National Fish and Wildlife Foundation

Sea Turtle Business Plan

March 2019

Purpose of a Business Plan

The purpose of a National Fish and Wildlife Foundation (NFWF) business plan is to provide a concise blueprint of the strategies and resources required to achieve the desired conservation outcomes. The strategies discussed in this plan do not represent solely the foundation's view of the actions necessary to achieve the identified conservation goals, but instead reflect the view of the many federal, state, academic, and organizational experts that were consulted during plan development. This plan is not meant to duplicate ongoing efforts, but rather to invest in areas where gaps might exist so as to support the efforts of the larger conservation community.

Acknowledgements

NFWF is grateful for the time, knowledge, and support provided by individuals and organizations that through input, review, discussion, and content, shared their expertise. In particular, thanks goes to the following individuals and networks who provided analysis, application, interpretation of data, and other technical assistance in preparation of this business plan: Barbara Schroeder, National Oceanic and Atmospheric Administration and Earl Possardt and AnnMarie Lauritsen from the U.S. Fish and Wildlife Service, for assistance in priority setting, funding support, draft review and population and recovery planning data; Bryan Wallace, Ecolibrium, Inc., the Laúd OPO network, and the 2018 NWA leatherback assessment expert working group for collating population data for the eastern Pacific and NWA leatherback populations and for coordination on implementation status to the Eastern Pacific Leatherback Business Plan; Alexander Gaos and members of ICAPO for population data compilation and coordination on implementation status to the eastern Pacific hawksbill; the team of experts that participated in drafting the NFWF Gulf Sea Turtle Strategy and 2017 update; and Carlos Diez, Puerto Rico Department of Natural Resources for assistance priorities for Puerto Rico leatherback beaches. In addition, NFWF wishes to thank key stakeholders from the Sea Turtle Program for ongoing partnership and counsel in maximizing NFWF's contributions to partnership goals and outcomes.

About NFWF

Chartered by Congress in 1984, the National Fish and Wildlife Foundation (NFWF) protects and restores the nation's fish, wildlife, plants and habitats. Working with federal, corporate and individual partners, NFWF has funded more than 4,500 organizations and generated a conservation impact of more than $4.8 billion. Learn more at *www.nfwf.org*.

Photo credit: All photographs provided by NFWF grantees funded through the Sea Turtle Program.

Background

For more than 20 years, the National Fish and Wildlife Foundation (NFWF) has been a leader in sea turtle conservation. Working with local communities, non-profit organizations, academic institutions, and local, state, and federal governments, NFWF has helped to reduce threats and conserve sea turtle populations throughout the Western Hemisphere. The 2019 sea turtle business plan builds on this foundation and updates priorities to incorporate new data on population status and threats to maximize conservation impact.

In partnership with the U.S. Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration (NOAA), NFWF's early role in sea turtle conservation focused on small grassroots efforts to protect critical nesting beaches. NFWF prepared its first sea turtle business plan in 2009 to advance a more comprehensive conservation strategy. This plan included seven Atlantic and Pacific sea turtle populations and focused on building grantee and partner capacity to facilitate population-level impact. As capacity and data increased through these investments, NFWF developed additional population-specific business plans in 2012 (Caribbean hawksbill), 2013 (eastern Pacific leatherback), and 2016 (eastern Pacific hawksbill). Together, these plans propelled a unified strategy for sea turtle conservation from 2008 through 2018.

In the past 10 years, NFWF has made significant progress – investing $4.9 million across 70 individual projects, leveraging an additional $6 million in local funding for a total conservation impact of $10.9 million[1]. These investments have saved thousands of hatchlings each year by protecting critical nesting habitat. New partnerships with the fishing industry have developed strategies that reduce the risk of incidental capture and mortality of sea turtles at sea. In addition, NFWF investments have supported the creation of global minimum data standards for sea turtle monitoring (SWOT Scientific Advisory Board 2011), global bycatch assessments (Wallace *et al.* 2013; Liles *et al.* 2017; Alfaro-Shigueto *et al.* 2018), and regional capacity networks and databases. These investments have, for the first time, allowed the conservation community to collect and share information at a population-scale and collaboratively prioritize threats and geographies for focused and effective conservation efforts.

In 2010, the Deepwater Horizon oil spill threatened thousands of sea turtles as they migrated to nesting beaches in the Gulf of Mexico. Two populations included in NFWF's 2009 sea turtle business plan – Kemp's ridley and northwest Atlantic loggerhead – were assessed as injured by the spill (DWH-NRDA 2016). NFWF responded immediately with rescue and rehabilitation, followed by longer term recovery investments through the Recovered Oil Fund for Wildlife and the Gulf Environmental Benefit Fund (GEBF). In 2012, NFWF modified the conservation strategies for Kemp's ridley and loggerhead sea turtles included in the 2009 business plan to principally focus conservation efforts on this geography.

NFWF's 2019 – 2029 sea turtle business plan builds on progress to date by focusing, unifying and guiding investments in sea turtle conservation to those populations where NFWF has the greatest opportunity to make conservation gains. The plan applies lessons learned to stabilize and increase endangered and threatened sea turtle populations in the Western Hemisphere and offers a catalyst for change globally on difficult issues such as bycatch and coastal development.

[1] Investments made as a result of the BP Deepwater Horizon oil spill are not included. These spill-related investments, in excess of $10M, are to reduce bycatch and conserve miles of high quality nesting beaches.

Conservation Need

Once abundant in tropical and temperate oceans, many global sea turtle populations have declined significantly as a result of decades of intense exploitation, habitat alteration, marine pollution, and incidental capture in fishing gear (bycatch) (Wallace *et al.* 2011; Mazaris *et al.* 2017). Six of seven sea turtle species that are found in U.S. waters remain listed as vulnerable, endangered, or critically endangered throughout at least a portion of their circumglobal range.

Sea turtle conservation has inherent challenges: sea turtles are long-lived, mature late in life in habitats that are difficult to monitor, and migrate each year across a sea of political boundaries and natural and human-made threats. Their complex life cycle includes both terrestrial and marine phases, each facing very different threats.

Sea turtles spend a vast majority of their lives at-sea, inhabiting a wide range of ocean habitats from near-shore waters adjacent to nesting beaches, to large-scale oceanic migrations that can span thousands of miles. Sea turtles face numerous threats at sea including exposure to pollution (Wilcox *et al.* 2018) and vessel strikes (Barco *et al.* 2016), but perhaps the single greatest threat is from bycatch, which occurs when turtles are incidentally caught in fishing gear (Wallace *et al.* 2010a; Wallace *et al.* 2013; Lewison *et al.* 2014). While gains have been made to address in-water threats particularly in large commercial fisheries that utilize trawls (Haas 2010) and longlines (Gilman & Huang 2017), the sheer volume of artisanal gillnets used in coastal waters around the globe make small-scale fisheries potentially one of the greatest causes of sea turtle mortality (Stewart *et al.* 2010; Lewison *et al.* 2014). A recent study revealed that in just 43 small-scale fishing ports in southeastern Pacific, over 46,000 sea turtles are incidentally caught in fishing gear each year, with as many as 16,000 lethal interactions (Alfaro-Shigueto *et al.* 2018).

Sea turtles spend a small portion of their lives on land, but this terrestrial phase is critical since reproductively mature females will return to their natal beaches to lay eggs deep in the sand. Females will often lay multiple nests and can produce hundreds of hatchlings in a single season. While the majority of those hatchlings will never reach adulthood even under natural conditions, a myriad of anthropogenic threats can significantly decrease survival. Terrestrial threats include direct loss from poaching and predation, as well as coastal development that brings light pollution and beach alterations that can prevent females from laying nests and disorient hatchlings in their journey from the nest to the sea. Emerging climate-related threats may further decrease hatchling survival as nests are inundated and washed away due to sea level rise, and rising temperatures can lead to skewed sex ratios that produce disproportionately female populations (Mainwaring *et al.* 2017).

Since sea turtles are so wide ranging and face very different threats by region and life stage, they are particularly challenging to manage at the species level. While there are seven different species of sea turtles globally, each species was recently further divided into population segments based on biological factors such as location of nesting sites, genetic stock delineation, and in-water distributions. This has allowed managers to focus conservation strategies at a scale that is relevant to regional threats and has supported assessments at the subspecies or population level. Sea turtle managers refer to these subspecies units or populations as Regional Management Units (RMUs) (Wallace *et al.* 2010b). This business plan focuses on four specific populations or RMUs. These terms are used interchangeably throughout this document.

Focal Populations

Eastern Pacific Leatherback (EP leatherback; *Dermochelys coriacea*) have nesting strongholds in Mexico, Nicaragua, and Costa Rica, and migrate throughout the eastern Pacific basin south to Chilean waters. The population has experienced a 95% decline since the 1980s, and with only 500 adult females remaining, it is among the world's most endangered RMUs (Wallace *et al.* 2011; Mazaris *et al.* 2017). Despite a renewed focus on the population spurred by NFWF investments, coordinated data gathering and research efforts across their range has revealed that the population will continue to experience a steep decline unless threats are significantly abated (Laúd OPO Network, in prep). This declining trend is thought to be attributed primarily to intensive longline and gillnet fishing effort resulting in high rates of bycatch throughout its range (Santidrián Tomillo *et al.* 2017; Alfaro-Shigueto *et al.* 2018). Threats on nesting beaches include a lack of beach protection and both direct (*e.g.*, altered nesting habitats) and indirect effects (*e.g.*, increased predation of nests by dogs, raccoons) of development encroachment.

Eastern Pacific Hawksbill (EP hawksbill; *Eretmochelys imbricata*) are found in coastal waters on the Pacific coast from Mexico to Chile. Only an estimated 700 adult females remain in the entire population (Gaos *et al.* 2017a). As recently as 2007, EP hawksbills were considered extremely rare in the eastern Pacific (Mortimer & Donnelly 2008), but the discovery of several important nesting and foraging sites led to a coordinated multilateral effort to assess the population. Seven primary nesting beach complexes have since been identified (Gaos *et al.* 2017a) and recovery targets have been established. Despite these recent discoveries, this population remains one of the most endangered RMUs in the world (Wallace *et al.* 2011). Unlike most other sea turtle species, EP hawksbills spend the majority of their lifecycle in nearshore waters (Gaos *et al.* 2017b), making them particularly vulnerable to bycatch in coastal fisheries such as lobster gillnet (Liles *et al.* 2017) and illegal blast fishing operations (Liles *et al.* 2011). In addition, while previous investments have successfully secured most nesting beaches, egg poaching remains a concern.

Northwest Atlantic Loggerhead (NWA loggerhead; *Caretta caretta*) nest in the southeastern U.S. and northern Caribbean, with about 90% of nesting taking place in Florida. Over the course of their complex life cycle, NWA loggerheads migrate throughout the Gulf of Mexico, along the eastern seaboard of U.S., and east across the Atlantic Ocean. The population has experienced a steady increase since 2007 (Ceriani & Meylan 2017), but these gains are clearly linked to extensive and dedicated conservation actions that must continue in order secure the population and meet long-term population recovery targets set by the USFWS and NOAA (NMFS & USFWS 2008). Damage from the Deepwater Horizon oil spill further threaten the recovery of NWA loggerheads (Lauritsen *et al.* 2017). Efforts to mitigate for this damage includes addressing in-water threats from trawl fisheries and vessel strikes, in addition to reducing light pollution, predation, and coastal development on nesting beaches.

Prospective Focal Population

Northwest Atlantic Leatherback (NWA leatherback; *D. coriacea*) is included as a prospective focal population as while the population is in decline and threats have been identified, more information is needed to set conservation goals.

NWA leatherbacks nest in large numbers in French Guiana, Suriname, and Trinidad, and in smaller numbers at nesting sites across the Caribbean, including Florida, the U.S. Virgin Islands, and Puerto Rico (NWA Leatherback Working Group 2018). NWA leatherbacks are ocean migrators traveling from their Caribbean nesting sites north along the U.S. eastern seaboard to Canada and throughout the Atlantic (*e.g.*, James *et al.* 2005; Eckert *et al.* 2006). While the population was previously thought to be increasing (Tiwari *et al.* 2013), a recent NFWF supported population assessment revealed a 60% decline in the NWA leatherback population from 1990 to 2017, with declining trends across most nesting beaches for which data were available (NWA Leatherback Working Group 2018). The most important threat to the RMU is from bycatch in coastal gillnets operated near nesting beaches in the Guianas-Trinidad region (Bond & James 2017), but bycatch mortality from fixed gear fisheries in New England and Canada have emerged as a growing threat in northern foraging grounds (Hamelin *et al.* 2017). Pressures from coastal development such as light pollution, beach alterations, and human-enhanced predation also pose significant concerns, particularly on U.S. beaches impacted by recent hurricanes. In order to consider NWA leatherbacks as a focal population, additional investments are needed to: 1) establish survivorship models, 2) support continued development of a regional data sharing network, 3) develop a regional bycatch reduction strategy for the Guianas-Trinidad region, and 4) support efforts to identify and secure important secondary nesting beaches in Puerto Rico and other places.

Current Conservation Context

NFWF benefits from a wide base of federal, state, and nonprofit partners that have been working towards shared goals in sea turtle conservation for nearly 20 years. Significant progress has been made protecting important nesting beaches for all four populations. Successes on nesting beaches have allowed the conservation community to turn its attention to more diffuse threats — such as coastal development and bycatch — that are cumulatively impacting populations. Previous NFWF investments in population-scale planning, prioritization, implementation, and monitoring have elevated the sea turtle conservation community to tackle these broad-ranging challenges, but there is much to be done to gain the traction needed to stabilize and eventually reverse population declines.

Eastern Pacific Region

NFWF has invested in building capacity and developing networks within the eastern Pacific region that have enabled population-wide conservation planning and implementation. The Eastern Pacific Hawksbill Initiative, known in Spanish as Iniciativa Carey del Pacífico Oriental (ICAPO), was established in 2008 and consists of over 85 members from the U.S. to Chile. Red Laúd del Océano Pacífico Oriental, known as Laúd OPO, the eastern Pacific leatherback conservation network, was established in 2016 and currently includes over 70 members from the U.S. to Chile. Through the coordinated efforts of these networks, nearly all significant nesting beaches are protected and regularly monitored. In addition, the networks have conducted region-wide bycatch assessments in order to identify bycatch hotspots for prioritized investment in the development, testing, and implementation of bycatch reduction strategies. NFWF will

continue to partner with both networks to drive population level change in the eastern Pacific region.

Northwest Atlantic Region

There is significant capacity for site-based conservation throughout the Gulf of Mexico and across the Caribbean. NFWF will leverage this capacity and partner with conservation organizations and state and federal governments in the conservation of NWA loggerhead and leatherback sea turtles.

Through the GEBF, NFWF has supported significant collaboration around the conservation of NWA loggerheads in the Gulf of Mexico leading to an unprecedented amount of investment in assessment, regulation, research, monitoring, and mitigation. As the trustees for the Deepwater Horizon oil spill continue to identify strategies to mitigate for the damages from the spill, NFWF will work closely with NOAA, the Gulf states, and other trustee partners to coordinate investments in habitat protection and restoration of nesting beaches, coupled with the adoption of, and compliance with, turtle excluder devices (TEDs) in the shrimp trawl fleet.

A recent population assessment indicated a steep decline in the NWA leatherback population, and identified bycatch in the Guianas-Trinidad region as a principal threat to the population (NWA Leatherback Working Group 2018). Additional work is needed to evaluate bycatch in the region and develop a comprehensive bycatch strategy. The population assessment also revealed a declining population trend among nesting beaches in the northern Caribbean. Within the U.S. Caribbean, however, long-term data indicate relatively stable or even increasing trends among several beaches in Puerto Rico, which may represent an important stronghold of nesting activity in the northern Caribbean. Recent hurricane damage has destroyed dune structure and vegetation and increased the feral dog population, which require coordinated investments to recover these important nesting sites and promote a 'turtle-safe' rebuild of the coastline. While there are long-standing data gathering networks, additional investment is also needed to continue to strengthen capacity to regularly share data and support population level monitoring.

NFWF, guided by this updated business plan, will complement regional, population-scale threat reduction in close coordination with the USFWS and NOAA. NFWF will focus on actions and investments at the local scale and will work to increase capacity, coordination, and potential solutions at a broader scale.

Conservation Outcomes

The long-term outcome of this business plan is to secure recovery trajectories of four sea turtle populations in the Western Hemisphere by: 1) reducing in-water mortality, 2) increasing nesting beach productivity, and 3) ultimately increasing the number of nesting females.

The conservation outcomes in the business plan are reflective of the sea turtle's complex life cycle (Figure 1). As a long-lived, highly migratory species that spends the vast majority of its life in the ocean, it is challenging to monitor sea turtles in a manner that can reliably detect population-level changes over a timeframe that is commensurate with conservation investments. Sea turtles are typically assessed by counting the number of nests laid on nesting beaches, which can be converted into an estimate of the total number of nesting females as a proxy for population abundance. However, hatchlings may take anywhere from 15–45 years to reach sexual maturity, which means investments made to increase

hatchling or juvenile survival today will take decades to manifest into an observable increase in the overall population.

Despite these challenges, it is possible to produce a meaningful estimate of how investments made in the 10-year period of this business plan will contribute to the long-term viability of a population. Reproductive values (RV) can be used as a means of comparing the impact of mortality across different life stages, each of which may face very different threats. The RV represents the potential of an individual to contribute offspring to future generations, thus a higher RV corresponds to an increased likelihood to survive and reproduce (NMFS & USFWS 2008).

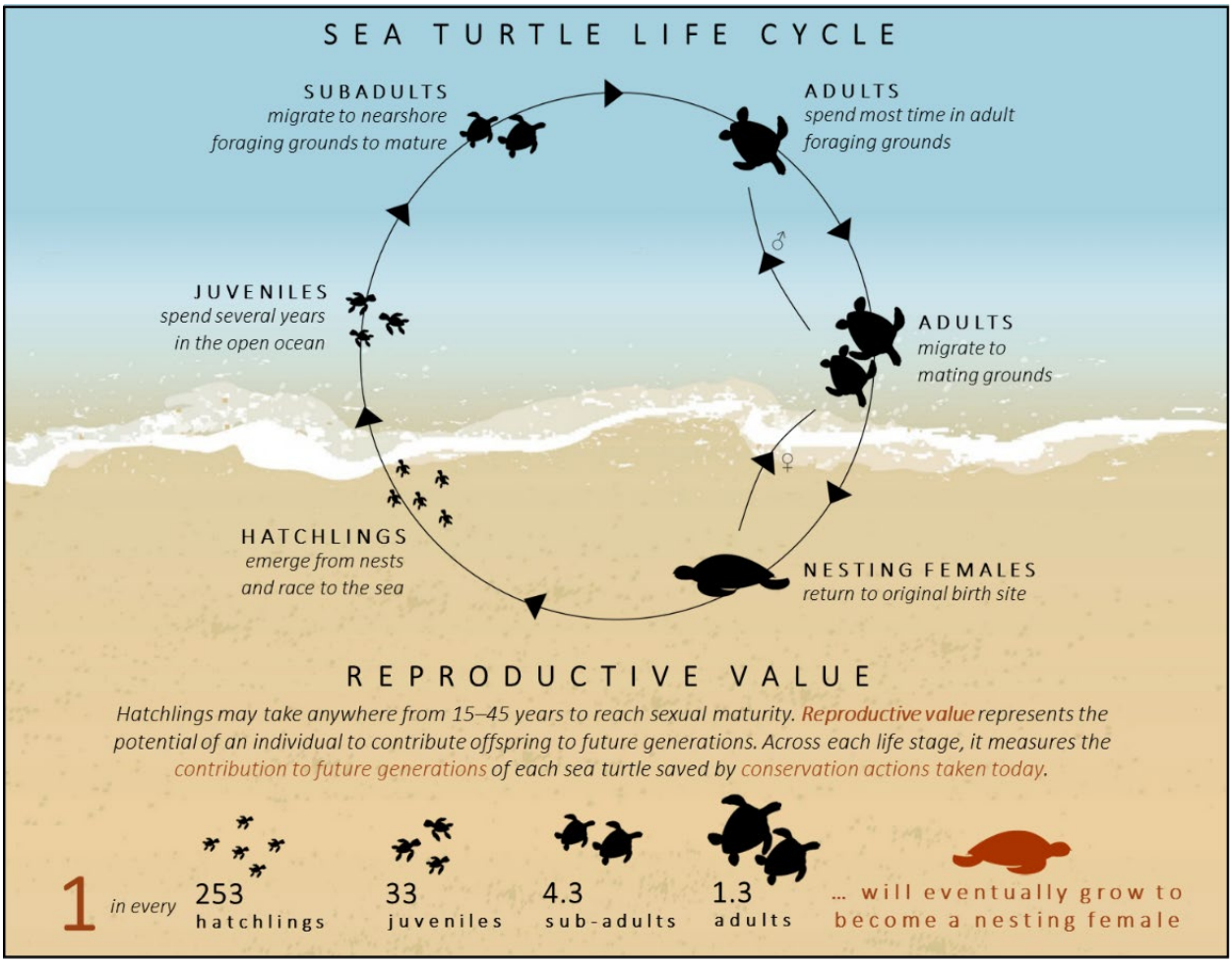

Figure 1. Generalized sea turtle life cycle with relationship to approximate reproductive values. Values are based on the life cycle of the northwest Atlantic loggerhead.

The following long-term outcomes are designed to help put each sea turtle RMU on a recovery trajectory over one generation in terms of relative RV (Table 1). Progress towards long-term outcomes will be evaluated based on 10-year business plan goals to maintain or increase hatchling production on priority nesting beaches and increase in-water survival across life-stages. For the EP leatherback population, the availability of long-term mark-recapture data have allowed researchers to develop robust population models that can better estimate population trends by incorporating in-water survivorship. Within the first three years of this business plan, NFWF will evaluate the success of this approach and support analyses needed to establish similar survivorship based goals for all focal populations if warranted.

Table 1. Outcomes and goals associated with focal populations[2].

Focal Populations	10-Year Business Plan Goals	Long-term Outcomes
Eastern Pacific Leatherback *Dermochelys coriacea*	Increase survivorship of adult females by 20% by 2029.	By increasing in-water survivorship and hatchling production at these levels during the next 10 years, we expect to add 100 new adult females and help stabilize the eastern Pacific leatherback population over one generation (30 years).
	Produce 270,000 hatchlings across fifteen priority beaches by 2029.	
Eastern Pacific Hawksbill *Eretmochelys imbricata*	Increase juvenile population to 1,000 individuals at five in-water index sites by 2029.	By increasing in-water survivorship and hatchling production at these levels during the next 10 years, we expect to add 500 new adult females and secure a recovery trajectory for the eastern Pacific hawksbill population within one generation (20 years).
	Produce 400,000 hatchlings across seven priority beaches by 2029.	
Northwest Atlantic Loggerhead *Caretta caretta*	Prevent 4,000 sea turtles from being taken as bycatch in the Gulf of Mexico shrimp trawl fleet by 2029.[3]	Address a portion of the damages sustained by from the Deepwater Horizon oil spill. By increasing hatchling production, we expect to add 1200 new adult females and help secure a recovery trajectory for the northwest Atlantic loggerhead population within one generation (50 years).
	Produce 300,000 additional hatchlings across Florida beaches by 2029.	

2 NWA leatherbacks, a prospective focal population, is expected to be added once conservation outcomes and goals have been established.

[3] This goal will only be pursued if and when skimmer trawl, pusher-head trawl, and wing net fishing vessels are required to use Turtle Excluder Devices (TEDs). A decision on the proposed rule is anticipated in Fall, 2019.

Geographic Focus

Strategic investment in priority geographies will allow NFWF to maximize shared outcomes for focal populations and drive change on global threats affecting all sea turtle populations. NFWF will focus investments in places where there are significant opportunities to enhance and secure nesting beach strongholds and work with fishing communities to reduce sea turtle mortality in bycatch hotspots (Table 2). By building institutional capacity to implement conservation actions locally, while also supporting coordinated regional networks, many of the priority nesting beaches also serve as important long-term monitoring sites to track nesting behavior, hatchling production, and other important demographic information.

NFWF anticipates that a significant share of funding will be deployed in priority geographies based on unique opportunities to maximize multiple goals and outcomes. However, since bycatch reduction strategies for a given fishing gear type are often transferable between regions, NFWF will continue to support bycatch reduction activities in those geographies most appropriate for testing, which may be outside of the areas listed below.

Table 2. Conservation strategies for each population by geography.

Sea Turtle Populations	Bycatch Reduction	Nesting Productivity	Network Capacity
Focal Populations			
Eastern Pacific Leatherback (Figure 2)	15 focal fishing communities from Mexico to Chile	15 priority nesting beaches in Mexico, Nicaragua, and Costa Rica	Laúd OPO regional network with members from U.S. south through Chile
Eastern Pacific Hawksbill (Figure 3)	6 focal fishing communities in El Salvador and Nicaragua	7 priority nesting beaches in El Salvador, Nicaragua, and Ecuador	ICAPO regional network with members from U.S. south through Ecuador; includes 5 in-water monitoring sites
Northwest Atlantic Loggerhead (Figure 4)	Focal fishing communities with active shrimp trawl permits in Texas, Louisiana, Mississippi, Alabama, and Florida, U.S.	37 priority nesting beaches in Florida, U.S.	Streamlined data collection in coordination with GEBF and the Deepwater Horizon Natural Resource Damage Assessment Trustee Council
Prospective Focal Population			
Northwest Atlantic Leatherback (Figure 5)	5 prospective fishing grounds in Trinidad and Tobago, French Guiana, and Suriname	7 prospective nesting beaches in Puerto Rico, U.S.	Network for bycatch reduction and data sharing in the Guianas-Trinidad region

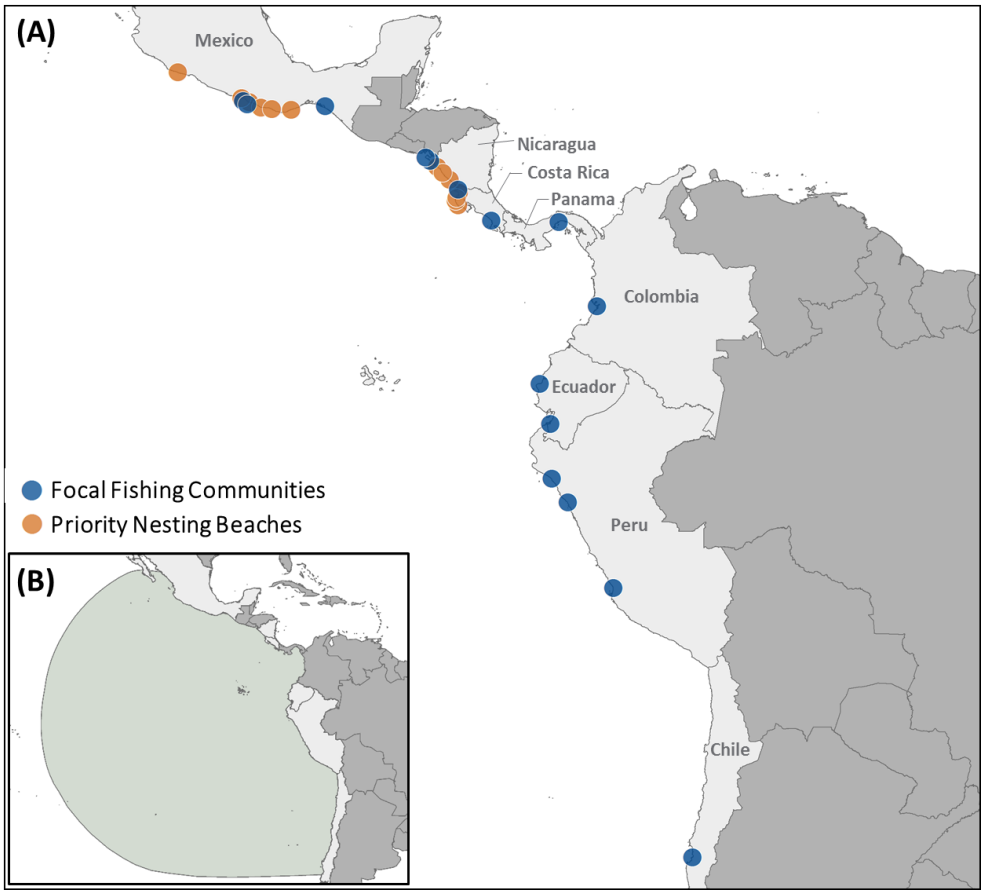

Figure 2. Eastern Pacific leatherback priority geographies. (A) Focal fishing communities (blue dots, n = 15) and priority nesting beaches (orange dots, n = 15). (B) Range of the eastern Pacific leatherback regional management unit.

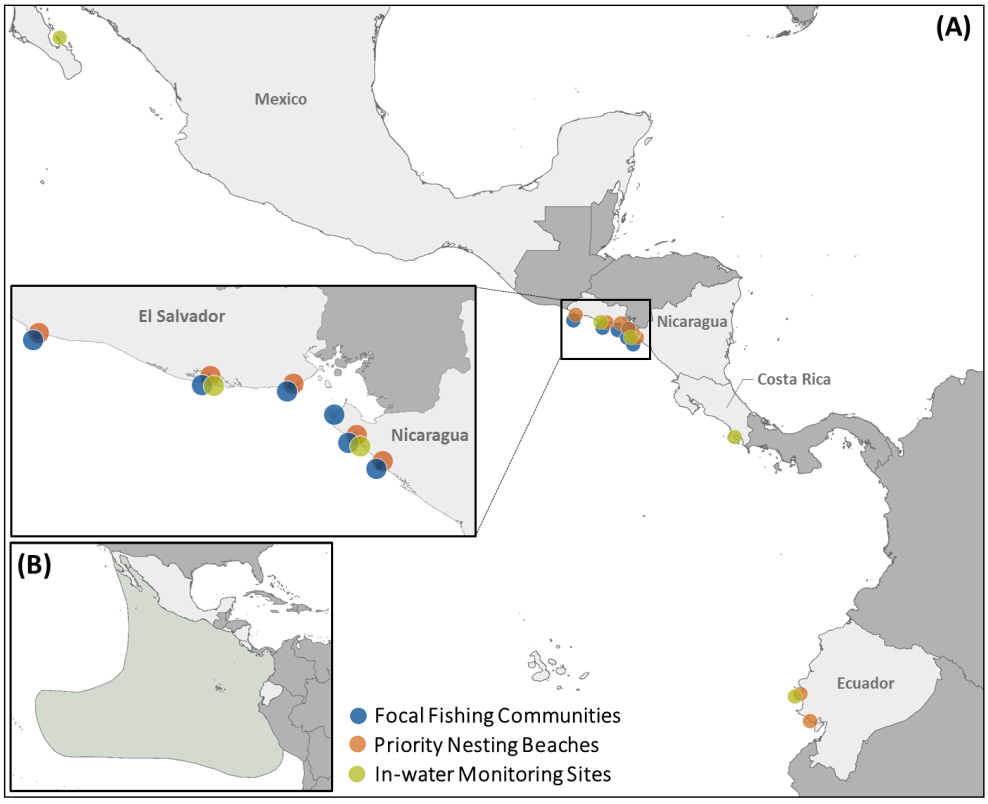

Figure 3. Eastern Pacific hawksbill priority geographies. (A) Focal fishing communities (blue dots, n = 6), priority nesting beaches (orange dots, n = 7), and in-water monitoring sites (green dots, n = 5); inset details sites in El Salvador and Nicaragua. (B) Range of the eastern Pacific hawksbill regional management unit.

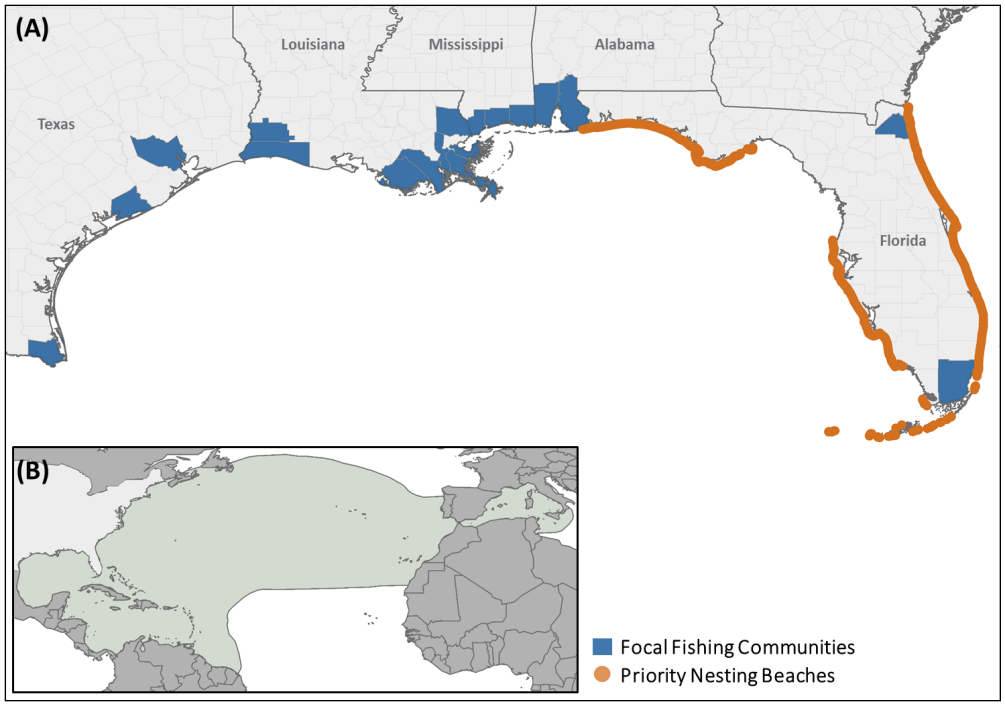

Figure 4. Northwest Atlantic loggerhead priority geographies. (B) Focal fishing communities with the highest density of shrimp trawl fishing permits (blue shading) and priority nesting beaches in Florida (orange, n = 37). (B) Range of the northwest Atlantic loggerhead regional management unit.

Prospective Focal Species

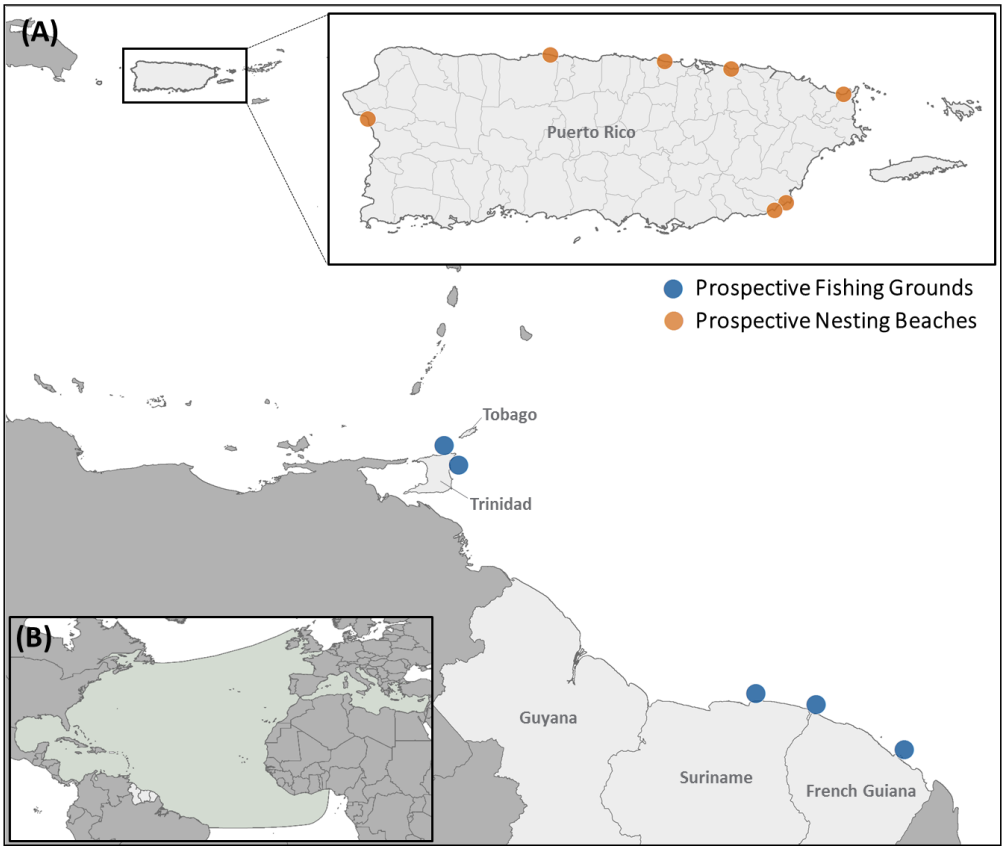

Figure 5. Northwest Atlantic leatherback priority geographies. (A) Prospective fishing grounds adjacent to large nesting beaches in the Guianas-Trinidad region (blue dots, n = 5) and – within the inset - prospective nesting beaches in Puerto Rico (orange dots, n = 7). (B) Range of the northwest Atlantic leatherback regional management unit.

Implementation Plan

The sea turtle business plan focuses on conservation strategies that build on the progress made since 2009. Strategies under this plan will reduce threats on nesting beaches to increase the probability that hatchlings become juveniles, while simultaneously decreasing sources of in-water mortality so juveniles have an increased probability of becoming reproductive adults, and reproductive adults have an increased probability of reproducing in successive years.

The key strategies to be implemented under this business plan include: 1) reducing the threat of bycatch to sea turtle populations, particularly from gillnets, and trawl fisheries, and 2) reducing threats on nesting beaches to maintain or increase hatchling production. The plan includes a limited set of high-priority network coordination and management actions that may not directly reduce threats, but are necessary to support conservation at the population-scale (*e.g.,* training, monitoring). These strategies guide investments to enhance the capacity of regional partners to deliver effective conservation planning, programs, and partnerships at increasing geographic scales, and to effectively engage stakeholders critical to achieving the plan's conservation goals. A logic model depicting these strategies, associated interim outcomes, and their contribution to business plan goals is provided in Figure 6.

Strategy 1: Promoting Sustainable Fishing Communities through Reduced Sea Turtle Bycatch in Focal Fisheries

As turtles migrate across ocean basins and spend the majority of their life in-water, interactions with fishing gear is a pervasive threat for all populations throughout their range. There has been success in the use of bycatch reduction devices such as TEDs, which if used properly can be 97% effective in preventing mortality in trawl gear (NMFS 2014), and circle hooks which can dramatically reduce the frequency and severity of sea turtle bycatch in longline gear.

While efforts to increase compliance with established solutions for large-scale, industrial fisheries are needed, work is also required to understand the drivers and opportunities to reduce bycatch in small-scale fisheries and to develop viable gear alternatives and adjustments in fishing practices that will reduce bycatch and sea turtle mortality. Small-scale and artisanal fisheries are far more prevalent than larger-scale industrial fishing operations and therefore can have the same or potentially even greater impact on sea turtle mortality (Peckham *et al.* 2007).

1.1 Accelerate Innovation of Economically Neutral Sea Turtle Bycatch Reduction Strategies

NFWF will support bycatch reduction including gear development and adjustments to current fishing practices (*e.g.*, soak times) in fisheries that do not yet have safer fishing solutions available — initially focusing on gillnets. Most of the activity in this step is developing prototypes and very early testing to evaluate performance in a general fishing practice. NFWF will evaluate potential modifications to gear and fishing practices both for ability to reduce sea turtle bycatch, and how well the gear/practice maintains a neutral or greater profit margin for fishermen, including low start-up and maintenance costs.

1.2 Support Localized Testing in Focal Fisheries

The initial 2009 NFWF business plan invested in rapid bycatch assessments across several population ranges to maximize the impact of bycatch reduction efforts. Once viable solutions to reduce turtle

bycatch are identified (see Strategy 1.1), NFWF will support the adoption and testing of gear innovations and best practices in these prioritized bycatch hotspots (Figures 2-5). Each fishery operates in a unique socioecological setting, which requires practitioners to customize best fishing practices and gear modifications to accommodate local conditions. Customizing and testing the bycatch reduction strategies within a prioritized fishery allows for conservation gains to begin even before widespread uptake, and creates leaders within the fishing community that can encourage broader adoption.

1.3 Foster Uptake and Management

Once viable solutions are achieved, NFWF will work with managers and local networks to increase the adoption of, and compliance with, safer gear options or best fishing practices. Possible investments under this sub-strategy could include fishermen training, gear exchange programs, fishery observers, and enhanced reporting and enforcement.

1.4 Explore Non-Gear Management Strategies for Reducing Bycatch

NFWF will assist local governments, nonprofit organizations, and the fishing community to understand hotspots for bycatch and to evaluate when additional solutions are needed beyond available gear modifications or fishing practices. Example activities may include: surveying fishing communities to understand fishing practices, assessing drivers of non-compliance, and evaluating economically sensitive options to reduce bycatch; bycatch assessments to determine rates of fishing gear interactions and mortality; and determining where turtles and fisheries overlap in space and time. For instance, this information may result in time–area closures for high turtle use areas or a gear-type closure for an area where the bycatch rate is unsustainable and there is no safer gear alternative.

Strategy 2: Nesting Beach Habitat Restoration, Protection, and Management

Less than one egg in every nest laid will survive to adulthood. Therefore, maximizing the number of sea turtle hatchlings that survive and enter the ocean is vital to stabilize populations and increase recovery trajectories. Nesting beaches are threatened in both number and quality. Beaches are being lost as the intensity of storms increases and from sea level rise in combination with the presence of hard structures like seawalls and roads that prevent beach migration landward. Development reduces the quality of beaches for nesting through light pollution, enhanced predation (particularly non-native predators), and poaching. Even direct disturbances from recreational fishing, boating, and hotels diminish nesting habitat quality as beaches are nourished, altered, and/or developed to support tourism.

2.1 Protect and Restore Critical Nesting Beaches

While sea turtles spend a majority of their time in-water, they return to specific nesting beaches to lay their eggs. Losing the nesting beach means losing future generations of sea turtles. Therefore, NFWF will help critical nesting beaches through enhanced protection, employing acquisition and conservation easement options, best practices for beach nourishment, and direct dune and beach restoration. The majority of these activities are anticipated for domestic nesting beaches (Figures 2-5).

2.2 Protect Nests from Predation and Poaching

Even protected beach habitat can produce a less than optimal number of hatchlings if illegal egg poaching and unsustainable predation - often enhanced by human activities – is left unchecked. Previous NFWF investments in these populations has reduced poaching and predation rates from nearly 100% of nests laid, to less than 5% in some cases. NFWF will continue to support these efforts on priority beaches (Figures 2-5) to achieve and maintain nest loss under 10% of nests laid, which is considered natural. In some areas of the eastern Pacific where populations are severely threatened by

poaching or sea level rise, NFWF will support conservation networks to collect eggs and maintain hatcheries while working to increase *in situ* nesting.

2.3 Enhance the Quality of Nesting Beaches

On more developed beaches, including those in Florida and Puerto Rico, NFWF will support efforts that enhance habitat quality on nesting beaches. Activities may include efforts to work with hotels, land developers, and other beach users to develop, disseminate, and implement best practices to reduce light pollution and remove obstructions from beaches. These actions will help reduce nesting female and hatchling disorientation caused by light pollution, while also creating a path that will increase the chances that the next generation will make it safely to the sea.

Strategy 3: Building and Maintaining Capacity for Population-Scale Conservation

3.1 Support Regional-Scale Networks

After over 20 years of local efforts to monitor and protect sea turtles at the scale of a single beach, partners from all sectors across RMUs have learned that true conservation gains are needed at the population scale. To achieve ambitious recovery goals, regional networks are necessary to not only allow for information sharing, but also to support coordinated conservation implementation. Previous NFWF investments have supported the establishment of two such networks, ICAPO (focused on the conservation of EP hawksbills) and Laúd OPO (focused on the conservation of EP leatherbacks). In just five years, these networks have established standardized data collection and centralized data housing, coordinated planning, research and equipment sharing, and provided a clear unified voice from the U.S. to Chile in international policy bodies. NFWF will invest in activities that aim to scale up restoration outcomes through enhanced partnership and coordination across organizations at broader regional- and population-scales. Example activities include improving processes for networked communications, operations, management, and monitoring at the population-scale, technical training and equipment for standardized data collection, and venues for practitioners to collaborate, share case studies, lessons learned, credible guidance, and other resources in support of conservation activities.

3.2 Catalyst for Applied Research and Delivery of Technical Assistance

Efforts to address the needs of one threat or geography, such as a rapid bycatch assessments, can be readily adapted by other locations and even networks. NFWF will serve as a catalyst for developing new ways to solve global sea turtle conservation problems. As an example, NFWF supported the development of a population model for the EP leatherback population that will allow managers to track survivorship more accurately and establish more meaningful targets in conservation. NFWF will invest in the development of similar population models for each of the populations included in this plan to better monitor the impact of bycatch reduction.

Delivery materials and mechanisms are needed to communicate these breakthroughs in research and management advancements to local, regional, and global forums to have the greatest impact. A significant portion of sea turtle threats are caused by preventable human activities. Resources for education, outreach, and technical assistance will be a critical part of recruiting fishermen, coastal community members, private homeowners, and managers to adopt and sustain conservation practices over time.

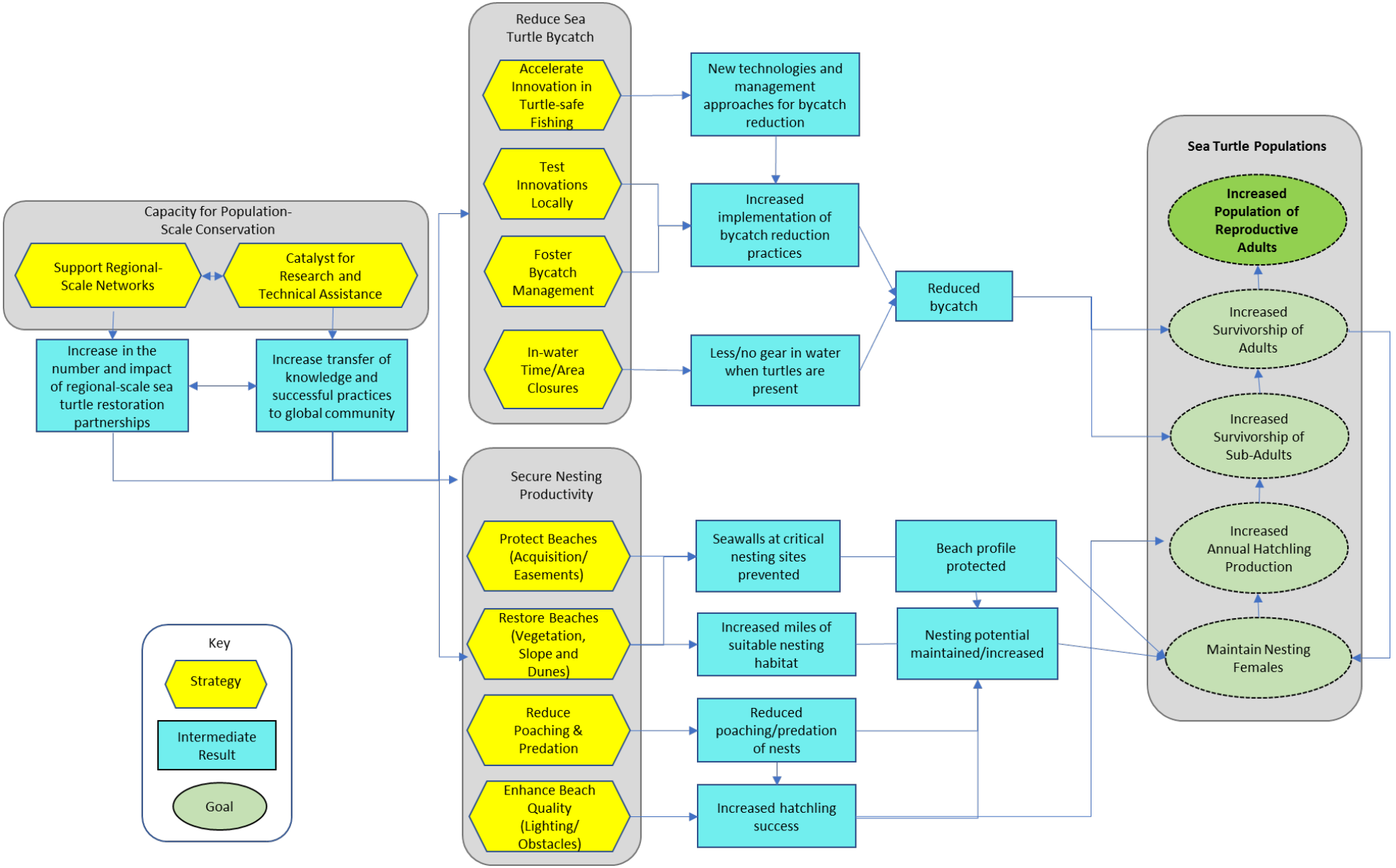

Figure 6. Logic model depicting how business plan strategies (yellow hexagons) are anticipated to lead to intermediate results (blue boxes) and ultimately to the sea turtle business plan goals (green ovals).

Risk Assessment

Risk is an uncertain event or condition that, if it occurs, could negatively affect business plan outcomes. We assessed seven risk categories to determine the extent to which they could impede progress towards our business plan strategies and goals over the next 10 years. Below, we identify primary risks to success and describe strategies that we will implement to minimize or avoid those risks, where applicable.

CATEGORY	RATING	RISK DESCRIPTION	MITIGATING STRATEGIES
Regulatory Risks	**Low**	Pending bycatch rule needs to be promulgated to meet one of the goals of the NWA loggerhead.	NWA loggerhead long-term off-set goal can be met even if bycatch goal in the business plan is not met and the bycatch strategy will shift to a higher focus on compliance with existing rule.
Financial Risks	**Moderate**	Current major funders have renewed their commitment in EP populations as their highest priority. Amounts and sources of NFWF funding required are considered realistic and diversified.	The NWA loggerhead population investments will be limited to Gulf directed investments and remaining population budgets are consistent with near level funding.
Environ-mental Risks	**Low**	Sea level rise impacts nesting beaches directly through inundation and indirectly through greater pressure to harden shorelines in FL. Hurricanes can cause significant damage to nesting beaches.	Plan includes strategy to relocate/raise eggs in hatcheries to avoid loss from inundation in international locations and to acquire identified parcels to prevent shoreline hardening in critical habitat for NWA loggerhead.
Scientific Risks	**Moderate**	Risk that effective bycatch reduction devices that are economically equivalent to current gear (so they will be easily adopted by artisanal gillnet fishing communities) will not be developed.	Plan invests heavily in R&D, testing multiple strategies, and testing options within fishing communities to ensure devices work for their situation and needs.
Social Risks	**Moderate. Linked to Scientific Risk.**	Blast fishing is conducted, despite being illegal. Risk associated with fishermen not adopting voluntary measures.	Plan strategy is to identify the drivers of blast fishing prior to further investment. Over time, we have built relationships with gillnet fishermen with whom we are currently working. If an economical device is identified, this risk becomes much lower (see Scientific Risk).
Economic Risks	**Low**	Many sea turtles nesting sites are in low income areas where their eggs are poached for protein.	Plan strategy pays poachers to protect/monitor nests.
Institutional Risks	**Low (overall)**	NGO capacity is sufficient to implement needed strategies.	

Monitoring & Evaluating Performance

Performance of the sea turtle business plan will be assessed at both project- and program-scales. At the program-scale, broader habitat and population outcomes will be monitored through targeted grants, existing external data sources, and/or aggregated data from relevant grant projects, as appropriate (Table 2). At the project-scale, individual grants will be required to track and report on relevant metrics for demonstrating progress on project activities and outcomes (Table 3). In addition, NFWF may conduct an internal assessment or commission a third-party evaluation at a future stage of the program to determine progress towards program outcomes and adaptively manage. In some cases, these course corrections may warrant increased investment; however, it is also possible that NFWF would reduce or eliminate support if evaluation indicates that further investments are unlikely to achieve intended outcomes.

NFWF will coordinate closely with long-standing, robust data collection programs to monitor progress towards business plan outcomes. Across priority nesting beaches, each sea turtle population has monitoring programs capable of measuring hatchling production each year. Due to differences in life histories and regional monitoring capacity, methods to monitor juvenile and adult sea turtles vary by population; however, this plan will invest in the development of population models that can evaluate population trends in a timely and consistent manner, and can serve as a direct measure of increased survivorship as a result of bycatch reduction. Previous NFWF investments supported the development of a population model for the EP leatherback population that utilizes mark-recapture data collected from nesting females to monitor adult survivorship and assess population trends on a triennial basis. Where possible, similar models will be developed for the remaining populations.

Tables 2 and 3 outline metrics and data sources to monitor progress towards population-level goals through the implementation of three key strategies:

Promoting Sustainable Fishing Communities through Reduced Sea Turtle Bycatch in Focal Fisheries – Metrics under this strategy will track the development, testing, and implementation of bycatch reduction strategies across 5 gear/geography fishery combinations. In addition to the goals outlined above, for a subset of focal fisheries where previous investments developed baseline bycatch estimates, NFWF will replicate the assessments towards the end of the business plan to quantitatively assess whether investments have contributed to an appreciable decrease in bycatch.

Nesting Beach Habitat Protection, Restoration, and Management – Metrics under this strategy will track progress towards the restoration, protection, and management of priority nesting beaches. While priority nesting beaches face very different threats (*e.g.*, predation, poaching, disorientation from lighting, loss of quality beach habitat), all will strive to attain and/or maintain natural levels of hatching and hatchling success such that ≥90% of nests produce hatchlings that make it to the sea.

Building and Maintaining Capacity for Population-Scale Conservation – In order to sustain previous investments and support regional capacity necessary to effectively implement conservation strategies, metrics will track participation in large-scale regional networks across 39 sites with long-term monitoring. In addition, metrics will track the assessment – and where appropriate – development of population models to establish adult survivorship outcomes for the EP hawksbill, NWA loggerhead, and NWA leatherback populations.

Table 3. Program-scale metrics for measuring progress towards conservation goals.

Category	Metric	Baseline	2029 Goal	Data Source(s)
Eastern Pacific Leatherback	% survival of adult females	0.78%	0.94%	CSP[4], Laúd OPO
	# of hatchlings (cumulative)	0	270,000	Laúd OPO
Eastern Pacific Hawksbill	# of juveniles	200	1,000	ICAPO[5]
	# of hatchlings (cumulative)	0	400,000	ICAPO
Northwest Atlantic Loggerhead	# of bycatch mortalities prevented	0	4,000	NOAA[6]
	# of hatchlings (cumulative)	0	300,000	Projects[7]

Table 4. Project-level metrics.

Category	Sub-Strategy	Metrics	Baseline	2029 Goal	Data Source(s)
Reduce Bycatch	*Accelerate Innovation*	*# of ports/communities assessed for sea turtle interactions*	6	23	Networks[8]; Projects
		# of fisheries with at least one bycatch reduction strategy developed	1	5	Networks; Projects
	Implement Proven Strategies	*# of boats implementing bycatch reduction strategy*	0	2,000	Networks; Projects
		% TED effectiveness (skimmer trawl)	0%	94%	NOAA
		% TED effectiveness (otter trawl)	94%	94%	NOAA
		# of bycatch mortalities prevented	0	7,500	Networks; Projects
Increase Nesting Beach Productivity	*Habitat Management*	*# of sites with < 10% nest loss from human enhanced causes*	11	34	Networks; Projects
		# of sites with enhanced protection	2	15	Networks; Projects
		# of sites restored (non-lighting)	8	14	Networks; Projects
		# of miles restored to darkness that prevents disorientation	20.1	40.2	Networks; Projects
Build Regional Capacity	*Partnership Development*	*# of sites being monitored*	37	39	Networks; Projects
	Applied Research	*# of tools developed*	1	4	Networks; Projects
		# of workshops, webinars, meetings	0	15	Networks; Projects
		# of peer-reviewed papers published	0	1	Networks; Projects

[4] Survivorship will be calculated by Conservation Science Partners (CSP) using a population model that is based on mark-recapture data gathered from adult females throughout the EP leatherback's range. Since the majority of non-natural mortality is due to fisheries interactions, bycatch reduction should result in an increase in adult survivorship, which in turn is indicative of population recovery.

[5] Juvenile hawksbill typically remain in coastal foraging grounds, which allows ICAPO to conduct direct in-water monitoring of the juvenile population; increasing hatchling production and reducing bycatch is expected to increase the number of juveniles utilizing foraging grounds over the course of the business plan.

[6] This outcome is subject to promulgation of a pending NOAA Fisheries regulation that would require TEDs for all skimmer trawl, pusher-head trawl, and wing net commercial fishing vessels.

[7] For sites in Florida, NFWF grantees will monitor the number of hatchlings produced as a direct result of conservation actions thereby boosting hatchling production by an amount equivalent to a portion of the damages sustained during the Deepwater Horizon oil spill.

[8] Networks include partner organizations that lead coordinated monitoring efforts for each population. Networks include: Laúd OPO (EP leatherback), ICAPO (EP hawksbill), Florida Fish and Wildlife Conservation Commission (NWA loggerhead), and WIDECAST (NWA leatherback).

Budget

The following budget shows the estimated costs to implement the activities identified in this business plan (Table 5). This budget reflects NFWF's anticipated engagement over the business plan period of performance; however, it is not an annual or even cumulative commitment by NFWF to invest. We acknowledge that in many cases the activities laid out in the plan build upon efforts funded by other organizations. This budget assumes that the current trajectory of funding by those other organizations continues over this business plan's time frame.

Approximately one-third of this budget is projected to support conservation actions for EP leatherback, EP hawksbill and NWA leatherback populations; two-thirds are projected to support conservation actions for the NWA loggerhead population. These allocations are based on implementation needs, historical funding levels, and NFWF's understanding of projected future funding.

Table 5. Budget for the Sea Turtle Business Plan.

BUDGET CATEGORY	10 Year Estimate
Strategy 1: Reducing Sea Turtle Bycatch in Focal Fisheries	**$ 8,400,000**
1.1 Accelerate Innovation of Economically Neutral Turtle Bycatch Reduction Strategies	
1.2 Support Localized Testing in Priority Fisheries	
1.3 Foster Uptake and Management	
1.4 Explore Non-Gear Management Strategies for Reducing Bycatch	
Strategy 2: Nesting Beach Habitat Restoration, Protection, and Management	**$ 21,600,000**
2.1 Protect and Restore Critical Nesting Beaches	
2.2 Protect Nests from Predation and Poaching	
2.3 Enhance the Quality of Nesting Beaches	
Strategy 3: Building and Maintaining Capacity for Population-Scale Conservation	**$ 1,700,000**
3.1 Regional-Scale Partnership Development	
3.2 Innovation Catalyst and Technical Assistance	
Monitoring and Assessment	**$ 300,000**
TOTAL BUDGET	**$ 32,000,000**

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