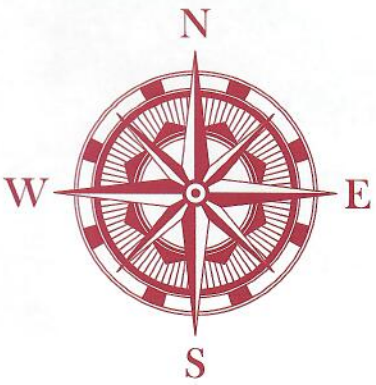
Wan-Hwa Cheng

Green sea turtles the apple of her eye



SEA TURTLES MAKE WAN-HWA CHENG HAPPY–"THEY ARE AMAZING creatures that are vital to the ocean ecosystem. Without that species, the ecosystem would be significantly and negatively impacted." Wan-Hwa began to learn about sea turtle biology, ecology, and conservation when she was just seven years old. Her father, Dr. I-Jiunn Cheng, is a sea turtle biologist, known as the "Father of Green Turtles" in Taiwan. Throughout her childhood, she visited the nesting beaches around the island with her father's students and listened to them discuss their research.

By the time she was 26 and a graduate student in Florida, Wan-Hwa realized that her father had lots of data with GPS locations, such as satellite tracks showing sea turtle nest locations, but no one had ever used GIS to analyze it. Her father needed help developing maps, and Wan-Hwa decided to test her research ideas on the data by using ArcGIS® software. Having started creating beautiful maps, she's found that she doesn't want to stop.

Currently, Wan-Hwa is a GIS and data analyst, project manager, and consultant for the International Union for Conservation of Nature (IUCN) Species Survival Commission (SSC) Marine Turtle Specialist Group (Taiwan) and a GIS analyst on-site vendor at Apple in Sunnyvale, California, via Apex Systems. In both roles, she uses GIS, programming, statistics, and data science to solve real-world problems, such as understanding the spatial distribution of sea turtles in the nearshore waters of Taiwan, and the interaction between

turtle movement behaviors and ocean environment on a three-dimensional scale.

People told her that GIS was difficult to learn, but Wan-Hwa never has been one to shy away from a challenge or hard work. Born in the United States, she moved to Taiwan at age five and returned 21 years later to become a part-time graduate student at the University of Central Florida. Her English was poor at that time, so to improve, she woke up at 5 a.m. every day to study and read. She also worked 35 hours per week as a hostess and cashier at a Chinese restaurant, often writing and designing research ideas on napkins.

Wan-Hwa, *front row right in white blouse*, and her colleagues at Apple in Sunnyvale, California. Wan-Hwa's team works together closely on their projects, and she likes the support she feels in a team environment.

At the end of 2014, as a master's degree student at the University of Central Florida, she was asked by Dr. Katsufumi Sato, from the University of Tokyo, and Dr. Junichi Okuyama, from Kyoto University, to give a presentation to their classes—and after that, she gave the same one to her father's students. She was invited to become one of the authors of "Ocean Says," which is the biggest ocean science Facebook site in Taiwan. *National Geographic* magazine (Taiwan branch) invited her to write an article about how people can reduce the negative impacts of artificial light on sea turtles by using GIS. That experience propelled her to attend her first Esri User Conference in 2014 in San Diego, California. Surrounded by 16,000 like-minded others in this hotbed of GIS enthusiasts, she decided to make GIS her career.

Wan-Hwa wanted to keep learning more to advance sea turtle research. She went to as many regional and international symposiums as she could. Attending symposiums has provided her with opportunities to network with sea turtle biologists from all over the world, learn new ideas, answer questions in oral presentations, and help organizations from other countries with GIS. In April 2015, she became a student evaluator and session co-chair at the International Sea Turtle Symposium in Dalaman, Mugla, in Turkey.

When she first started to attend symposiums, she lacked confidence and didn't know how to interact with other students. She remembers attending a regional meeting and standing alone during the social event, waiting for other people to come talk to her. Frustrated, she called her friend, who gave her inspiring advice. Her friend reminded Wan-Hwa that social interaction was different in the United States, but that she needed to overcome the obstacles to approaching others. She went back to the conference room, listened to some presentations, and, gathering her courage, started to discuss her research with other students. Once Wan-Hwa decided to be brave and not make excuses, the ice was broken. Now she can attend conferences and talk to others easily.

In early 2016, she transferred to the master of advanced study in GIS (MAS-GIS) program at Arizona State University, which allowed her to fully develop her GIS skills. All the while, she continued sea turtle research with GIS, and presented her projects at the Esri Ocean GIS Forum in Redlands, California, in 2017.

Wan-Hwa gives a presentation at the International Sea Turtle Symposium in Las Vegas in 2017.

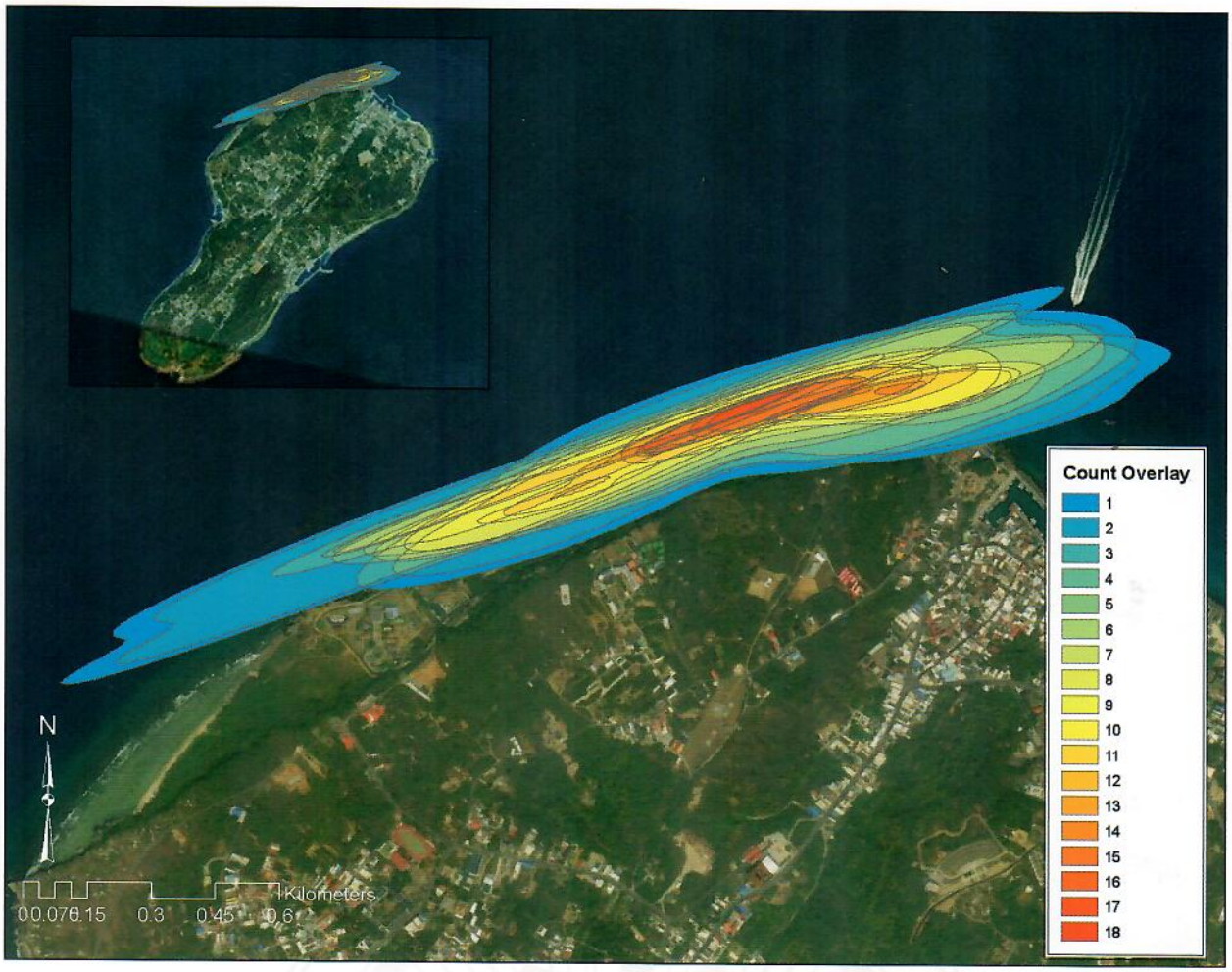
Of course, she encountered obstacles along the way, including one of her own making—often overworking herself to find the answer to a problem.

Some people laughed at me and tried to discourage me. Even some friends did not understand my dedication to academics and research, or underestimated me, as in "helping" me do my poster presentation in the school conference without asking [my] permission. This bothered me when I was younger, but as I matured, I decided to celebrate how I am different by continuing to do what I love and enjoy.

After graduation in 2017, master's degree in hand, Wan-Hwa began her work as a GIS and data analyst for the IUCN SSC Marine Turtle Specialist Group. In the beginning, she helped map the sea turtle satellite track using two-dimensional data that tracked longitude and latitude. Using spatial analysis, she began to train the graduate students from the Institute of Marine Biology, National Taiwan Ocean University, on their GIS skills and helped with spatial analysis for the Taiwanese government. Currently, she is working on understanding the interaction between the three-dimensional ocean environment and sea turtle movement behaviors, focusing on the spatial distribution of the sea turtle population in one main foraging ground in Taiwan.

As Dr. Dawn Wright [an oceanographer and chief scientist of Esri] points out, the ocean is a three-dimensional environment. If we use only two-dimensional data, we probably cannot provide the best suggestions for strategizing sea turtle conservation. Therefore, recently we began to use three-dimensional satellite tracking data, which includes longitude, latitude, and dive depth. This is important since sea turtles do not [swim only] on the sea surface, and the plastics and trash [are not only on the surface] either.

Wan-Hwa's IUCN team in Taiwan uses science to help the Taiwanese government protect sea turtles and increase sea turtle populations. The team has been doing sea turtle research in Taiwan for more than 20 years on both the land and in the ocean. On land, they help the Taiwanese government build marine turtle rescue centers for the diseased and damaged turtles that people find. Every year they conduct a beach survey to count the number of nests and measure the size of nesting female turtles. Wan-Hwa has also participated in investigations to determine how certain beach environments affect turtle eggs and turtle health.



Wan-Hwa's map shows her analysis of sea turtle home range. She presented this map at the International Sea Turtle Symposium in Las Vegas in 2017.

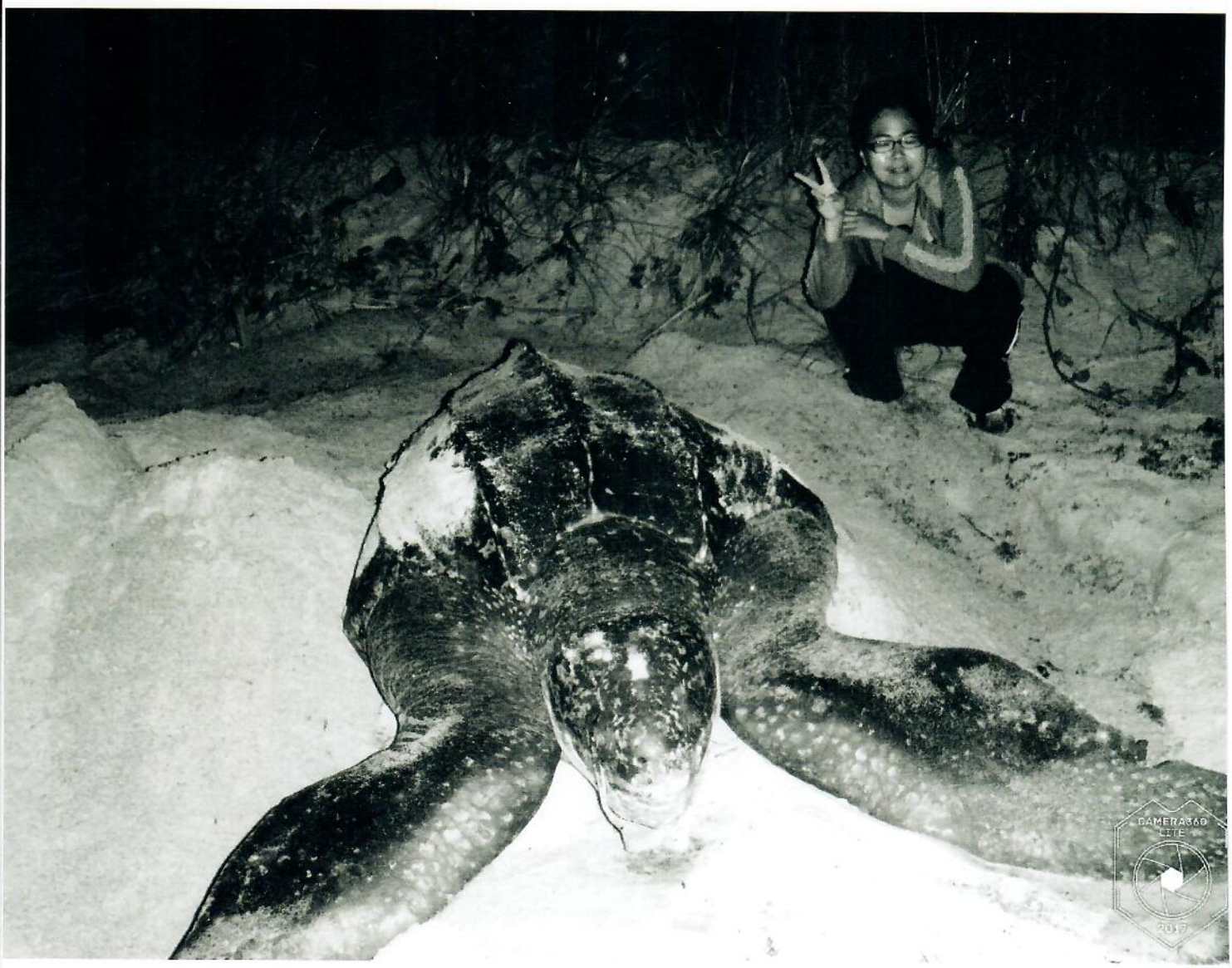


Photo taken during state and federally permitted research activities.

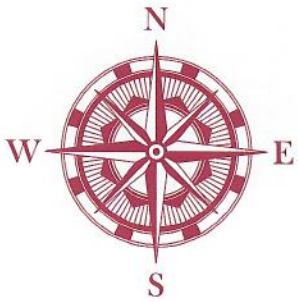
Wan-Hwa with a giant leatherback turtle at night after the team had finished taking all the measurements and was waiting for the nesting female to return to the ocean. Leatherbacks, the largest sea turtle species, can measure up to nine feet and weigh over a thousand pounds.

In the ocean, the team analyzes satellite tracking and in-water surveys to understand how the ocean environment influences green turtle swimming behaviors. They estimate population size and home range around the island of Taiwan, often collaborating with NOAA and sea turtle biologists in Japan.

All of Wan-Hwa's projects require spatial analysis, data science, sea turtle biology, oceanography, statistics, and programming skills—all STEM skills, which traditionally females worldwide have not been encouraged to learn. Having a father with the celebrity status of a rock star in his country for his scientific prowess in sea turtle study, Wan-Hwa managed to sidestep most discouragement. In fact, when working and traveling globally, she rarely makes it known that she is this famous man's daughter.

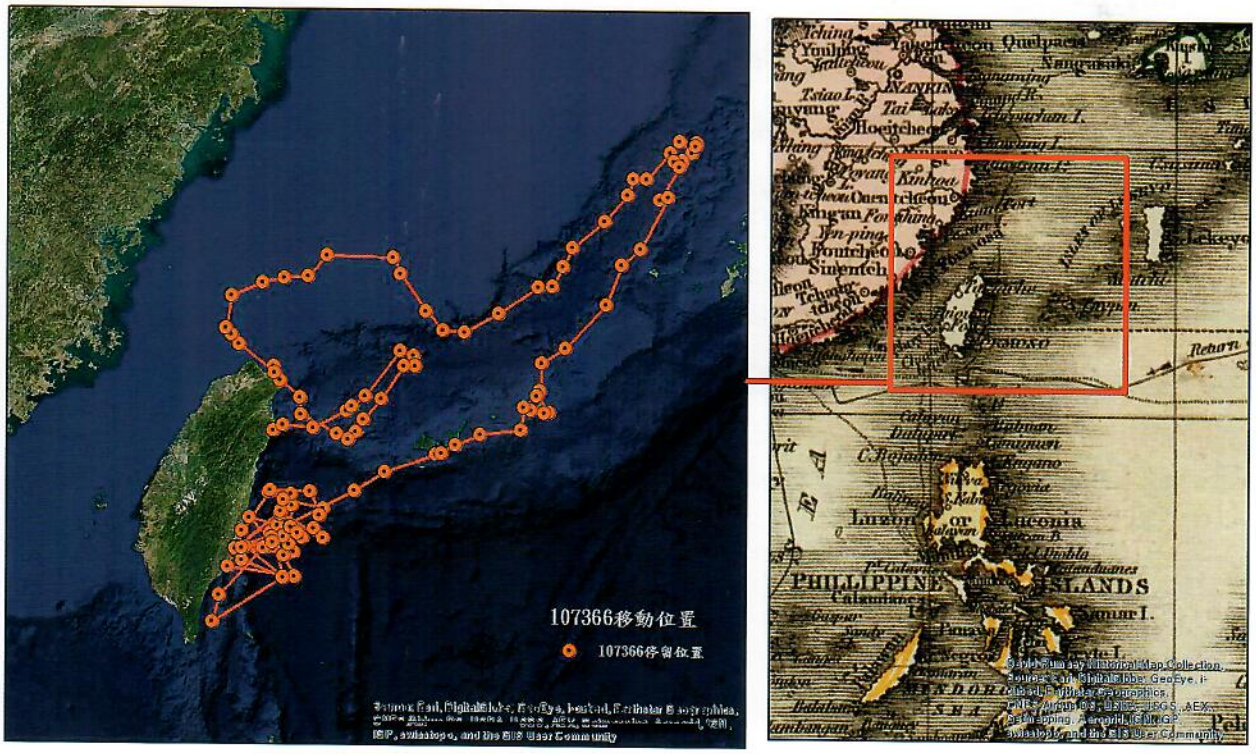
Many teachers, students, friends, and biologists encouraged me to pursue my passion. Yet, growing up in Taiwan, I did encounter people who think men are better than women and [that] women should not receive higher academic degrees but be more marriage-minded.

For her current success, she credits the support of her family, especially her parents and grandparents, and their belief that men and women are equal. Her father is still a major influence and supporter of her work. Wan-Hwa uses the long-term datasets from his laboratory to test her research ideas. "I love discussing my research with my father," she says, "because he is always honest and helpful."



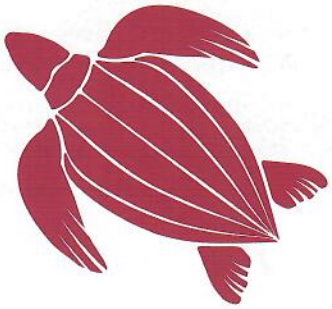
She points to other career mentors, the professors and students from the Department of Biology, University of Central Florida, as key to her learning to develop and design research projects independently: "to be able to ask good research questions, to think about how to use scientific methods to solve real-world problems, to convince and explain research ideas, and to get information from a large number of publications in a short period of time." She also credits the professors and lecturers from Arizona State for showing her "how ArcGIS and programming languages can help people to solve their problems with real examples."

Wan-Hwa's love of research to learn more about important ecosystems using technology's tools is ongoing. It rewards her daily with the same delight that came at her first sight of a sea turtle, and she feels moved to share it.



Wan-Hwa's map, *left*, tracks a loggerhead sea turtle, #107366, that was released at Dong'ao, Yilan, Taiwan, on February 22, 2014, and is still being tracked. She used a map from the past, *right*, as the basemap to show that sea turtles already existed in the era of dinosaurs.

I tell young women that if they dream of helping the environment or saving endangered species, they should enter the STEM fields. It's my hope that in the future, people will use what they learn from my work to make the world a better place. ✸



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WOMEN AND GIS

Mapping Their Stories

Written by Esri Press

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Dedication

We at Esri Press dedicate this book to all the women right here at Esri who bring their special knowledge, intelligence, and life experience to help craft cutting-edge technology each day and to render their support in advancing GIS and The Science of Where®.

Because we couldn't possibly choose between all these many doers and achievers, we wish to express our appreciation and thanks for all these women, for their talents and for their hard work and integrity in making this a better Esri. And we encourage all the other women out there yearning to make their way to take inspiration from the women featured in this book and to "strive for excellence and never give up your dreams," to "be honest and thoughtful, and then make a difference," to be "courageous and creative," to "never stop being in wonder of your work," and above all, to "not be afraid to fail."

We urge the women who are still rising to the fore to take the dare and be open to what life may bring—both the challenges and the rewards. And thus, to celebrate the triumph in doing the type of work it is that you love and enjoy.

Contents

Foreword

The release of this book could not come at a better time, a time that ranks among the most significant in terms of the sheer power and impact of women's voices.

Indeed, a new generation of female activists—seven million of them worldwide—came forward to participate in the 2017 Women's March. And millions more were expected for the third Women's March, in January this year.

The women's movement has ignited a powerful cultural conversation, forcing people to face their own beliefs and behavior, especially in the workplace.

More women are running for elected office than ever before, and from a variety of professions, from nursing, to geology, to naval aviation.

Lehua Kamalu became the first woman to serve as both captain and lead navigator of a Polynesian voyaging canoe, successfully guiding the *Hikianalia* over 2,800 nautical miles from Honolulu, Hawaii, to Half Moon Bay, California, in 23 days.

Starting by the end of this year, publicly traded corporations headquartered in California must have a representative number of women on their boards of directors thanks to a bill signed into law by then governor Jerry Brown.

And perhaps to top it off, two women received science Nobel Prizes in 2018: Donna Strickland in physics—only the third female winner ever, and the first woman to win it in 55 years—and Frances Arnold in chemistry—only the fifth female winner after Ada Yonath in 2009.

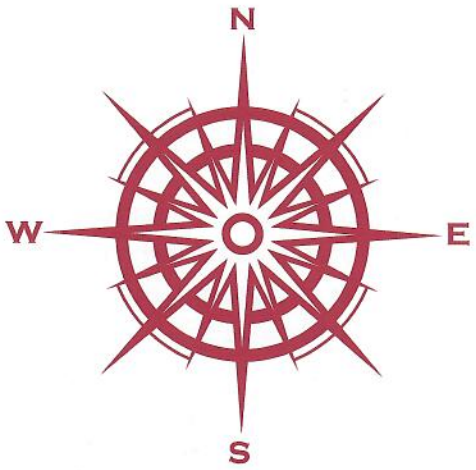
As Donna noted upon receiving her prize, "We need to celebrate women physicists because they're out there. ... I'm honored to be one of those women."

So, too, is the case with GIS. We need to celebrate the women of GIS because they're also out there. And they're exceedingly proud

and honored to be part of a field and a technology that is literally saving the world. And more women are coming into the field all the time, bringing with them powerful and positive voices, diverse perspectives, and surgical insights. They're exerting influence within the GIS industry, as well as in the worlds of academia, STEM education, government, the humanitarian nonprofit space, exploration, conservation, even the Catholic Church.

This book is a wonderful sampling of these prescient forces. These are the stories of innovators, leaders, explorers, teachers, mentors, doers (!), many of whom have been hidden figures for far too long. But no more. I hope that you are as blown away by these profiles as I am. The quotations from these women alone are an absolute treasure trove. And while these are stories for GIS veterans and newcomers alike, both women and men, may this book be especially inspiring for female newcomers to the world of GIS.

—Dawn J. Wright,
Esri Chief Scientist



Preface

In early 2018, Stacy Krieg (my acquisitions manager) and I were given the extraordinary opportunity of spending an hour with Kathryn D. Sullivan (one of the women profiled in this book). We wanted her thoughts about how we could be part of bringing the knowledge and use of GIS to everyone. How we could reach beyond our existing users to people of any age, walk of life, job, or interest. How we could show them that applying data science to any problem or idea could improve the outcome. Things from better predictive models for wildfires to save lives, to real-time evacuation routes for hurricanes, to finding the best location for a sports park.

As we talked, Kathryn guided us to the realization that perhaps the most important group we should focus on is young people. They are the future generation(s) that will take on the challenges of the world. She said, speak to them about what interests them, not about the technology. Most are passionate about making the world better and improving the lives of those around them. Show them how mapping and GIS can help their passions become reality. Encourage them to take science, technology, engineering, and math (STEM) classes. Break the misconception that STEM is hard and not for girls. Break the "I can't do that" mindset.

When I left the meeting, I continued to think about what we'd discussed. It made me think of my own daughter. She has always had a natural talent for engineering and math. When she was 8 and 9 years old, you could place a box of gears, switches, and other parts in front of her, and she'd build you things. Complex things. No directions, no guidance. She'd say she just saw it in her mind and knew how to build it. She's still that way today, in high school. So you can imagine my shock every new school year when she comes home stressed about how difficult the new biology, math, physics—whatever—class is going to be, just because that's what her peers are saying about it. Even a young girl who was building

adult-level construction sets by age 11 is at risk of falling victim to the myth that STEM is hard, especially for girls.

My daughter is lucky enough to have people around her who help her break her fears and have confidence in her ability to do whatever she sets her mind to, but not all young people have that support. Someone who will tell them they can when they think they can't. Someone who will tell them it doesn't matter where you come from or the struggles you face. Someone who will tell them it's where you're going that matters, and that you should believe in yourself.

Having that type of support then made me think of my own mother. She was a stay-at-home mom, and she was (and still is) exceptional at that job. She was the person who taught me that I could do anything, be anything, and that I was strong enough to face anything. She insisted I take every science and math class I could squeeze into a schedule. The term STEM wasn't used back then, but she knew the value in it, and she trained me to never be afraid of it. She was the one who encouraged me to go back to school for GIS. She knew nothing about GIS but had read a magazine article about it. She felt so strongly that it was my future that she and my grandmother brought me the magazine. I didn't always listen to these two women, but on that occasion, I did. Now, 25-plus years later, I can say that I still thank them both, every day.

It was the influence of these women in my life, and my desire to be the same influence in my daughter's life, that gave me the idea for this book. I wanted to show that it didn't matter who you were, where you came from, or the struggles you faced. I wanted people to read about women from different backgrounds, different countries, and different generations who faced struggles along the way but never gave up on their dreams. Women who use science, technology, engineering, and math to make the world, and the lives of the people around them, better. If these women can do it, so can they.

I took my book idea to Stacy. I trust her opinion and honesty and her extensive experience in the publishing world. I also know she wants to have the same influence on her youngest daughter (also in high school) as I want to have on mine. She saw the vision and the goal of the book—to show young people someone like themselves, and then they might begin to believe that they can do it, too. When

they believe they can, the ability to learn the technology and methodology comes easier. And so began our journey together creating (eventually, along with all the other amazing people we work with at Esri Press) a book that maps the life stories of the women in it, and hopefully inspires others to begin mapping their life stories, too.

—Catherine Ortiz

Manager and publisher, Esri Press