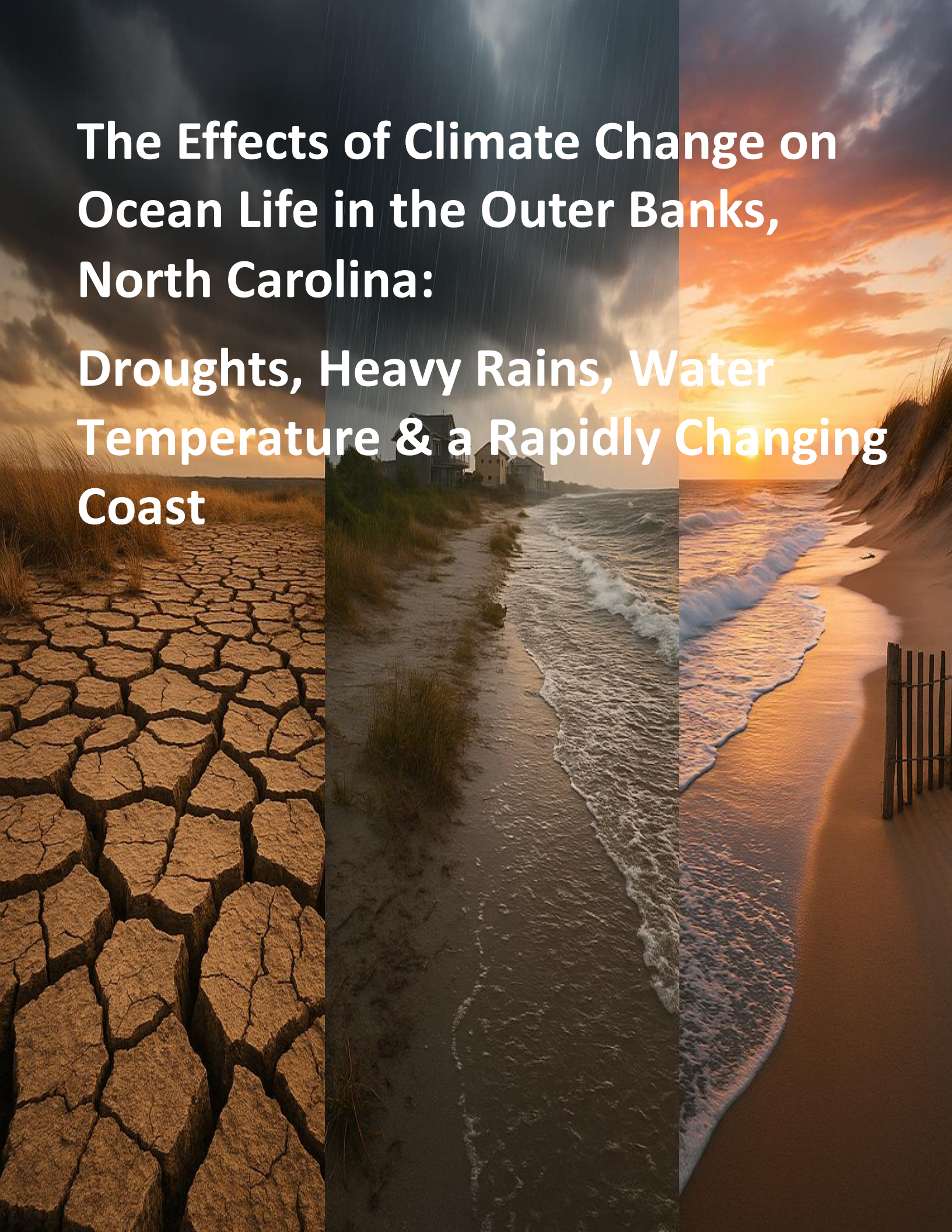


The Effects of Climate Change on Ocean Life in the Outer Banks, North Carolina: Droughts, Heavy Rains, Water Temperature & a Rapidly Changing Coast



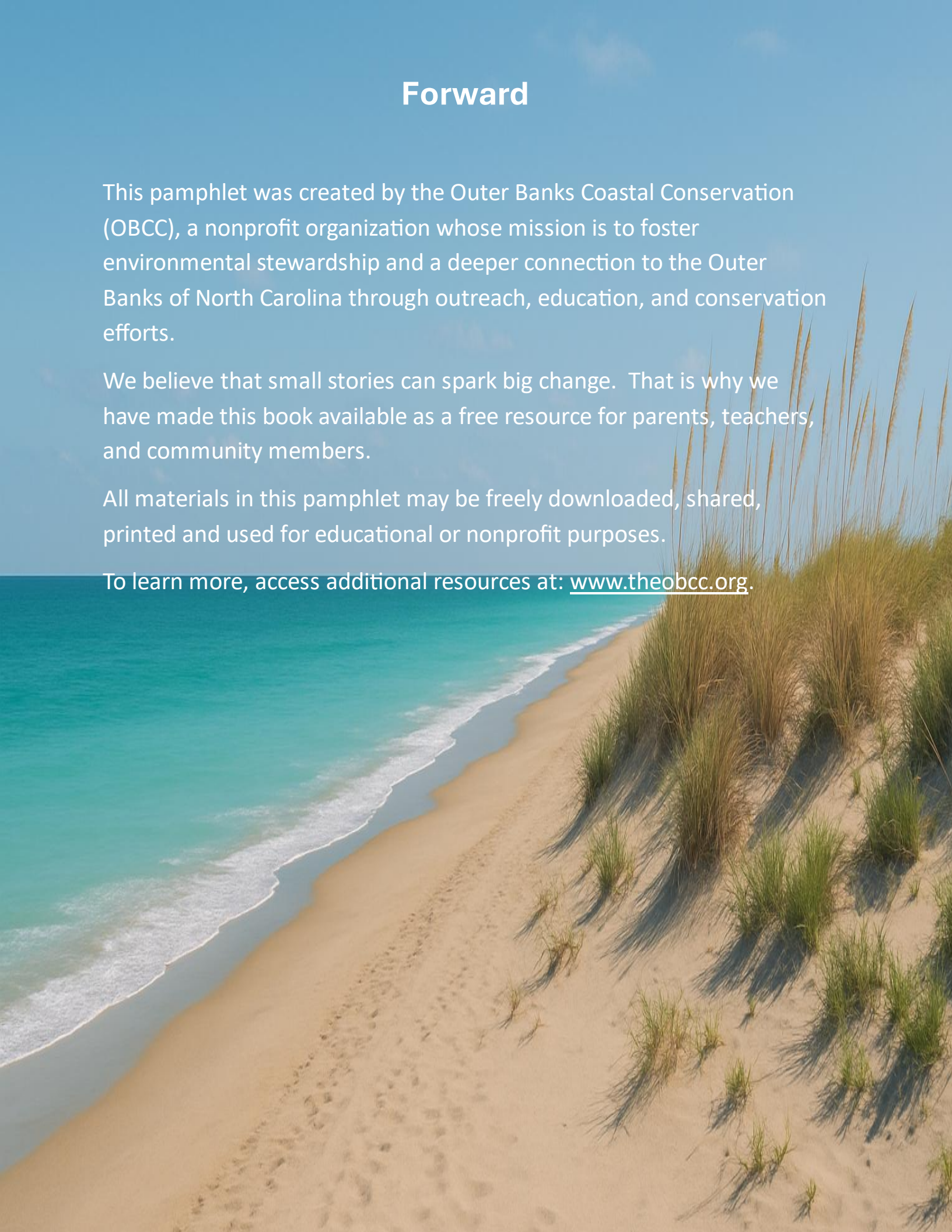
Forward

This pamphlet was created by the Outer Banks Coastal Conservation (OBCC), a nonprofit organization whose mission is to foster environmental stewardship and a deeper connection to the Outer Banks of North Carolina through outreach, education, and conservation efforts.

We believe that small stories can spark big change. That is why we have made this book available as a free resource for parents, teachers, and community members.

All materials in this pamphlet may be freely downloaded, shared, printed and used for educational or nonprofit purposes.

To learn more, access additional resources at: www.theobcc.org.



Climate-Driven Droughts: How Dry, Hot Periods Transform Coastal Waters

Drought doesn't simply dry out land — in the Outer Banks, it raises salinity, water temperatures, and biological stress across sounds and estuaries.

Salinity Surges + Heat Stress

During droughts, freshwater inputs decline and shallow areas heat quickly.

This leads to:

- High salinity (near ocean levels)
- Elevated water temperatures, often exceeding 86–90°F (30–32°C) in shallow creeks
- More evaporation, further concentrating salts

Species Impacts

Seagrasses (eelgrass, shoal grass)

Sensitive to heat + salinity together. Effects include:

- Reduced photosynthesis
- Canopy die-off
- Loss of habitat for juvenile fish and blue crabs



Oysters & clams

High temps + high salinity = ideal conditions for:

- Oyster diseases (Dermo, MSX)
- Summer die-offs
- Reduced filtration efficiency

Fish

Thermal stress affects:

- Red drum
- Speckled trout
- Flounder
- Mullet
- Spot and croaker

Warm water holds less oxygen → fish become sluggish, more vulnerable to predators and disease.

Low Dissolved Oxygen (Hypoxia) from Heat

Warm water can't retain oxygen.

Results:

- Nighttime oxygen crashes in shallow creeks
- Bottom-water hypoxia
- Fish kills
- Benthic organism die-offs

Heat + drought stagnation is one of the leading drivers of localized fish mortality events.

Increased Algal Blooms

Warm, still water = perfect bloom conditions.

Effects:

- Low oxygen
- Toxins harmful to fish & dolphins
- Shading of seagrass meadows
- Taste and odor compounds in shellfish

Marsh Heat Stress

High temperatures evaporate surface water and bake soils.

Impacts:

- Dieback of upper marsh species
- Soil cracking
- Loss of nursery edges where juvenile crabs shelter
- Greater susceptibility to fire



Heavy Rains & Flood Events: Freshwater + Temperature Shocks

Rainfall extremes often bring large cold freshwater pulses into the warmer sound — or, after summer storms, warm runoff flows into already hot waters.

Both cause rapid shifts that stress marine life.

Rapid Salinity *and* Temperature Crashes

After tropical storms or intense rainfall:

- Freshwater pours into the sounds
- Temperatures drop suddenly in localized areas
- A thermal and salinity shock wave spreads outward

Biological Consequences

Oysters

Cold freshwater in summer → shock + mortality

Warm freshwater in winter → increased disease susceptibility

Juvenile fish

Temperature swings disrupt:

- Metabolic rates
- Feeding behavior
- Schooling patterns

Dolphins

Thermal shock + salinity crash → skin lesions & illness

Runoff Temperature Effects

Stormwater runoff is often warmer than the receiving water — especially from:

- Roads
- Parking lots
- Rooftops

Warm runoff:

- Increases estuarine temperatures
- Worsens bacterial growth
- Stimulates harmful algal blooms

Turbidity + Heat Interaction

Sediment plumes reduce light penetration.

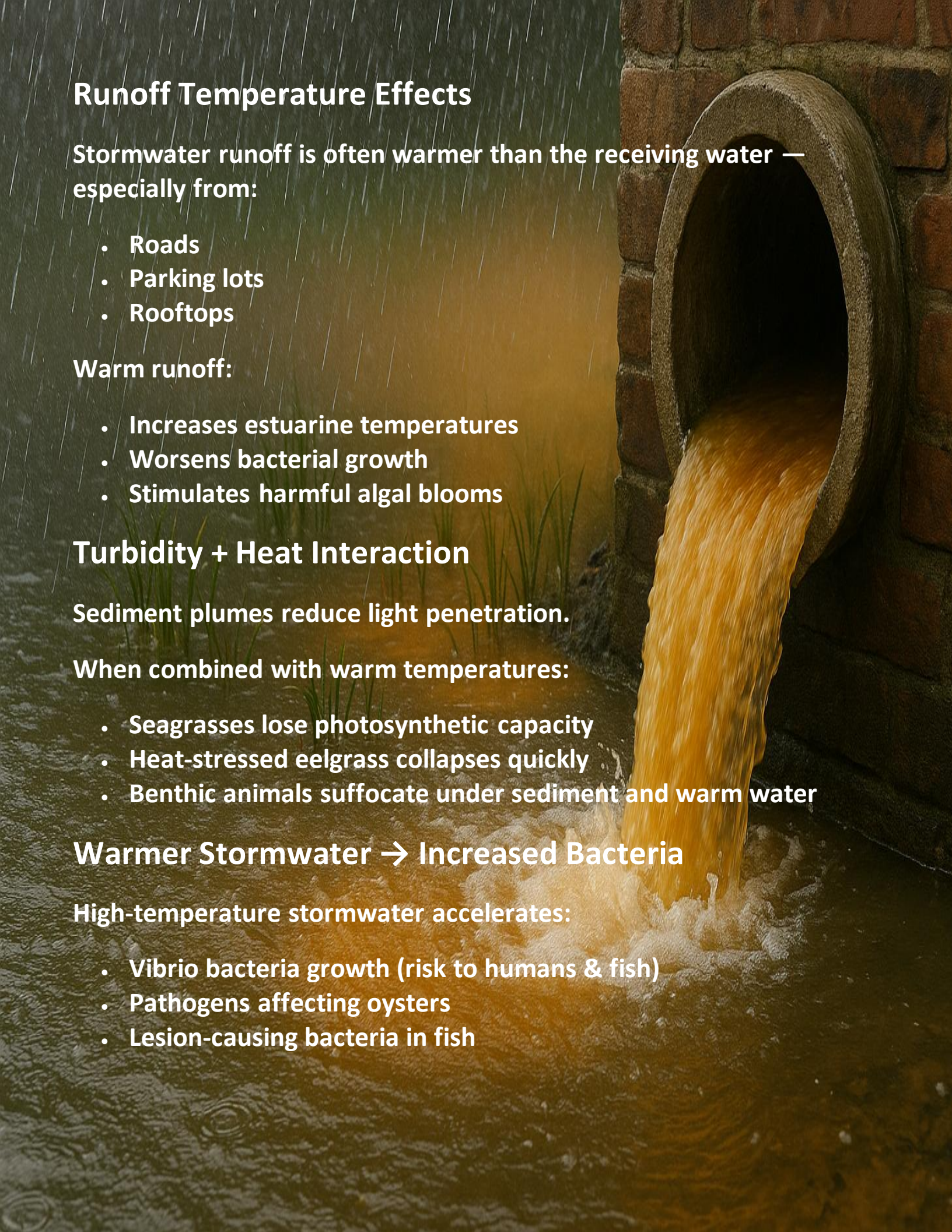
When combined with warm temperatures:

- Seagrasses lose photosynthetic capacity
- Heat-stressed eelgrass collapses quickly
- Benthic animals suffocate under sediment and warm water

Warmer Stormwater → Increased Bacteria

High-temperature stormwater accelerates:

- Vibrio bacteria growth (risk to humans & fish)
- Pathogens affecting oysters
- Lesion-causing bacteria in fish



Warming Waters: A Direct Climate Pressure on Outer Banks Wildlife

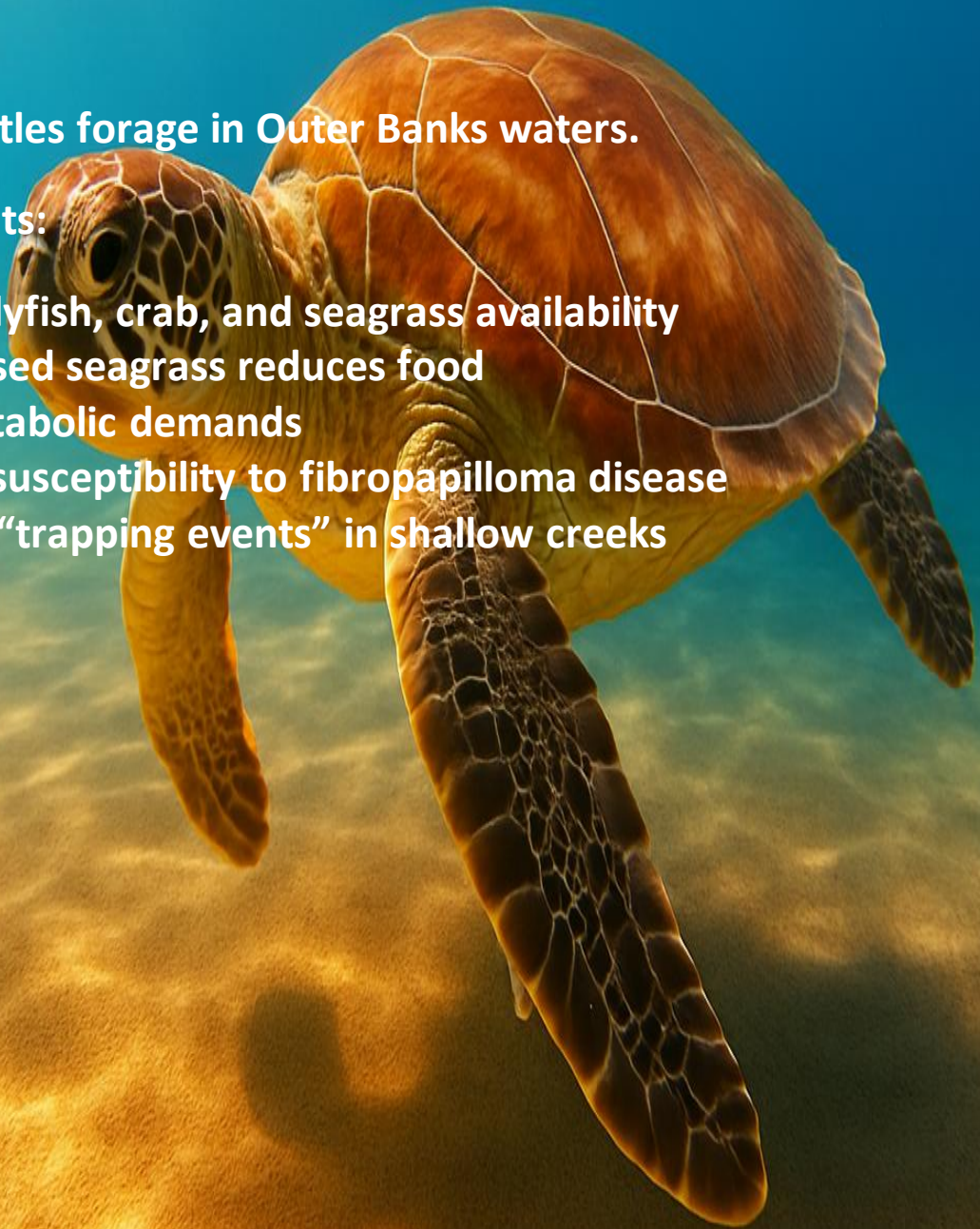
Temperature doesn't just interact with drought and rain — it is a primary stressor on Outer Banks ocean life.

Sea Turtles

Juvenile sea turtles forage in Outer Banks waters.

Warming impacts:

- Altered jellyfish, crab, and seagrass availability
- Heat-stressed seagrass reduces food
- Higher metabolic demands
- Increased susceptibility to fibropapilloma disease
- Hot water “trapping events” in shallow creeks



Dolphins

Dolphins depend on predictable fish behavior.

Warming waters cause:

- Prey shifting deeper or northward
- Extended heat exposure → immune suppression
- Higher Vibrio levels → infection risk

Combined with rainfall-driven salinity crashes, temperature swings drive widespread skin lesion outbreaks.

Fish Communities

Different species have different thermal thresholds:

- Speckled trout struggle above 85°F (29°C)
- Flounder feeding declines above ~82°F
- Menhaden schools scatter in hot shallows
- Mullet experience stress during sharp temp shifts

Warm water also increases:

- Parasite activity
- Disease incidence
- Metabolic stress

Shellfish

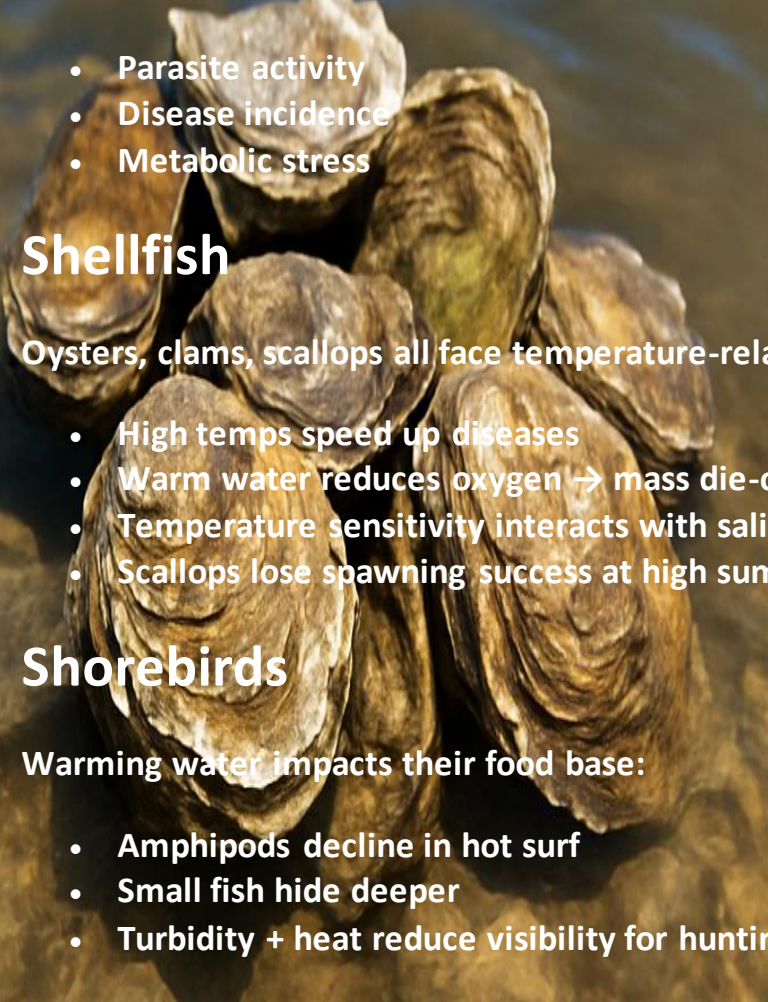
Oysters, clams, scallops all face temperature-related threats:

- High temps speed up diseases
- Warm water reduces oxygen → mass die-offs
- Temperature sensitivity interacts with salinity extremes
- Scallops lose spawning success at high summer temps

Shorebirds

Warming water impacts their food base:

- Amphipods decline in hot surf
- Small fish hide deeper
- Turbidity + heat reduce visibility for hunting



Habitat Impacts Under Combined Heat, Drought & Rainfall Extremes

Seagrass Meadows — Highly Temperature-Sensitive

The Outer Banks has the largest seagrass system on the Atlantic Coast, but it is now shrinking.

Heat + salinity + turbidity interact to cause collapse

- Heat $>86^{\circ}\text{F}$ → photosynthesis shuts down
- Sediment from storms blocks light
- Drought-driven high salinity adds stress
- Algal blooms worsen under warm water

Seagrass decline → sharp declines in:

- Blue crabs
- Shrimp
- Juvenile fish
- Sea turtle forage



Oyster Reefs

Oysters are extremely sensitive to temperature.

High temperature impacts:

- Speeds disease
- Reduces filtration
- Weakens shells
- Causes summer die-offs

Freshwater + heat → the most lethal combination.

Salt Marshes

Heat accelerates:

- Evaporation
- Plant desiccation
- Soil salinity increases
- Marsh edge erosion during warm-storm events

Marsh resilience declines under repeated thermal stress.



Soundside & Tidal Creeks

Shallow creeks heat extremely quickly.

Summer actions:

- Fish kills in creek “hot spots”
- Loss of dissolved oxygen
- Crab and shrimp mortality

Rainfall then adds:

- Freshwater plumes
- Nutrient loads that warm water favors
- Temperature instability



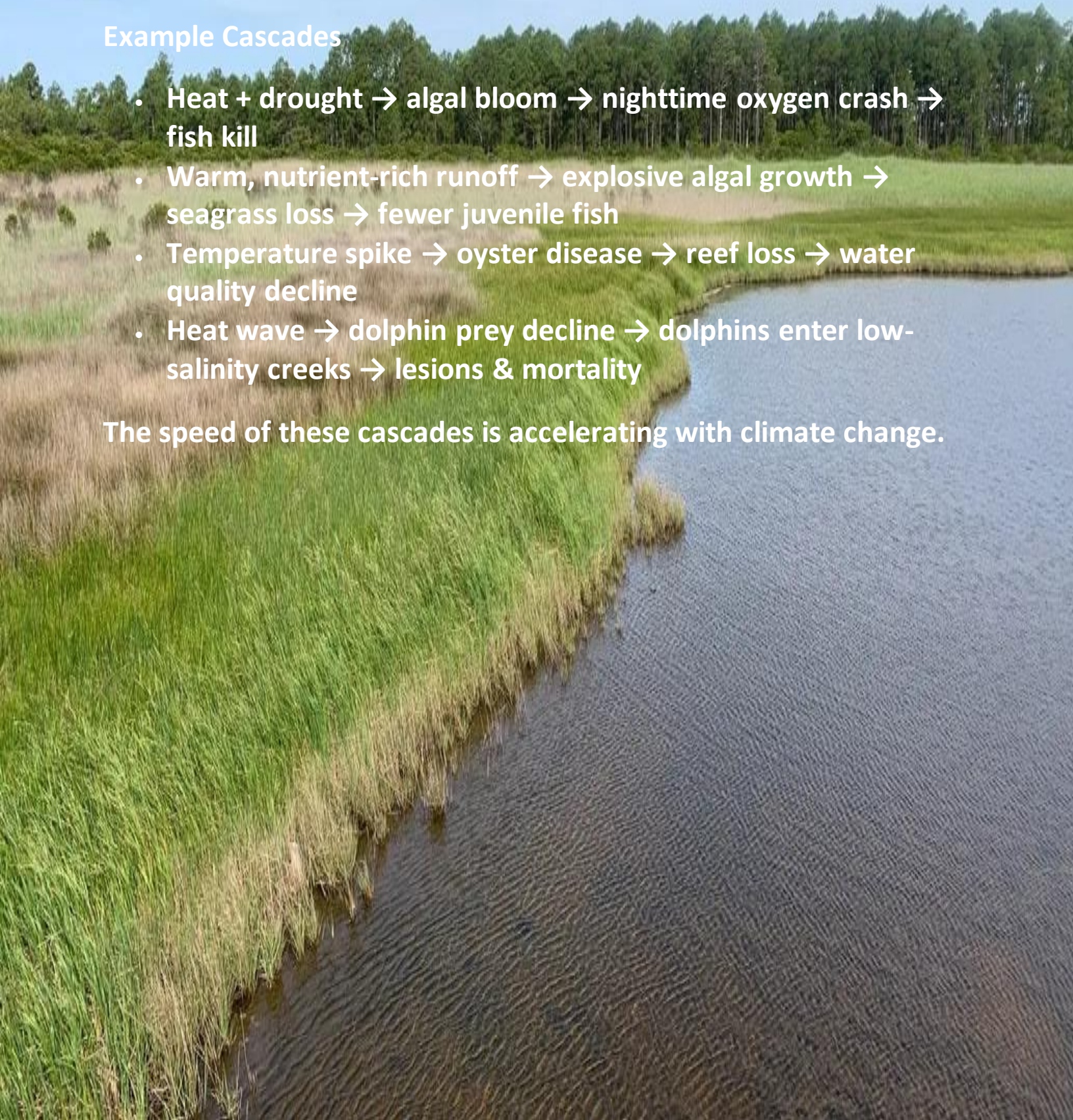
Ecological Cascades from Temperature, Drought & Rainfall

These climate drivers interact to create compounding effects.

Example Cascades

- Heat + drought → algal bloom → nighttime oxygen crash → fish kill
- Warm, nutrient-rich runoff → explosive algal growth → seagrass loss → fewer juvenile fish
- Temperature spike → oyster disease → reef loss → water quality decline
- Heat wave → dolphin prey decline → dolphins enter low-salinity creeks → lesions & mortality

The speed of these cascades is accelerating with climate change.



Human & Economic Implications

Fisheries

Temperature extremes affect:

- Shrimp migration timing
- Blue crab molting success
- Oyster survival
- Fish nursery productivity

Drought and heat years often mean poor harvests.

Recreation & Tourism

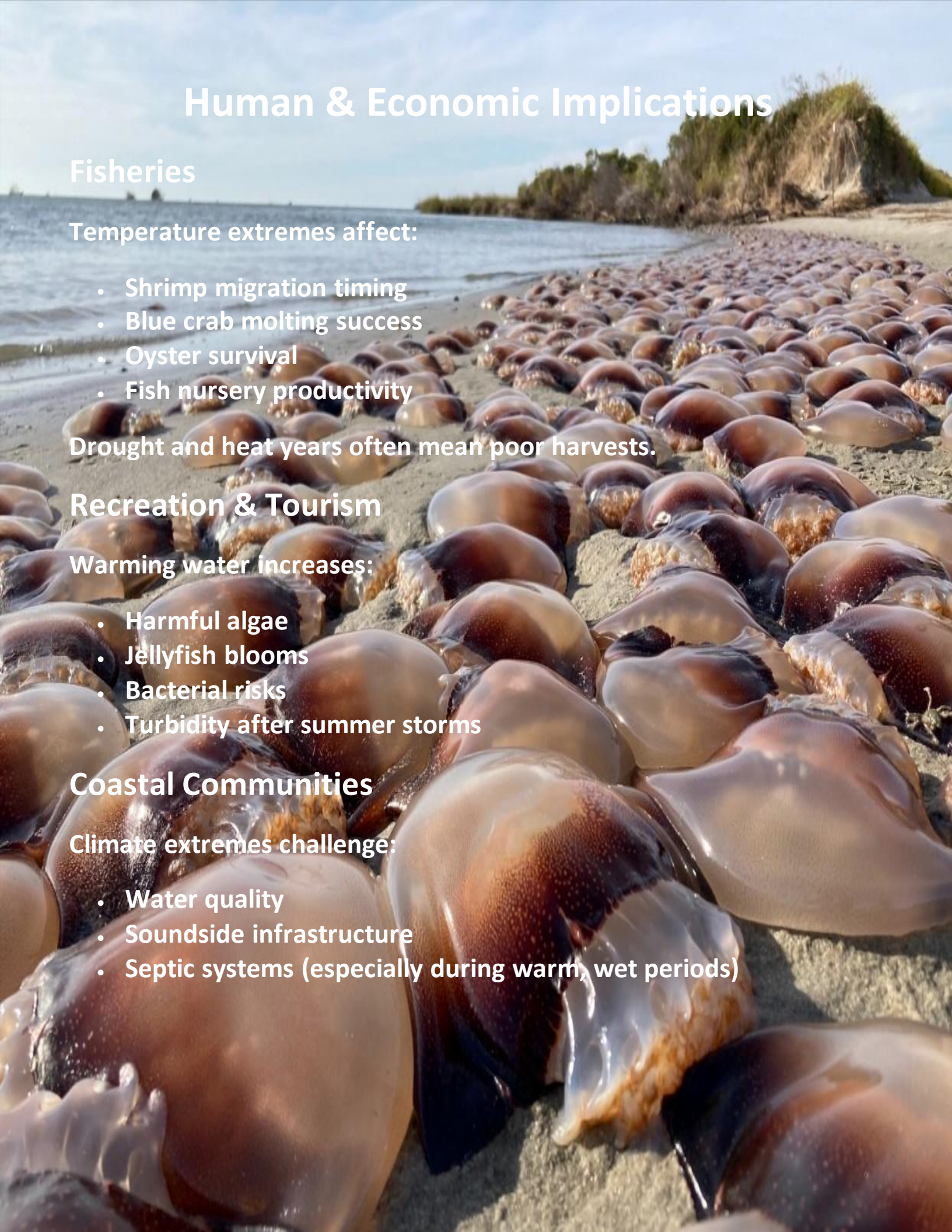
Warming water increases:

- Harmful algae
- Jellyfish blooms
- Bacterial risks
- Turbidity after summer storms

Coastal Communities

Climate extremes challenge:

- Water quality
- Soundside infrastructure
- Septic systems (especially during warm, wet periods)



Building Resilience in a Warming, Wetter, Drier, Hotter Future

Key Solutions

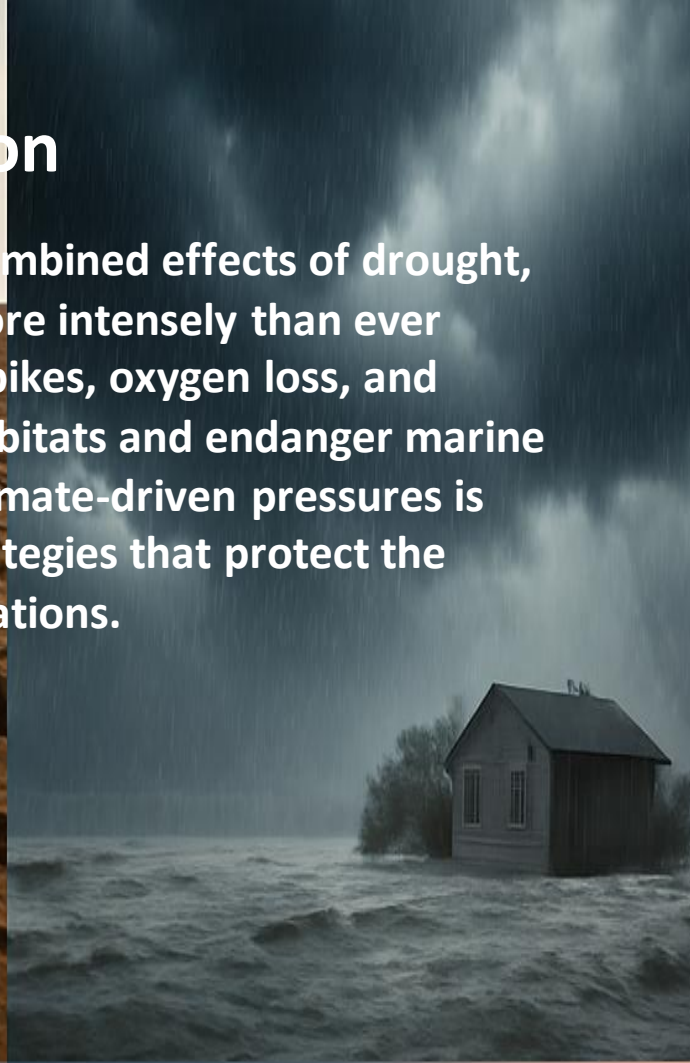
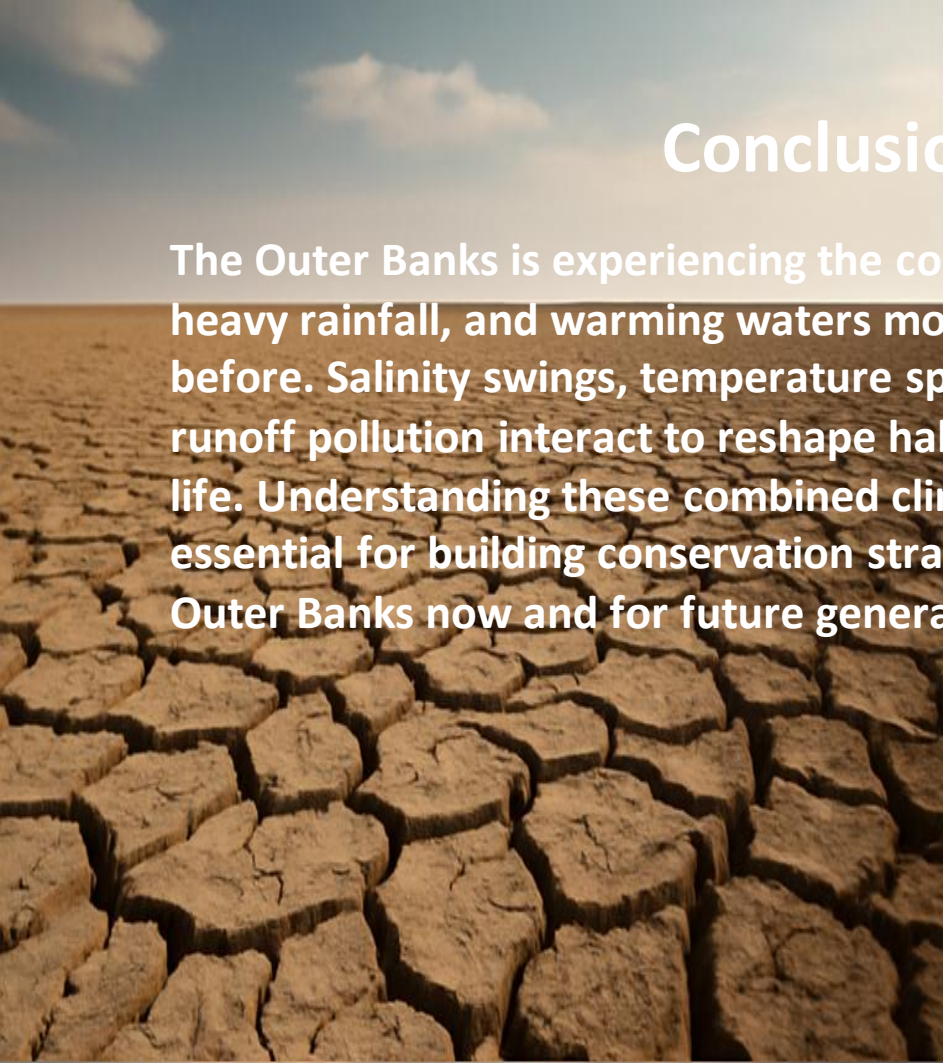
- Restore oyster reefs to filter warm, nutrient-rich water
- Replant seagrass to stabilize habitat and cool shallow areas
- Build living shorelines to buffer heat + runoff impacts
- Reduce fertilizer use across the Outer Banks
- Improve stormwater filtration
- Expand marsh migration corridors
- Increase monitoring of salinity + temperature + oxygen

These measures help stabilize a system facing rapid destabilization.



Conclusion

The Outer Banks is experiencing the combined effects of drought, heavy rainfall, and warming waters more intensely than ever before. Salinity swings, temperature spikes, oxygen loss, and runoff pollution interact to reshape habitats and endanger marine life. Understanding these combined climate-driven pressures is essential for building conservation strategies that protect the Outer Banks now and for future generations.



Did You Know?

- Some shallow Outer Banks creeks can heat up faster than the air—reaching 90–95°F on a sunny summer afternoon, creating underwater “hot spots” that fish literally cannot escape?
- A single healthy oyster can filter 50 gallons of water a day, but during heat waves their filtration rate can drop by more than half, allowing algae and bacteria to explode in warm water?
- Seagrass meadows are so sensitive to heat that an increase of just 4°F can shut down photosynthesis entirely—turning a vibrant nursery into a biological desert in less than 48 hours?
- Dolphins in the Outer Banks develop freshwater skin lesions after heavy rain because their skin literally begins to break down when salinity drops too quickly?
- Blue crabs time their molts to temperature—and when heatwaves arrive too early or too late, entire local crab populations can become “out of sync,” hurting both the species *and* the fishery?
- During droughts, salinity in some soundside areas rises so much that oysters experience the equivalent of a salt overdose, causing mass mortality even though they’re marine animals?
- Heavy rainfall doesn’t just freshen the water—it can drop sound temperatures by 10°F in a single afternoon, shocking fish, clams, and sea turtles that rely on stable thermal conditions?
- Sediment from just one big summer storm can block enough light to reduce seagrass growth for weeks, affecting everything from shrimp nurseries to juvenile flounder habitat?
- Warm stormwater runoff from roads and rooftops is often hotter than the sound itself, raising water temperatures and fueling bacteria and harmful algae?
- Juvenile sea turtles in the sound can be “trapped” in overheated pockets of water created during droughts, forcing them into dangerous shallow creeks in search of cooler refuges?
- A sudden drop in salinity after a tropical storm can cause oysters to experience osmotic shock, a physiological collapse similar to a plant suddenly being watered with distilled water?
- Climate change affects coastal communities too—warm, wet periods often overwhelm septic systems, sending nutrient-rich water directly into canals and soundside habitats?

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