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Title:

Geoliteracy through aerial photography: collaborating with K-12 educators to teach the National Geography Standards

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Abstract:

Geoliteracy is a necessary skill for the twenty-first century. By collaborating with K-12 educators, geographic information librarians can play an important role in geoliteracy initiatives as well as gain knowledge and experience to benefit their home institutions. The newly released *Geography for Life: National Geography Standards, Second Edition*, published in 2012, is a useful tool to bridge the gap between librarians and educators by providing a common framework for educational goals. While there is a wealth of resources within geospatial information collections, aerial photography is particularly suitable for meeting the needs of the K-12 educational community and can be linked directly to many of the national standards. This article provides six rationales for increasing the involvement of geographic information librarians in geoliteracy at all educational levels and demonstrates how twelve of the eighteen *Geography for Life* standards can be taught using aerial photography.

Keywords:

geoliteracy, spatial literacy, geographic information librarianship, K-12 education, National Geography Standards, aerial photography

Introduction

For decades, libraries have been strong proponents of information literacy, and librarians in all types of libraries have played a prominent role as information literacy educators. As a subset of this vital skill, geographic information literacy, or geoliteracy, should now be similarly promoted by geographic information librarians. As denizens of the geographic community, these librarians not only are they responsible for promoting geoliteracy to their core constituents but they are needed to provide educational support to those outside their walls, from primary and secondary school teachers to other information professionals. By doing so, they foster a more geographically literate and aware society, as well as raise their own profiles within libraries and communities.

School libraries have limited access to geospatial information collections. Even though more and more of these collections and related lesson plans are accessible online, they can be difficult to locate and K-12 teachers need additional training to bolster their confidence in using such resources (Maier and Jones 1999). With support and instruction from geographic information librarians, teachers can become equipped to utilize readily available geospatial information in their classrooms and lesson plans.

This article will first highlight the need for geoliteracy education and show how involvement of geographic information librarians in K-12 schools is a mutually beneficial arrangement. Next, it will provide a clear and structured way of teaching geoliteracy skills by way of the revised standards outlined in Geography for Life: National Geography Standards, Second Edition (Heffron and Downs 2012). Finally, it will showcase aerial photography collections to illustrate how geospatial information can be used to teach geoliteracy to K-12 students using the National Geography Standards.

Geoliteracy: A Vital Twenty-First Century Skill

Geoliteracy has been touted by many as a necessary skill for the twenty-first century (Bishop and Johnston 2013). To explore its importance in today's information age, it is necessary to first define geoliteracy as a point of reference. Geoliteracy (sometimes written as geo-literacy) is often used interchangeably with spatial literacy within the literature. One study even used the term "geo/spatial literacy" to describe the important skill (Nazari

and Webber 2011). While spatial literacy can be expanded to include an understanding of spatial relationships outside of geographic location, many times it is firmly grounded in the realm of geography. According to Goodchild (2006), spatial literacy can be described as the "ability to capture and communicate knowledge in the form of a map, understand and recognize the world as viewed from above, recognize and interpret patterns, know that geography is more than just a list of places on the earth's surface, see the value of geography as a basis for organizing and discovering information, and comprehend such basic concepts as scale and spatial resolution." Alternatively, one can look at the definition of information literacy to further define geoliteracy. Information literacy is the ability to "recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information" (ACRL 1989). Using this definition as a base, geoliteracy can then be defined as the ability to recognize when geographic information is needed and then to locate, evaluate, and use effectively the needed geospatial information. Finally, the National Geographic Education's website, *Geo-Literacy* (NGE 2013) simply states: "Geo-literacy is the ability to use geographic understanding and geographic reasoning to make decisions." No matter how it is defined, geoliteracy makes critical thinking about human-environment interactions a top priority.

The twenty-first century world is interconnected and globalized on a scale never seen before, which makes the study of these interactions even more important. It is imperative to understand the role geographic information plays in visualizing, evaluating, and ultimately solving many problems the world faces today. Unfortunately, many students in the United States continue to score poorly on geoliteracy tests (NGS 2006; Guertin et al. 2012). This lack of geographic awareness leaves students without the necessary skills to meet the demands of the Information Age. The National Research Council (NRC) report, *Learning to Think Spatially* (2006) states "without explicit attention to spatial literacy, we cannot meet our responsibility for equipping the next generation of students for life and work in the 21st Century."

A number of national initiatives are being promoted to help raise awareness about the importance of geoliteracy. Legislation titled TGIF, "Teaching Geography is Fundamental Act" aims to increase federal funding to geography education. In addition, "the National Geographic Society received a two-year, $2.2 million grant from

the National Science Foundation entitled 'Establishing a Road Map for Large-Scale Improvement of K-12 Education in the Geographical Sciences'" (Foster 2011). The project brings together collaborators from both professional and educational backgrounds "to develop an educational system that will prepare students for the challenges of the modern, globally connected world" (Foster 2011). Another ongoing initiative is the National Geographic's Network of Alliances for Geographic Education, also known as Geographic Alliances. While extending to the national level, these are state alliances between geographers, geography faculty, and K-12 educators.

As shown above, there are numerous opportunities for geographic information librarians to get involved in geoliteracy education. The questions then become, why get involved and are the results worth the effort?

Moving beyond our borders: Why geographic information librarians should be involved in K-12 education

Geographic information librarians in academic and research libraries are more than just curators of geospatial collections. They regularly offer a wide variety of services from GIS (geographic information systems) consulting, course-specific bibliographic instruction, community exhibits, and GIS Day celebrations, all of which help increase awareness of library services and collections. Sometimes these services, such as an annual GIS Day celebration, extend to the primary and secondary schools (Weimer, Olivares, and Bedenbaugh 2011). Some map libraries make the K-12 education community a priority. Theunissen (2007) reports that the Osher Map Library and Smith Center for Cartographic Education at the University of Southern Maine has a donor-charged mandate to provide educational opportunities to all age groups. While the value of supporting K-12 education and geoliteracy is beginning to be recognized, these cases of intense involvement are still fairly rare and it is far from being seen as a fundamental responsibility of most geospatial information librarians (Theunissen 2007).

The main challenges facing librarians who want to extend their services to the K-12 community are shrinking budgets and limited time. Hope and Peterson (2002) speculate a reason for the lack of attention to K-12 and academic library relationships is because "so much work remains to be done in partnership building on campus" leaving little room for outside activities. They admit these "collaborative initiatives" can require a large output of "time, energy, and resources" (Hope and Peterson 2002). Shires (2006) points out, "budget cuts to public and

academic libraries combined with growing demands for information are forcing academic librarians to reconsider who they should or can serve."

While the challenges are daunting and represent important considerations, there is a lot of evidence pointing to the value of cross-institutional collaborations. There are both practical and ideological reasons a geographic information librarian may decide to make geoliteracy education a priority. Based on a review of the literature and a summation of the various benefits, there are at least six reasons, i.e. 'rationales,' for geographic information librarians to become involved in geoliteracy education across all educational levels**.**

Rationale #1: Geographic information librarians are part of an educational community that extends past the walls of their institutions.

"There appears to be a consensus within the profession that to remain viable in the twenty-first century, special collections need to broaden their reach beyond their traditional reading room base" (Theunissen 2007).

By restricting activities to home institutions, it is impossible to take advantage of the benefits of collaboration inherent in multi-institutional cooperative efforts (Maier and Jones 1999; McKinstry and Garrison 2001; Hope and Peterson 2002; Manuel 2005; Burhanna and Jensen 2006; Jackson and Hansen 2006; Bloodworth and Peterson 2011). The American Association of School Librarians/Association of College and Research Libraries' *Blueprint for Collaboration* (AASL/ACRL 2006) further provides examples of academic and K-12 collaborative efforts and explores "ways and means for affecting closer collaboration between librarians in K-12 and post-secondary education" specifically indicating that "all educators – teachers, faculty, and librarians – share roles in helping students acquire information literacy skills effectively. Collaborative efforts that enhance the ability of these groups to fulfill their mission are imperative" (AASL/ACRL 2006).

Geographic information librarians need to take a more active role in the geographic education community. Getting involved in geoliteracy education in K-12 schools provides them the opportunity to "show leadership by

reaching out to groups beyond the campus borders" (McKinstry and Garrison 2001). With foresight and proper planning, "collaborative outreach programs can translate into concrete activities that are exciting, energizing, and, often unexpectedly rewarding to all" (McKinstry and Garrison 2001).

Rationale #2: Geographic information librarians have access to highly useful materials and knowledge bases that can be used to improve geographic education.

Geographic information librarians in academic research libraries have access to a wealth of information within their geospatial collections, both print and digital, as well as subject expertise with those collections. Among these collections are materials few middle and high schools have ready access to, such as Sanborn Fire Insurance maps, old city street maps, travel guides, as well as primary source materials like aerial photographs (Manuel 2005; Bloodworth and Petersen 2011). Events such as National History Day promote "partnerships between K-12 schools and academic libraries, public libraries and museums" (Manuel 2005). In the role of subject expert and information professional, their knowledge base and experience provides a unique perspective, which can make a lasting contribution to geography education (McKinstry and Garrison 2001).

One multi-institutional project between the National Aeronautics and Space Administration (NASA) Johnson Space Center (JSC) and the University of Houston-Clear Lake (UHCL) worked to train area K-12 teachers in the use of shuttle imagery to enhance geography lessons. The staff at JSC sought out UHCL faculty because they understood the educational value of their collection and felt it was being underutilized in that role. "Geography education can be strengthened by interaction between preservice and inservice teachers and experts applying geographic insights and perspectives in other settings". By working together, they were able to provide educators with "1) utilization of a readily available and free resource through the internet of shuttle imagery, 2) teacher contact with scientists who use geographic knowledge daily in their work for NASA, 3) increased knowledge of other NASA resources for geographic education". It is clear geographic information librarians possess an abundance of knowledge and resources that can be used in geography education at all levels. (Maier and Jones 1999)

Rationale #3: Geographic information librarians can raise awareness of their collections, both in their communities and within their institutions, through educational opportunities.

As mentioned earlier, many libraries are facing continuously tightening budgets. While it can be difficult to justify new initiatives in this budgetary climate, it is important to remember that those same initiatives can help a library or collection survive during difficult times. Map libraries are specifically threatened due to a lack of knowledge about their specialized collections among higher administrators and decision makers. This awareness deficit must be overcome to effectively compete for funding. Education and collaboration opportunities can be particularly useful ways to enhance the visibility of geospatial information collections, the services of a geographic information library, and work to restate the role of the library in the community (Jackson and Hansen 2006). This is fully supported by literature studying collaborations between higher education libraries and K-12 educators. Studies repeatedly show such collaborative efforts result in increased exposure for the collections and technology, improved community relations, enhanced public image, and emphasized the institution's importance in lifelong learning (Hope and Peterson 2002; Burhanna and Jensen 2006; Jackson and Hansen 2006). Furthermore, raising awareness of the need for geoliteracy education and its relevance to modern society increases the general awareness of the strategic importance of geospatial information collections as a valuable resource.

Rationale #4: Geographic information librarians can gain new experiences that are applicable to problems facing users in their home institutions.

While there is a lot the profession can offer K-12 education, increased involvement in raising awareness of geoliteracy can have benefits at home institutions as well.

First of all, information literacy skills are enhanced by collaborative relationships through shared resources and continuous discussion. Because of the focus on standards and learning outcomes, collaborations with K-12 schools can serve as testing grounds for larger issues that need to be addressed such as improved assessment of geoliteracy programs in higher education. Increasing involvement with the K-12 educational community allows

academic librarians to learn about different perspectives and experiences in dealing with similar problems, resulting in a "broader view of information literacy" and "new, creative solutions" to "shared challenges" (Hope and Peterson 2002).

In addition, as the importance of geoliteracy and geospatial reasoning is further realized by educators and administrators at all educational levels, there is the increased likelihood geoliteracy can make its way into general education requirements and core courses at the university level (Tsou and Yanow 2010). A solid foundation in geospatial reasoning gives students in many disciplines additional tools to handle the complex scientific and social questions facing society today (Guertin et al. 2012). The fields of science, technology, engineering, and math (STEM) are greatly enriched by the incorporation of geospatial tools and an increased spatial perspective (Wai, Lubinski, and Benbow 2009; Newcombe 2010; Baker 2012). Furthermore, geoliteracy learning should be embedded into the undergraduate geography curriculum and it should involve both the geography faculty and the geographic information librarian working together to create a comprehensive geoliteracy plan (Kimsey and Cameron 2005).

Geographic information librarians must also consider the needs of the fellow librarians at their institutions. Bishop and Johnston (2013) found that "geoliteracy, or spatial literacy, has emerged as a type of information literacy that librarians of all types need to understand in that geospatial data are sources of information." Geographic information librarians can and should play a central role in the process, whether through input into LIS curriculum development or through continuing education training for library professionals.

<u>Rationale #5: Geographic information librarians have a professional responsibility to participate in geographic education as well as a public mandate to provide services to all public groups since many institutions and collections are publicly funded.</u>

Many collections of geospatial information contain materials that were produced by government agencies via public funds such as United States Department of Agriculture aerial photography collections, United States

Geologic Survey topographic maps, Central Intelligence Agency country studies, National Oceanic and Atmospheric Administration nautical charts, and anything received through the Federal Depository Library Program. In addition, geospatial information collections are often housed in publicly funded institutions. In a study surveying Florida academic libraries, Shires (2006) notes that while "no respondents to the survey discussed a mandate for public services… academic librarians in public and land-grant institutions may, in fact, have a legal obligation to serve the schools." There is an expectation that "broad educational opportunities" will be provided to the general population, including K-12 schools (Shires 2006). Clearly, those academic libraries that participate in the Federal Depository Library Program and/or founded as land grant institutions have missions extending beyond service to their own students and faculty.

Mandates can come from social contracts, the mission of the library, or can be a "reflection of good community citizenship" (Shires 2006). As such, being an active participant in geoliteracy education for the benefit of the community is a worthwhile endeavor in its own right. Geographic information literacy professionals "need to be less defined by place or teaching level and more collaborative in nature and focus" (Jackson and Hansen 2006). In a 2001 interview, Patricia Breivik, a leader in bringing information literacy to the libraries, stated "It's a matter of how we see ourselves as a profession. Are we the keepers of the library, or do we have something to offer to the larger good? If we really have something to offer, how dare we keep it to ourselves?" (quoted in Hope and Peterson 2002).

<u>Rationale #6: Geographic information librarians can increase their ability to receive additional funding through grants and nonprofit organizations.</u>

As library budgets dwindle, the pressure to bring in outside funding rises. Improving K-12 education has long served as an admirable and highly fundable grant-supported activity. There are many examples specifically relating to the collaboration between higher education and area schools, such as the Library Services and Technology (LSTA) grant "Community Resources without Walls" and the Institute of Museum and Library Services (IMLS) National Leadership Grant "Information Literacy for the 21st Century: Preparing Students to Learn for Life"

(Jackson and Hansen 2006). Both of these projects strengthened communication and collaboration among school and academic libraries to further meet the needs of students. The National Science Foundation has shown increased interest in funding literacy projects involving STEM fields, an area where geoliteracy awareness has been shown to have a major impact (Bloodworth and Petersen 2011). And since "digitized resources help teachers meet state requirements without great cost to the schools", libraries seeking to digitize their unique historic geospatial collections can highlight this benefit when applying to funding agencies (Shires 2005).

A framework for success: Using the National Geography Standards to structure geoliteracy initiatives

The question then becomes, how can this cooperative effort be best accomplished? While the answer is complex with many possible approaches and actions to be taken, the following takes a closer look at how the use of national standards can aid in communication and collaboration with K-12 schools.

When collaborating with K-12 schools, it is important to understand the system in which they have to operate. They use curriculum standards and learning outcomes to provide organization and consistency to educational goals. Geographic information librarians can also benefit from using the National Geography Standards in their geoliteracy education initiatives. Kimmel (1996) states, by "using the standards to organize material and activities" educators provide "the necessary organizational framework for incorporating physical and human processes into existing curricula." For the same reason, geoliteracy education at the university level can be enhanced by using the National Geography Standards (Johnson 1995). When working across educational levels, standards provide "common ground for discussion, programming and assessment projects" (Burhanna and Jensen 2006). By linking geospatial information collections to these proven standards, geographic information librarians lend credibility to their educational roles and increase confidence in their abilities when speaking with other geography educators.

The first edition of *Geography for Life: National Geography Standards* was published in October 1994 by the National Council for Geographic Education and has served as the basis for numerous states' curriculum standards in geography and for many textbooks. While the original standards served well for many years, an update was

deemed necessary to reflect the changes in the way the world looks at and uses geography, notably the paradigm shift that has occurred with the widespread use of online mapping and GIS (Heffron 2012).

The revised 2012 edition maintains consistency with the 1994 standards so the state standards based on them will be easily connected to and still be supported by the new standards (Heffron 2012). The new edition expands on the original 18 standards by providing additional educational materials to teach geographic perspective and reasoning. Additionally, the wording of two standards was changed slightly. Standard 1 now reads "How to use maps and other geographic representations, geospatial technologies, and spatial thinking to understand and communicate information" representing the addition of "geospatial technologies" and "emphasizes the concept of spatial thinking" (Heffron 2012). Standard 9 now reads "The characteristics and spatial distribution of ecosystems and biomes on Earth's surface." Heffron (2012) suggests, "the addition of biomes reflects the importance of regional scale biophysical communities that are impacted by global environmental change."

While there is a wealth of resources within geospatial information collections, aerial photography stands out as a particularly useful resource for the needs of the K-12 community and one that links directly to many of the *Geography for Life* standards. Aerial photography, in this case, provides a proof-of-concept example.

Using aerial photography collections to teach geoliteracy

"Aerial imagery has a great capacity to engage and maintain student interest while providing a contextual setting to strengthen their ability to reason proportionally. Free, on-demand, high-resolution, large-scale aerial photography provides both a bird's eye view of the world and a new perspective on one's own community." (Roberge and Cooper 2010)

Many resources in geospatial collections can be used to enhance geoliteracy education. Aerial photography, in particular, has a number of noteworthy attributes making it ideal for this purpose. Aerial photography has a long history of value and is used in a wide array of fields utilizing geospatial information. Secondly, aerial photography is a primary source, a type of material highly sought after by teachers. Finally, while not every geospatial collection

has an aerial photography collection onsite, aerial photographs are often targeted for digitization projects and many examples can be found online. Aerial photography, when digitized and geo-referenced, pairs well with GIS providing an extremely useful tool when teaching students spatial reasoning skills.

Historically, the United States Department of Agriculture has been one of the largest producers of aerial photography in the United States for the purpose of assisting farmers in accurately assessing their productivity as well as providing information on soil conservation. Today, "aerial photography can provide a historical record for studying such things as land use change, landform change, demographic change, and habitat assessment. It can be used for community planning, environmental enforcement, industrial projects, transportation planning, creating base maps, and basic enjoyment" (Mathews 2005).

Aerial photographs are the epitome of primary source materials. Using primary sources promotes "authentic learning" because it allows students to ask their own questions and form their own conclusions (Dennis 2001; Manuel 2005). This is particularly helpful when teaching information literacy since it focuses on developing reasoning and analytical skills. Maps portray the physical and cultural landscape as interpreted by a cartographer. Cartographers make many decisions while creating maps that influence how the audience perceives the spatial information. In contrast, aerial photography captures the surface of the Earth as it existed at the time the photograph was taken. This includes the physical terrain, as well as all buildings, bridges, roads, developed areas, and other man-made features. In addition, these features are shown with precision and accuracy, which are often not replicated maps.

Aerial photography and other remote sensing products are increasingly available freely online for public use, making them easily accessible to teachers and students. Some geovisualization sites, like GoogleEarth, even include historic aerial photography layers. Plus, geo-referenced aerial photographs can be downloaded and used in GIS, which allows students to explore spatial relationships to an even greater degree. While these materials have been available online for some time, teachers have not been using them to their full capacity because they do not feel they have the "ability to accurately identify and interpret the photographs" (Maier and Jones

1999). Furthermore, some websites that provide digital access to aerial photographs are difficult to navigate and require additional instruction on how to find materials. Geographic information librarians can play an important role educating teachers on "how to use the images accurately, effectively, and with confidence" (Maier and Jones 1999).

As stated earlier, using the National Geography Standards improves communication with other educators. By applying this framework to aerial photographs, geographic information librarians can increase teacher confidence in using this highly useful geospatial resource.

Linking aerial photography to the new "Geography for Life" standards.

In *Geography for Life: National Geography Standards, Second Edition* (Heffron and Downs 2012), K-12 curriculum in geographic education has been grouped into six Essential Elements: The World in Spatial Terms, Places and Regions, Human Systems, Physical Systems, Environment and Society, and The Uses of Geography. Each Essential Element has a number of standards associated with it for a total of 18 standards describing the "content of knowledge of geography" (Heffron 2012). To effectively and comprehensively teach all of these standards, many types of geospatial resources should be utilized. Aerial photography, in particular, is a useful resource for teaching a number of the standards as demonstrated below.

ESSENTIAL ELEMENT: THE WORLD IN SPATIAL TERMS

Standard 1. "How to use maps and other geographic representations, geospatial technologies, and spatial thinking to understand and communicate information"

Specific Application: Aerial photographs are primary geographic sources that can be used in geospatial technologies to enhance the analysis and communication of geospatial information. They can be compared and contrasted with other forms of geographic representations and how they communicate different aspects of geospatial information.

Standard 3. “How to analyze the spatial organization of people, places, and environments on Earth's surface”

Specific Application: Aerial photographs provide opportunities to study spatial relationships and their influence on the surface of the Earth. They allow for combined studies of physical and human systems and the analysis of spatial patterns as they change over time.

ESSENTIAL ELEMENT: PLACES AND REGIONS

Standard 4. “The physical and human characteristics of places”

Specific Application: Aerial photographs provide a detailed view of both the physical and human characteristics of a place. They differ from maps because there are no biases inherent in the photography.

Standard 6. “How culture and experience influence people's perceptions of places and regions”

Specific Application: Aerial photographs help students to think critically about their ideas regarding the world and how life experiences have influenced their perceptions. Aerial photographs provide students with an accurate view of their environment, which they can use examine their own ideas and biases.

ESSENTIAL ELEMENT: PHYSICAL SYSTEMS

Standard 7. “The physical processes that shape the patterns of Earth's surface”

Specific Application: Aerial photographs are a primary source for observing how physical processes such as volcanic eruptions, forest fires, droughts, and erosion change the patterns on the surface of the Earth over time.

Standard 8. “The characteristics and spatial distribution of ecosystems and biomes on Earth's surface”

Specific Application: Aerial photographs provide a way to identify different types of ecosystems such as wetlands, hardwood hammocks, etc., and to observe changes in ecosystems over time as they are impacted by physical processes and human activity.

ESSENTIAL ELEMENT: HUMAN SYSTEMS

Standard 9. “The characteristics, distribution, and migration of human populations on Earth's surface”

Specific Application: Students can learn about human systems by studying man-made structures and other characteristics of human population and distribution in the photographic record.

Standard 12. “The processes, patterns, and functions of human settlement”

Specific Application: Aerial photographs show many processes, patterns, and functions of human settlement. They allow for in-depth studies of human phenomena, such as urban sprawl.

ESSENTIAL ELEMENT: ENVIRONMENT AND SOCIETY

Standard 14. “How human actions modify the physical environment”

Specific Application: Aerial photographs allow for the study of how human actions, such as deforestation, urban development, and the construction of dams and canals, have significant impacts on the environment.

Standard 15. “How physical systems affect human systems”

Specific Application: Aerial photographs show the immediate impact of natural disasters on human populations. They can show both specific regions affected and the full extent of the devastation caused by physical systems.

ESSENTIAL ELEMENT: THE USES OF GEOGRAPHY

Standard 17. “How to apply geography to interpret the past”

Specific Application: The historic record is captured in aerial photography. This allows students to interpret the past and explore historic sites and events in new ways.

Standard 18. "How to apply geography to interpret the present and plan for the future"

Specific Application: Aerial photography allows students to view what is on the ground now, develop ideas about what shaped the environment in the past, and how it will be shaped in the future.

The following two examples further illustrate how aerial photography relates to the National Geography Standards.

Example 1: The Cross Florida Barge Canal: Ocklawaha River and the Rodman Dam

The effort to create a canal traversing Florida, to save on travel time and shipping costs, has a long history. After a number of failed attempts to gain the needed funding, the canal project officially broke ground in 1964. As part of the larger canal project the Rodman Dam was completed in 1968 on the Ocklawaha River, which resulted in Lake Ocklawaha, also known as Rodman Reservoir. Citing environmental concerns, the project was halted in 1971 and was officially cancelled in 1991. While the Cross Florida Barge Canal Project is now defunct, the Rodman Dam remains, though there are many ongoing campaigns to restore the Ocklawaha River to its previous state.

Using aerial photography, it is easy to see how the dam's construction changed the Ocklawaha River over time. Figure 1 shows the natural flow of the river in 1964. The flood plains surrounding the river are clearly visible. The same area shown in 1972 (Figure 2) shows the radical change that has occurred due to the building of the dam. The flood plain in the area of the dam is now completely underwater while certain parts of the river are still exposed. This transitional period highlights the effect of human actions on the environment (Standard 14). Additionally, the imagery can be used to study rivers and flood plains (Standards 7 and 8) and to study the historical impact and future ramifications of the Rodman Dam and the Cross Florida Barge Canal Project (Standards 17 and 18).

FIGURE 1. Aerial photography image of Ocklawaha River (Putnam and Marion County, Florida), 1964.

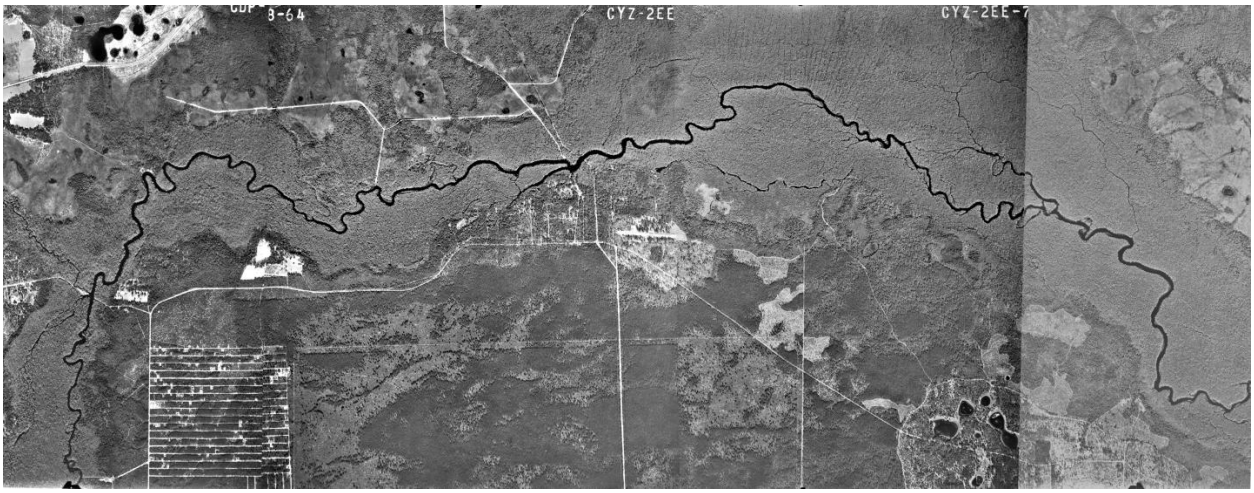

FIGURE 2. Aerial photography image of Ocklawaha River with the inclusion of the Rodman Dam and Reservoir (Putnam and Marion County, Florida), 1972.

Example 2: Urban Growth in South Florida: Roosevelt Middle School, West Palm Beach, FL

Florida's population grew tremendously in the later part of the twentieth century. Between 1950 and 2000, the number of people living in the state jumped from 2,771,305 to 15,982,378. Florida's growth during that time period can be attributed to an increase in job opportunities, recreational amenities, and the convenience of air conditioning (Smith 2005). This increase had "a major impact on the economy, culture, and natural environment in Florida" (Smith 2005). South Florida and Palm Beach County, in particular, gained popularity as a retirement location. The city of West Palm Beach showed almost 100% growth rate from 1950 to 1960 and substantial growth rates in the decades following as well (Palm Beach County History Online 2013).

Students currently attending Roosevelt Middle School can use aerial photography to view changes in West Palm Beach over the last 50 years. When the school was built in the 1990s, a reengineered Lake Mangonia can be seen to the east of I-95 (Figure 3). Aerial photography from the same region in 1953 (Figure 4), challenges the students to examine their own impressions and perceptions of the areas in which they live (Standard 6). The change reflects "the characteristics, distribution, and migration of human populations on Earth's surface" (Standard 9). The development of the swamp lands on the west side of Lake Mangonia from 1950s to the 1990s can help students study urbanization and the effects of urban sprawl (Standard 12). Finally, the photographs provide a unique look into the past, allowing students to track changes over time, and gives the students the tools to try and predict future development (Standards 17 and 18).

FIGURE 3. Aerial photography image of Lake Mangonia (West Palm Beach, FL), 1995.

FIGURE 4. Aerial photography image of Lake Mangonia (West Palm Beach, FL), 1953.

Conclusion

Collaboration between K-12 schools and academic libraries is widely documented and the mutual benefits are generally acknowledged. Additional research is required to quantify the advantages to geographic information librarianship as described by the six rationales listed above. The mutual benefits of multi-institutional collaborations for geographic information libraries should correlate to higher usage statistics of geospatial collections, a raised profile and general awareness of geospatial collections and services at the library, an increase in geoliteracy initiatives at home institutions, and an increase in outside funding based on involvement in education at all levels. Each of these could be evaluated through additional research, thereby opening up numerous exciting areas for future study. Similarly, further research is required to evaluate if the *Geography for Life: National Geography Standards, Second Edition* are meeting the needs of educators and which geospatial resources and technologies are the best tools for teaching. With the intense focus on STEM fields, it would be helpful to take a closer look at how aerial photography can be used in conjunction with GIS to further enhance STEM education.

It is important to remember that while collaborating with K-12 educators is one way to become involved in furthering geoliteracy education, it is certainly not the only way. Most states have Geographic Alliances who work to promote geoliteracy and fill state-level geography curriculum needs. These groups actively welcome volunteer involvement from knowledgeable professionals within their state. Professional organizations such as the National Council for Geographic Education (NCGE), the American Association of Geographers (AAG) and the American Geographical Society (AGS), offer scholarship and training opportunities as well as additional avenues for collaboration. The development of workshops and webinars for K-12 educators, school media specialists, geographers, and other librarians is another area where geographic information librarians can lead in geoliteracy education.

Geographic information librarians have an important role to play in geoliteracy education, both at their home institutions as well as within K-12 school systems. By collaborating with educators, geographic information librarians can raise the profile of their collections and services while providing much needed knowledge of and access to a wide range of geospatial resources. It is vital that geography education is supported by those in the field of geography. As members of the geographic community, promoting geoliteracy goes beyond being a professional opportunity and moves into the realm of professional responsibility

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