



sentinels

OF THE

sea

BY TESSA BUCHIN

PHOTOGRAPHS BY KATIE SCHULER
AND KRISTIN HETTERMANN

**MARINE TURTLES
HAVE ROAMED EARTH'S SEAS
FOR 100 MILLION YEARS. NOW
GLOBAL WARMING IS ALTERING
THEIR HABITATS AND
THREATENING THEIR SURVIVAL.
RESEARCHERS ARE OPTIMISTIC
THAT THEY WILL ADAPT TO THE
CHANGING ENVIRONMENT,
BUT THEY'RE GOING TO
NEED OUR HELP.**

“SEA TURTLES are like the canaries in the coal mine,” warns Doug Mader, DVM, Florida Keys resident and sea turtle veterinarian, “They are the ambassadors of our world.” Mader, the kingpin of the sea turtle community, stands before a mural of the many species he has treated at the Marathon Veterinary Hospital. I let his metaphors sink in. Within the marine science and conservation communities, sea turtles are considered to be “indicator species”—their health directly reflects the health of our oceans. If they are unwell, all is unwell.

Today, sea turtles face a gauntlet of challenges; only 1 in 1,000 turtle hatchlings makes it to adulthood. Natural predation, disease and anthropogenic impacts, including entanglement in fishing gear, poaching, marine debris ingestion, boat strikes, coastal development and chemical pollution, have been the main drivers of sea turtle mortality. And now, there's climate change. “Global warming does not mean global ‘warming.’”

KRISTIN HETTERMANN





Previous page: Green sea turtle. Above: Sea turtle veterinarian, Doug Mader, DVM, sees firsthand the harm human activities cause marine wildlife and urges us to, “Respect our planet, respect our oceans, respect the animals that live here.” Right: Green sea turtle.

It means that the weather events are becoming more dramatic. In some places, there is global freezing,” explains Mader. Climate-related issues—diminished nesting habitats, cold-stunning events, and the feminization of sea turtle populations in hotspots like Florida, the Texas Gulf and the Hawaiian Islands—reveal a global crisis and direct turtle research and conservation efforts worldwide.

Erosion in the Sunshine State

THE FLORIDA COASTLINE comprises 1350 miles of shifting beaches and hosts six marine turtle species—the most abundant being the regionally threatened loggerhead and green, and the endangered leatherback. In 2017, Florida’s Department of Environmental Protection (DEP) reported that 420 miles of its beaches were critically eroded, a natural process accelerated by development, rising sea levels, storm surges and an increase in extreme weather events.

In September 2017 when Hurricane Irma hit the Florida Keys with 185 mph winds, it wiped out infrastructure, displaced residents and eroded beaches. Harry Appel, president

of Save-A-Turtle (SAT), a Florida Keys non-profit, can attest to the devastation. Irma destroyed the organization’s education trailer and 30 years’ worth of record-keeping.

Despite the setback, SAT has persevered in its mission to protect and preserve beaches in the Keys. Their “beach walker” volunteers monitor nests, rescue turtles, collect hatchling data for the state, and orchestrate beach cleanups. In addition to public outreach, SAT also educates Keys residents and businesses about county codes and the DEP’s Coastal Construction Control Line (CCCL) program, which protects fragile beaches in 25 of Florida’s coastal counties. The CCCL manages permitting for proposed coastal projects and regulates disturbances like light pollution, which disorients a hatchling’s ability to navigate to sea by moonlight. “It took me 10 years just to get our beaches here in the Keys CCCL-designation. [Now] the DEP has some authorization to stop development on beaches here, including rock walls and



organization. Gomes's role is to work with site stewards like Kobayashi to determine which sites need the most work, then promote the workday and ensure that tools, plants and snacks are brought to the site.

Gomes especially appreciates that this project gives people the experience of being in nature when they might not have the opportunity otherwise: "Nature inspires a sense of wonder. Once you start looking, you see how much is going on." Through her work on the Green Hairstreak Corridor project she has deepened her appreciation for the interconnectedness of the ecosystem and not only learned more about this small green butterfly, but about other pollinators, dune habitats and the effects of climate change.

All these links are reflected in the data collected by citizen scientists using the iNaturalist app, which allows anyone with a smartphone or camera to upload nature photos to the website. Using crowdsourced identification, the app logs species occurrences in every nook and cranny of the city and even throughout the world. Data collected during one-day events such as a Bioblitz, and by individual observers, has identified more than 200 unique species in the Green Hairstreak Corridor, including 40 kinds of insects (six of which are

"...if people discover creatures in peril right where they live, and they are given tools to help restore an ecosystem to health, they begin to understand how easy and fun it is to play a role in creating positive change."

AMBER HASSELBRING,
EXECUTIVE DIRECTOR, NATURE IN THE CITY

butterflies) and 23 kinds of birds. These are supported by more than 130 types of plants that have been observed.

NTC also introduces people to the flora and fauna in the area through annual walks they host in the Corridor, inviting residents from around the Bay Area to see the butterflies in flight. Walks are also held along the peaks and the shorelines of the city, focusing on iconic species such as the bank swallows at Fort Funston, the American avocets at Heron's Head Park, or the California sea lions at Pier 39. One of the most popular tours leads participants through the urban core along Market Street where NTC is working to expand habitat for another butterfly, the western tiger swallowtail.

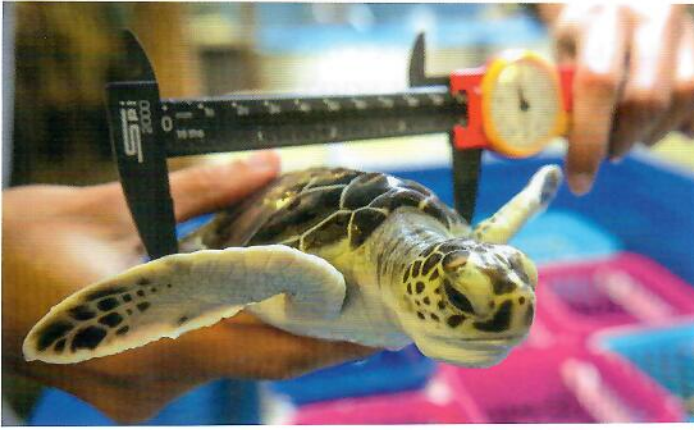
These walks, along with community-led restoration projects like the Green Hairstreak Corridor, reflect the heart of NTC's mission: inspiring San Franciscans to discover local nature. As people become increasingly aware of serious

global environmental problems, they may overlook the need to address these same problems in their own community. However, urban ecology reflects many of the same broader environmental issues, making local actions an essential part of halting biodiversity loss, improving public health and illuminating environmental injustices.

As Hasselbring puts it, "Topics like climate change and potential extinction for a species like the monarch butterfly loom large in our minds and can feel overwhelming. But if people discover creatures in peril right where they live, and they are given tools to help restore an ecosystem to health, they begin to understand how easy and fun it is to play a role in creating positive change. We enjoy giving people simple, meaningful actions that can collectively create much greater impacts—that we hope take hold in cities everywhere and throughout our planet."

These might seem like lofty and daunting goals given the enormity of global challenges, but could a little green butterfly provide a spark that lights the way? **WH**

To learn more about the Green Hairstreak Corridor project and discover how you can help protect habitat for vulnerable species in your community, visit Nature in the City online: natureinthecity.org.



Left: Researchers at Florida Atlantic University Marine Lab collect morphometric data on captured juvenile green turtles and tag them in order to track where they go once they're released back into the ocean. Lab Director, Jeanette Wyneken, PhD, says, "Understanding where imperilled animals go is key to conservation."
Right: Green sea turtle.

sand collection from offshore reef and seagrass habitats creates damaging sediment plumes and hurts key ecosystems, she says. "We tend to think of the turtles when on the beach, but nearly 100% of their time is in the water. We're ignoring what we don't see." Yet Wyneken remains hopeful: "Weather events are producing more severe storms. The species that we are working with have been around for up to 100 million years. As long as they have food and a place to reproduce, they have persisted. [Natural] selection has selected for resilience to extremes."

Cold Snaps in the Gulf

SEA TURTLES ALONG THE SOUTH TEXAS COAST face the opposite extreme: cold. "Sea turtles are ectotherms," explains Tim Tristan, DVM, director of the Texas Sealife Center (TSC), a non-profit organization that rescues and rehabilitates coastal and aquatic wildlife, including sea turtles. "They're dependent on their environment. If water temperatures drop below their optimal temperature of 56–57°F, their system functions shut down one by one." This hypothermic state is referred to as "cold-stunned." When a sea turtle is cold-stunned, their body enters lifesaving mode and shunts blood to the brain and heart. This affects their digestive enzymes, organ function, immune

system and mobility. Unable to move or swim, they're susceptible to drowning and pneumonia. Affected turtles float to the water's surface and become vulnerable to many dangers, including boat strikes or being swept away by ocean currents, which can cause them to strand and die of exposure or predation.

From November to early February, geographic, oceanographic and meteorologic conditions trigger a rapid drop in water temperatures along the Texas coast, causing juvenile green sea turtles caught feeding in shallow waters to become severely hypothermic. Cold-stunning events, which previously happened every other year in Texas, have occurred annually for the last five years. In 2018 Texas saw the largest cold-stunning event in the state's history with more than 3,000 turtles affected. "These are trends and changes that can't be ignored and are progressively getting worse," says Tristan.

He and the team of volunteers at the Texas Sealife Center assess each turtle rescued, collect morphometrics (body measurements), and run blood work on patients that are often anemic, underweight, covered in fibropapilloma tumors, and have foreign debris such as fish hooks in their digestive tracts. Many qualify for surgery in addition to cold-stunning rehabilitation, which involves methodical dry-docking, gradual

warming and intense supervision. Patients are held until they can dive and maintain homeostasis; once the water and weather warm up, they are released.

The Texas Gulf is unique in that it sees acute cold-stunning cases, compared to chronic cases on the East Coast, which require longer rehabilitation processes. As each year brings more cold-stunned patients into Texas Sealife Center, the evidence can't be ignored, explains Tristan: "These animals are the sentinels of our ocean health. This is just one little snapshot of what's going on out there. Until we realize this is only a small part of the bigger picture, we're not going to be able to make the differences we want to."

The Loss of East Island

EAST ISLAND IS, OR RATHER WAS, a sand islet in the French Frigate Shoals, an atoll in the Northwestern Hawaiian Islands. In October 2018, Hurricane Walaka, a category 5 cyclone, wiped out East Island, the primary nesting area for 96% of Hawai'i's *honu* or green turtle. Previously, East Island had been entirely protected: "No harvesting, no people, no human-related impacts...100% protected, until now," explains

illegal hardening," confirms Appel.

Shoreline hardening or armoring—the use of seawalls, rock walls or jetties to reinforce developed coastline—expedites erosion and increases the need for routine beach renourishment. Malnourished beaches—ones that have lost sand—severely impact turtle habitats and can result in false nesting attempts (also known as “false crawls”) and poor nest viability. Sand replenishment projects and seagrass and mangrove habitat restoration can help slow the loss of beach zones, which is why Appel says SAT’s future programs will be aimed at habitat restoration and marine stewardship.

The Future Is Female

“BEACHES HAVE ALWAYS BEEN DYNAMIC but they are disappearing because of current and past coastal development,” says Jeanette Wyneken, PhD, of Florida Atlantic University, who has been documenting the alarming trend of skewed sex ratios in Florida’s sea turtle clutches since 2002: “[We’ve seen] a strong female bias in the production of hatchlings. And there are more and more years of hot, dry conditions, which lead to nest failure. Of the nests that don’t fail, we see 100% female production.”

Wyneken’s team provides foundational data for Palm Beach County, which hosts 17% of loggerhead births in the US. “Basically we’ve lost production some-

“WE ALL NEED TO MAKE A CONSCIOUS EFFORT TO REDUCE OUR CARBON FOOTPRINT. WE ARE ALL RESPONSIBLE FOR GLOBAL WARMING. DON’T THINK THAT IT’S SOMEONE ELSE’S PROBLEM OR THAT ONE PERSON CAN’T MAKE A DIFFERENCE. IT STARTS WITH THE INDIVIDUAL—SET AN EXAMPLE FOR OTHERS TO FOLLOW.”

— DOUC MADER, DVM

where in the life cycle of these animals...the overall goal is to establish a baseline so we can recognize change,” she explains. Sexual dimorphism is only apparent once turtles mature, which makes sexing immatures in the field impossible, so Wyneken uses laparoscopy to sex 120 to 200-gram sea turtles. Her expertise—skills that she gained as a PhD student and later while working with veterinarians—satisfies permitting agencies’ criteria to maintain sea turtles in her lab. She studies how particular environmental variables and moisture levels influence sex ratios in a controlled environment: Warmer, dryer conditions lead to faster incubation times and predominantly female clutches; slower, moist conditions lead to more males.

Neither for nor against replenishing beaches with sand, Wyneken thinks it’s trading one set of imperfect solutions for another. Although renourishment technology has improved,



THEY CARRY THE WORLD,

or so the ancient myth goes.

Here are the facts about sea turtles.

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Seven species persist in tropical and subtropical regions worldwide: flatback, green, hawksbill, Kemp’s ridley, leatherback, loggerhead and olive ridley. All but the flatback are found in US waters.

Long-lived and late to mature, sea turtles reach sexual maturity between 25–40 years of age or 12–17 years for the Kemp’s ridley and leatherback. Once mature, the female mates and returns to her natal beach to lay eggs in the sand.

Until the Endangered Species Act of 1973, sea turtles were brazenly exploited for their meat, eggs, leather and shells.

The International Union for the Conservation of Nature and Natural Resources (IUCN) currently classifies the loggerhead, olive ridley and leatherback species as vulnerable, the green as endangered, and the Kemp’s ridley and hawksbill as critically endangered.



Irene Kelly, Sea Turtle Recovery Coordinator with the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service Pacific Islands Regional Office. In the years since the Endangered Species Act of 1973 was enacted, green turtles have thrived on East Island. Because of its remoteness, only scientists ventured there to collect nesting, population and migration data. The tiny refuge provided more than 40 years of valuable research that has been used to craft the green sea turtle recovery plan. Although the impact of the loss of East Island on the green sea turtle population is unknown, it is a tragedy to lose a prime research site.

Marine turtles are essential for healthy reefs and ecosystems—they forage and manicure algae to prevent overgrowth. Although reef degradation occurs in heavily touristed areas of Hawai'i like Waikiki, the honu return to North Shore O'ahu year after year. Here, unlike anywhere else in the world, both males and females come ashore to bask. The non-profit organization Mālama na Honu has been protecting these populations since 2007. "Sea turtles throughout Polynesia are highly respected and revered, emblems of fertility, strength and spiritual guardians to many people of Hawai'i," explains Kelly. NOAA provides grant funding for Mālama na Honu, whose turtle guardians educate visitors, enforce responsible viewing

guidelines, collect data and protect the turtles 365 days a year.

Although the feminization of sea turtle populations hasn't shown up in Hawaiian waters yet, the threats of global warming and habitat loss loom large: "The climate is changing and we definitely have to study its effects and come to terms with it by developing management strategies to mitigate potential impacts, including reducing our dependence on fossil fuels," says Kelly, who is working with partners to formulate strategies for the future. Early propositions include cooling nest temperatures with shading and watering. Finding long-term solutions is complex, Kelly, however, remains sanguine: "Marine turtles by definition are a long-lived, slow growing, late maturing animal. While they are very sensitive to human impacts and disturbance, they are also very resilient. Turtles have survived for many millions of years, and we are very optimistic that they will continue to evolve and adapt during this next phase of life." **WH**

Find out how you can help support organizations working to safeguard sea turtles: save-a-turtle.org; texassealifecenter.org; malamanahonu.org.

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COVER: NEST OF CEDAR WAXWING
(*BOMBYCILLA CEDRORUM*), CORNELL
UNIVERSITY MUSEUM OF VERTEBRATES,
COLLECTED IN 1992. POPULATIONS
OF CEDAR WAXWINGS ARE CONSIDERED
STABLE AND IN SOME PLACES ARE
INCREASING.
PHOTOGRAPH BY SHARON BEALS.

LEFT AND BACK COVER:
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