat Launch Locations are areas on Long Island Sound (LIS) or on the mouths of rivers directly emptying into the LIS that allow for private boat launch and mooring. Trailered Boast Launches with LIS Access are areas that allow for larger boats to launch. Part and Charter Boat Locations are boat launches and marinas that allow for commercial fishing boat docking and launching.

The SWFR seen in Figure 1 was created in 2013 and in need to updating as of summer 2015. The issue with this map was the scripts of the language it was written in, Java Script, were not optimized for simple updating or revision. Given that shops and licensing agents go in and

out of business around the state, and that enhanced opportunity shore fishing sites change based on annual fish species' surveys, the need for constant revisions of data was paramount. CT DEEP decided using Arc GIS Online (AGOL) to host the SWFR successor would transfer the impetus of upkeep from the agency to ESRI. The new SWFR would incorporate AGOL's widget templates to create a functional host of tools easily manipulated by the public. Furthermore, when CT DEEP created updated layers of resources around the state, data could be easily uploaded to AGOL.

To this end, I was tasked with creating the AGOL widget template that would be populated with corresponding data layers once they were approved. While data for the hosted map is still being approved, the model includes the following tools available for manipulation by the general public: address locator, latitude and longitude search system, shop/business name search engine, print function, toggle map layers on/off, and distance based search radii.

3.1b Projects: Distribution of Black Sea Bass Catch Rates on the East Coast 2005-2014

Several employees of CT DEEP, including my boss Deb Pacileo, are part of an interstate board of researchers that study specific species of fish within state waters of Maryland, New Jersey, New York, Connecticut, Rhode Island, and Massachusetts. Researchers are assigned a single species to report on and present annual statistics for such as catch rates, recruitment ranges, species density, and habitat extent/status.

A conference for Black Sea Bass (*Centropristis striata*) was held mid-July. I created a map for CT DEEP to present at the conference detailing the shift in range of mean catch rates from 2005-2014. Original data for the product came to me in the form of a Microsoft Excel spreadsheet that gave the catch rates of each fishing site along the coast of the Atlantic Ocean within the range of states noted above. After creating a projected coordinate layer based on latitude and longitude of the given sites, a combination of Mean Center and Linear Directional Mean was used in ArcMap to display a general trend of change in Black Sea Bass catch rates along the East Coast. Note the purpose was not to determine the terrestrial areas with the highest catch rates, rather the intent was to show how the mean range of harvest shifted from 2005-2014. The results were surprisingly distinct; mean center of catch rates in 2004 lay squarely within New Jersey water, however as years progressed, the mean center of catch rates shifted increasingly northward, until the final point of 2014 rested off the southern coast of Long Island,

NY.

3.1c Projects: Create Trawl Database in Microsoft Access for post-Field Entry

The creation of the Microsoft Access (MS Access) Database for post-field entry was a project of a similar scope as the AGOL SWFR map. The program that CT DEEP formerly used was incompatible with the updated operating system incorporated into all computer terminals as of 2015. Thus, my task on this assignment was replicating the original database as faithfully as possible within MS Access.

Form was as stressed as function in this case, to allow for streamlined use by seasonal trawl internees as well as DEEP employees that had worked on the old database for decades. All told the database had six different pages of data entry: Tow, Count, Lab, Lobster_lab, Winter Flounder_lab, and Blackfish_Lab. Tow included general information about individual tows such as start/end latitude and longitude, tow number designation, time of day, date, water salinity, depth, and crewman present. This page was linked to the rest of the database pages so that ubiquitous data such as tow number and date could be retrieved as opposed to being retyped. The Count page was a list of fish/crustacean species caught during a particular tow, the weight of all fish of a particular species, their species shorthand (e.g. Winter Flounder = WFL) and a check box next to the species kept for the lab. The Lab page allowed for individual fish sent to the lab to be weighed, measured (length) and sorted for subsequent species pages. The three species pages, Lobster_lab, Winter Flounder_lab, and Blackfish_lab, were where lab technicians input more specific data such as sex, otolith length, and age of the fish. More fish species were slated for addition to the database, but I needed only to create pages for these three animals.

3.2a Field Work: Long Island Sound Trawl Survey

During the days when seasonal trawl workers were sick or absent, I was often called to help out on the John H. Dempsey to assist in net release and fish sorting. The trawl survey kept strictly to the LIS, using GIS-generated coordinate maps to create a grid pattern of trawl lines across the LIS that were visited every season, every year. These were long days, often exceeding 12 hours with cast off at 6 a.m. Tasks aboard the Dempsey included: salinity measurements, net setting, fish sorting/weighing/release, and ship upkeep.

3.2b Field Work: Seine Survey

At the first week of each summer month, the coastal seine survey captured fish with a

seining net to quantify recruitment rates of fish found in the LIS. Sites I worked on included: Clinton, New Haven, Bridgeport, Niantic, and Groton. Seine surveys worked in 3-person crews, two dragging the net between them, and the third counting once the net was drawn up to land. Juvenile fish, cephalopods, and crustaceans were counted, measured and released, while unidentified samples were taken back to the office for assessment. Data generated from this project was often used in board meetings and represented spatially through GIS.

Chapter 4. Internship Assessment

4.1a Skills Required

Of the many skills taught throughout my first year in the GISDE program at Clark University, python programming, map composition, and map presentation were most practical when working for CT DEEP in the summer of 2015. Specific classes where these attributes were taught include: Python Programming, taught by Jie Tian, Introduction to GIS, taught by Professor Yelena Ogneva-Himmelberger, and Advanced Vector GIS, taught by Professor Yelena Ogneva Himmelberger.

Python Programming was integral to my success at CT DEEP for two reasons. The first involved the ability to read other users' scripts without meeting them, determine script functionality, and fix errors that resulted in execution. As noted in Chapter 3, one of my projects was to run all former internees' scripts and ensure that the programs functioned adequately on the new CT DEEP operating system. Thus, examining each script with the eye of an editor, a skill repeatedly enforced in Professor Tian's class, allowed me to complete this project with relative ease.

The second reason Python Programming aided me at CT DEEP was its similarity to other programming languages. During my time at the agency, certain parts of Arc GIS Online and the Trawling Database required that I understand a modicum of Java Script. Python programming is much like a simplified version of Java Script, so when the time came for me to practice scripting in this unfamiliar language, my previous knowledge of Python Programming allowed for accelerated understanding.

Map composition and presentation were similarly necessary skills at CT DEEP because of the nature of my work: with few exceptions, products of my work were to be shown at conferences, to other CT DEEP internees, or to my superiors for review and editing. Therefore, not only understanding how to make descriptive, well laid-out maps was necessary, but also tailoring comprehension level and content to specific audiences. For example, in Chapter 3 I noted that one of my projects was to be shown to a board of researchers concerned over the potential shift in range of the Black Sea Bass (*Centropristis striata*). In this instance I chose to include latitude and longitudinal information on each area of harvest within the metadata of the product, and explain the mathematical functionality behind the Mean Center and Linear

Directional Mean tools incorporated. Conversely, in the Trawl Survey Database my supervisors wanted to make data insertion for seasonal trawl workers as streamlined as possible, so I chose to mask much of the iterative programming behind simple editable boxes. The end product of both of these projects was vastly different in the amount of supplemental information available to users/viewers, a concept Professor Ogneva-Himmelberger imparted through her classes.

4.1b Skills Learned

Skills learned during my time as a CT DEEP GIS intern revolved greatly around integrating ArcMap products into online, interactive maps. This is a concept not covered in my past courses at Clark University, therefore work in this topic was slow and methodical. Arc GIS Online was a favorite tool of my supervisor, as such I learned much about the website and hosting service in order to create the widget template for a functional Saltwater Fishing Resource map.

Skills learned on the job were not restricted to ESRI-products; the creation of the Trawl Survey Database required that I learn as much of Microsoft Access in a month's time as I could, leading to a high level of comprehension by the end of my time as an intern. Projects revolving around Arc GIS Online and Microsoft Access took up the majority of my time during the internship, which speaks to the necessity of versatility when it comes to working for CT DEEP.

4.2 Relation to Career Goals

Working for CT DEEP was informative in what I should expect as a GIS technician for federal agencies or government bodies. Work is heavily reviewed by supervisors and as such, the publishing process became arduous. However, being the CT DEEP GIS intern taught me the 'hierarchy' or format of spatial work in the office, making the experience important in deciding how I might utilize knowledge gained from the GISDE program as whole in the future. Ultimately, this internship acted as an informant to my incumbent job search, as I know have a better understanding of what agencies such as departments of environmental protection, departments of transportation, or other related federal agencies might ask of me during a future job.

4.3 Recommendation

I would recommend this internship to other IDCE students, specifically GISDE students, because it requires that interns be flexible in applying their knowledge of GIS to projects that may not be drafted in ArcMap or similar products. It is easy to forget that there is a world of spatial analysis and software outside of ArcMap and Terrset, and CT DEEP required that I familiarize myself with several programs and scripting languages, such as ArcGIS Online and Java Script, not covered by the core curriculum at Clark University. However, this recommendation comes with a warning; there were projects I worked on (e.g. Trawl Survey Database in Microsoft Access) that had nothing to do with GIS, nor supplemental skills that a GISDE student might find useful. Therefore, experience gained from this internship is largely based on the projects passed down by supervisors.

Chapter 5. Conclusions

The GIS Summer Internship position at CT DEEP allowed me to explore not only different applications of tools in GIS but supporting software and software analogs. As I have said previously, this experience is an excellent way for any GISDE student to experience what working for a federal agency might offer after graduation. Despite the weaknesses of CT DEEP noted earlier, I would recommend this internship to any prospective 2nd year as it will broaden their expertise and refine their interests, either toward government work or away from it. Furthermore, as with any GIS-related internship, this was an excellent chance to expand my network of contacts in the field and insurance that I will have positive references when looking for other employment.

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Figure 1. Original SWFR map created through Java Script. My task was to take this program and create a sister program through Arc GIS Online.