

Scope	2026–2031
Common Name	Central American River Turtle
Local (Belize)	Hicatee
Scientific	<i>Dermatemys mawii</i>

(TOP VIEW)

CARAPACE

66 cm (max recorded)

22.5°

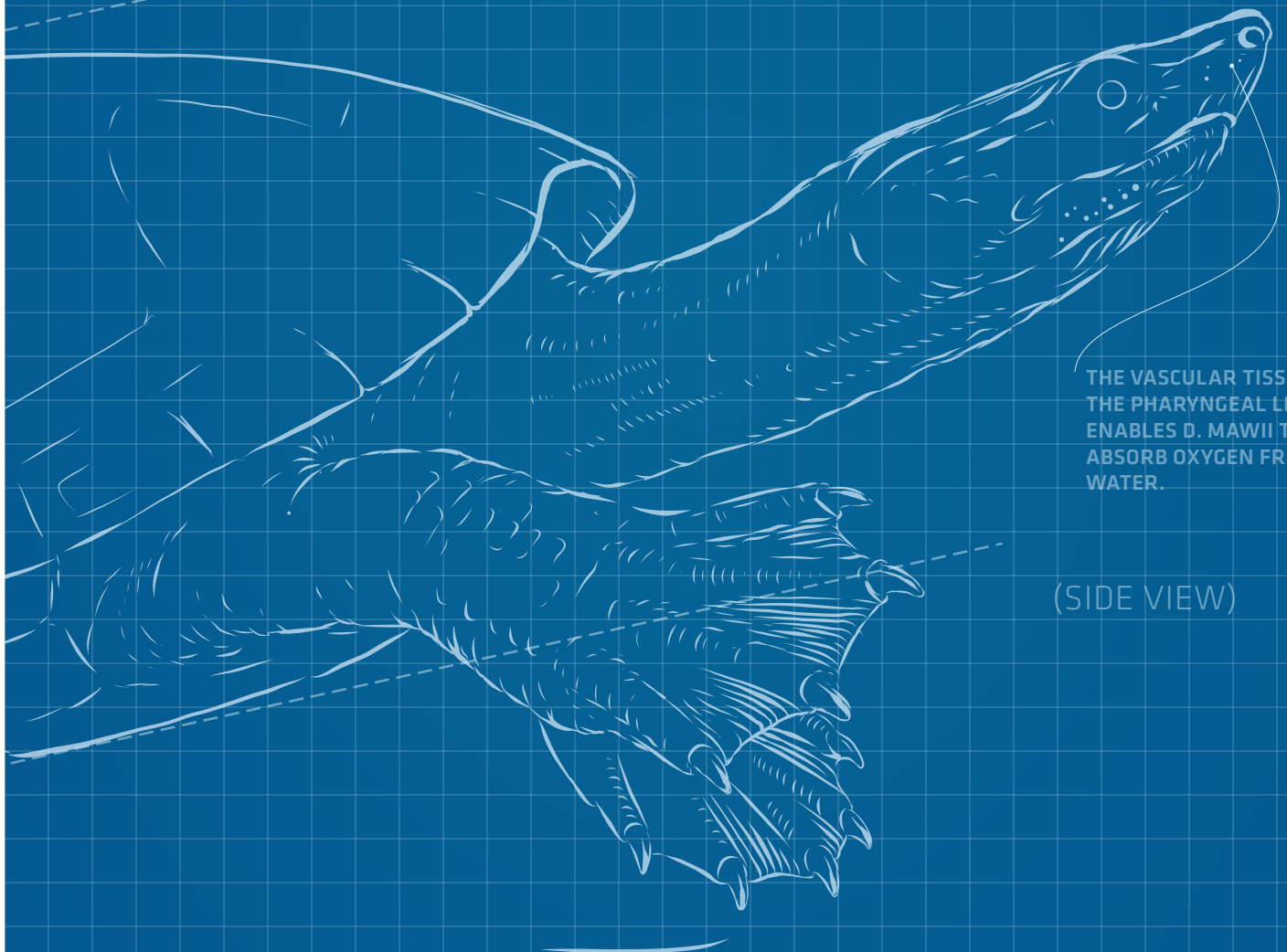
Title

Conservation & Action Plan

Produced by Belize Foundation for Research & Environmental Education (BFREE)

and The Belize Fisheries Department

A plan to ensure the long-term survival of ecologically relevant populations of *D. mawii* in Belize through a combination of legislative action, strategic law enforcement, community participation, protection of key habitats, population monitoring and augmentation, and essential natural history research.



THE VASCULAR TISSUE OF THE PHARYNGEAL LINING ENABLES *D. MAWII* TO ABSORB OXYGEN FROM WATER.

(SIDE VIEW)

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Compiled by
Ed Boles, Ph.D., *Past Coordinator*, Dermatmys Program
and Jacob A. Marlin, *Executive Director*, Belize
Foundation for Research & Environmental Education
(BFREE). With contributions by participants in
Dermatemys mawii workshops in 2022 and 2025

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Government of Belize Endorsement

On behalf of the Government of Belize, the Ministry of Blue Economy & Marine Conservation is pleased to formally endorse the *D. mawii Conservation & Action Plan*.

This action plan represents a comprehensive and collaborative effort to ensure the long-term survival and sustainable use of *D. mawii*, an ecologically and culturally significant species that is now critically endangered. We commend the Belize Foundation for Research and Environmental Education (BFREE), the Turtle Survival Alliance, and all stakeholders, particularly the traditional fishing communities, for their unwavering commitment to the conservation of this iconic species.

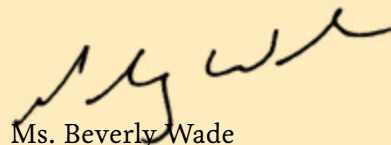
The Government of Belize recognizes that the successful conservation and sustainable use of *D. mawii* is inseparable from the broader goal of sustaining healthy freshwater ecosystems and safeguarding the livelihoods of our riparian communities. We are particularly supportive of the Plan's emphasis on:

- Strengthening law enforcement and regulatory frameworks;
- Empowering local communities through stewardship and co-management;
- Advancing science-based strategies for habitat protection, population recovery, and threat mitigation;
- Integrating traditional ecological knowledge into long-term conservation solutions.

As such, the Ministry of Blue Economy and Marine Conservation, under the purview of the Belize Fisheries Department, reaffirms its commitment to supporting the implementation of this Action Plan through inter-agency coordination, policy alignment, technical support, and the mobilization of relevant national and international resources.

Let this serve as a clear statement of our full support for the *D. mawii Conservation & Action Plan* and our shared vision of a future where self-sustaining populations of *D. mawii* thrive in Belize's rivers and wetlands.

Sincerely,



Ms. Beverly Wade
Chief Executive Officer
Ministry of Blue Economy & Marine Conservation
Government of Belize

On behalf of Turtle Survival Alliance, I am pleased to announce the long-awaited *D. mawii Conservation & Action Plan* (*Dermatemys mawii*), is now a reality. Species recovery doesn't happen without a plan, one with stakeholder support and buy in. The culmination of multiple stakeholder and informal planning workshops, the first at BFREE in 2016 and the last two virtual in 2022, consolidates our current thinking of what is required to save the Hicatee in Belize.

To put *D. mawii* into context, we must consider turtles from a global perspective. Simply put, turtles are in trouble. They represent one of the most threatened groups of vertebrates on the planet with ~50% under threat and facing possible extinction. Their decline is due to 1) being reduced to commodities, 2) a broad range of threats related to habitat and climate change, and 3) overwhelming collection for the illegal wildlife trade.

What started with the Asian turtle crisis in the mid-1990s—the driving force in Turtle Survival Alliance's formation—has grown into a global turtle crisis. When we began organizing conservation programs to address the needs of the most critically endangered chelonians, one species—*D. mawii* “jumped out at us” due to its potential of “slipping through the cracks.” *D. mawii* is the sole surviving member of a formerly widespread family of turtles and like other turtles around the globe, it faced:

- Over-harvesting due to its potential as a sustainable food source and its revenue capacity, resulting in catastrophic population declines in Mexico and Guatemala.
- Unregulated commercial collection, causing local populations of *D. mawii* to disappear.

Without improved regulation and enforcement, this species could become functionally extinct throughout its range. As there was no integrated program capable of addressing the species' comprehensive needs, we knew we must start somewhere.

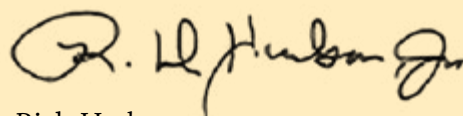
It started in 2010 with a phone call to BFREE Executive Director, Jacob Marlin, and grew into a BFREE/Turtle Survival Alliance partnership. The partnership was founded on two assumptions:

1. Belize is the best stronghold population remaining for the Hicatee within its limited three country range, and
2. Belize offers the brightest hope for saving this highly threatened species and could develop a model program for the region.

I am confident this plan will serve as a road map to the recovery of the Hicatee in Belize. As I reflect on the past 12 years, I take pride in what we have achieved. Those achievements would not be possible without:

- The drive and energy of BFREE Executive Director, Jacob Marlin, who kept this species at the forefront and ensured this effort did not lose momentum.
- The Belize Fisheries Department which has provided critical support, guidance, and partnership to allow this project to move forward.
- Ed Boles in his role as the first official *Dermatemys* Program Coordinator for building an inclusive process that benefitted from a broad range of stakeholders' ideas and viewpoints.

It is imperative to clarify that conservation organizations will not save the Hicatee in Belize. We can provide an action plan framework to inspire people to action, but the people of Belize, especially riverine communities, ultimately determine if Hicatee will persist in sufficient numbers to ensure their long-term survival. As we move forward, we must highlight the inextricable connection between the survival of the Hicatee and the protection of aquatic ecosystems that Belizeans and this turtle ultimately depend.



Rick Hudson
President Emeritus
Turtle Survival Alliance

Acknowledgements

This management plan was based on input and collaboration of 37 researchers, conservationists, educators, managers, and fishers involved with *Dermatemys mawii* attending the May 17, and December 1, 2022, and Jan. 31, 2025 on-line workshops. This initiative was made possible through support from the Turtle Survival Alliance (TSA) and invaluable mentoring by Rick Hudson (TSA president emeritus), Andrew Walde (TSA Director of Conservation and Science); Zoo New England (ZNE) represented by Bryan Windmiller (Past-Director of Field Conservation) and Emilie Wilder (Field Conservation Officer); the Belize Fisheries Department represented by Felicia Cruz (Past Fisheries Officer), Gilberto Young (Inland Fisheries Officer), Shakera Arnold (Fisheries Officer), Mauro Gongora (Past Fisheries Officer); and the Belize Foundation for Research and Environmental Education (BFREE) staff, represented by Jacob A. Marlin (Executive Director), Heather Barrett (Deputy Director), Thomas Pop (Hicatee Conservation and Research Center Manager), Jaren Serano (Dermatemys Social Scientist), Jonathan Dubon (Past Wildlife Fellow), Tyler Sanville (Past Program Manager) and Ed Boles (Past-Dermatemys Program Coordinator).

The workshops were facilitated by Yvette Alonzo. David Hedrick (TSA) ensured the Zoom session went without technical issues. Workshop participants providing valuable information and discussion to the breakout sessions, and the organizations they represent include Elma Kay (Managing Director, Belize Maya Forest Trust); Isabelle Paquet Durand (Veterinarian, Belize Wildlife and Referral Clinic); Calvin Gonzalez (Outreach Officer, Belize Wildlife and Referral Clinic); Thomas Rainwater (Research Scientist, Clemson University); Conway Young (Administrative Officer, Community Baboon Sanctuary); Eduardo Reyes Grajales (Researcher, El Colegio de la Frontura Sur, Mexico); Peter Paul van Dijk, (Red List Authority Coordinator of the IUCN/SSC Tortoise and Freshwater Turtle Specialist Group); Donald McKnight (Turtle Biologist, La Trobe University); Day Ligon (Professor of Biology, Missouri State University), Denise Thompson (Per Course

The individuals listed below held the positions indicated at the time this plan was developed and produced. Titles and organizational roles may have changed since publication.

Faculty, Missouri State University); Manual Gallardo (Turtle Researcher, Olmaca University); Vanessa Kilburn (Director, Toucan Ridge Environmental Education Society); Elliott Jacobson (Veterinarian, University of Florida); Venetia Briggs-Gonzalez (Faculty, University of Florida and Director, Lamanai Field Research Center); Paul Evans (Outreach Officer, University of Florida); Julie Lester-Gordillo (Universidad Juarez Autonoma de Tobasco); Brian Horne (Wildlife Conservation Society); Boris Arevalo (Wildlife Conservation Society-Belize); Yamira Novelo (Technical Assistant, Wildlife Conservation Society-Belize); and Carlos Guichard-Romero (Chiapas, Mexico). Note takers for breakout sessions were Debora Olivares (Galen University), Celine Chan (Galen University), and Jessica Schmidt (University of British Columbia). Ms. Schmidt also transcribed two of the breakout sessions and edited the first draft.

Special recognition is given to traditional fishers of the lower Belize River Valley and the lower Sibun River who contributed important insights through consultations. Dudley Hendy IV (Isabella Bank) attended the workshop. Wilhelm Casasola, Jr. (St. Paul's Bank), Percival Flowers (Willow's Bank), Doc Gill (Rancho Dolores), Dudley Hendy II (Isabella Bank), Archabold Lodge (Scotland Half-moon), Aurie McFadzean (Willow's Bank), Freddy Renalds (Lemanol), Reubin Rhaburn (Flowers Bank), Gabriel Tun and Roberto Tun (Freetown Sibun) and Mike Myvette (More Tomorrow) provided detailed information on the history of *D. mawii* fishing, population densities in local areas, distribution, current fishing pressures (including illegal fishing), and fisher-based conservation strategies that helped create this conservation, management, and action plan.

Photographs contributed for the preparation of this document: Heather Barrett, Ed Boles, Jacob Marlin, John Polisar, Dick Vogt, and Barney Hall. A complete list on the inside back cover of this document.

This conservation, management, and action plan was generated from the outcome of three Hicatee Conservation Forum and Workshops held virtually on May 17 and Dec 1, 2022, and January 31, 2025 co-hosted by Belize Foundation for Research and Environmental Education (BFREE), Turtle Survival Alliance (TSA), Zoo New England (ZNE) and the Belize Fisheries Department (FD). The first two forum/workshops were held online via a Zoom webinar coordinated by BFREE staff and facilitated by Ms. Yvette Alonzo, with technical assistance from Mr. David Hedrick of TSA. The third and final workshop was held at BFREE with on-line participants and was coordinated by BFREE and the Belize Fisheries Department. The events were attended by 37 professionals supporting *D. mawii* research, conservation, and outreach, including key Government of Belize (GoB) officials from the Belize Fisheries Department.

The objective of the workshops was to review, update, revise, and discuss the detailed management plan outline resulting from the information gathered over the past twelve years as well as several recent small workshops and meetings held during 2020–2021. The first workshop was held virtually on May 17, 2022. Participants divided into five breakout groups to discuss background, ideas, and concerns for 66 proposed actions divided among seven conservation goals. Results of the workshop yielded a 33-page transcript that served as a guiding document for the compilation of the first draft of the *D. mawii Conservation & Action Plan*. The first draft was shared with all participants of the May 17th workshop, including fisherfolk for review prior to the second workshop. The second workshop was held on December 1, 2022. Participants further refined the working draft, added an additional goal, and shortened the proposed actions to 59. The third workshop was held on January 31st, 2025, where stakeholders indicated their prospective commitments to actualizing the plan over the coming five years. The completed, integrated, and inclusive plan for Belize, guided by research and decades of

traditional fisher experience, was approved by the Government of Belize in September, 2025.

This plan includes traditional issues covered by most species-specific plans, but also recognizes that successful, long-term conservation and management of *D. mawii* must also address the landscape that contains it, or more specifically, the riparian/aquatic corridors within that landscape, those ecosystem units that are the habitat of these aquatic turtles. This includes the lower reach rivers and lagoons where *D. mawii* live, and the wetlands and tributaries that are interconnected with and feed into those water bodies. It also includes the riparian forests that are the filter systems of the landscape, reducing pollutants and sediment loads, and providing the bulk of the food that sustain *D. mawii* populations. The conservation and management of *D. mawii* is a landscape/ecosystem management challenge.

The *D. mawii* landscape also includes communities of people who draw their subsistence from the riparian/aquatic corridors of the landscape, including these turtles as a food resource. Successful conservation of *D. mawii* requires full engagement and empowerment of these communities, especially fishers, but also farmers, women, and youth in community-based management throughout the *D. mawii* range.

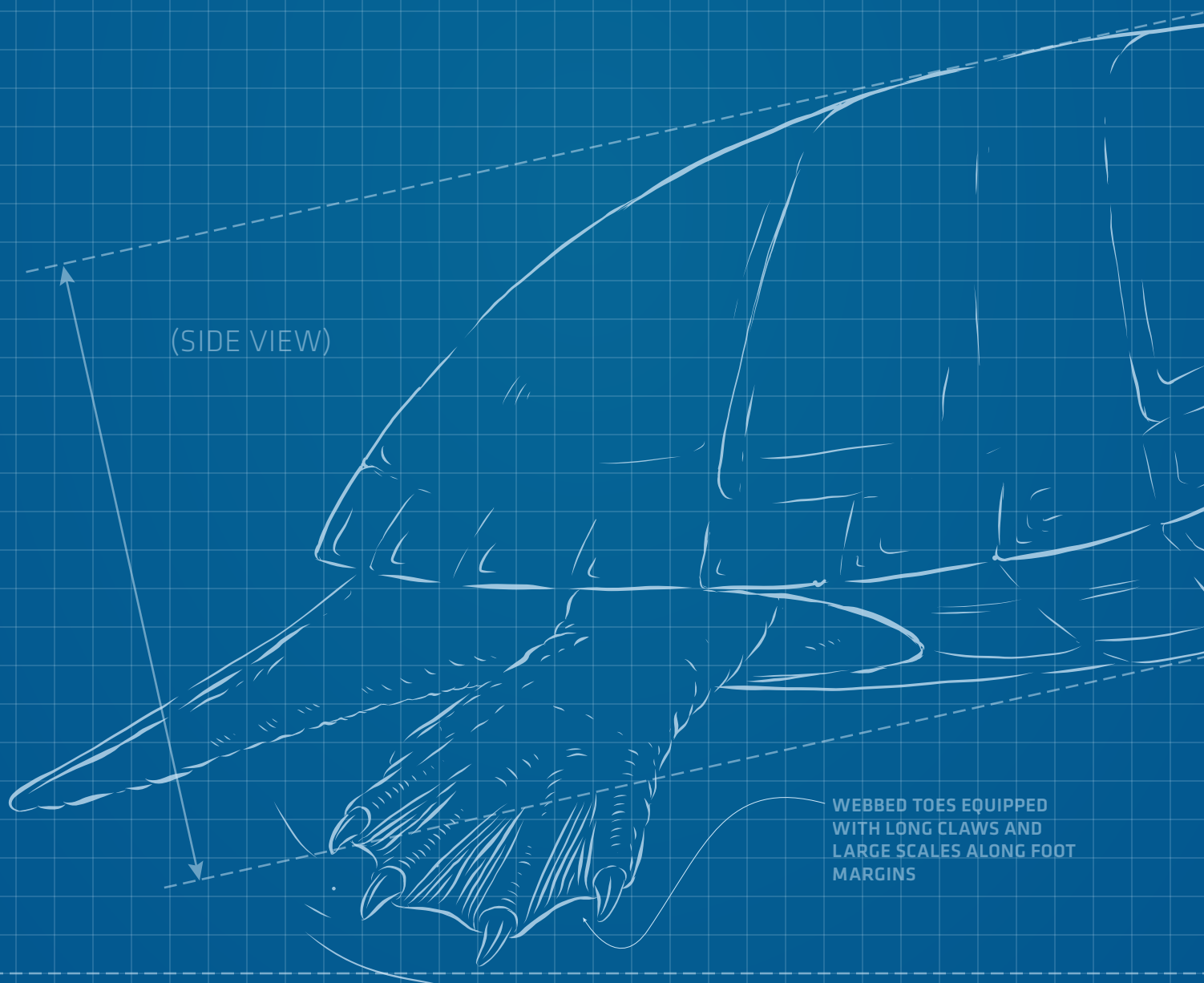
Please reference this document as follows:

D. mawii Conservation & Action Plan 35 pp. Belize Foundation for Research and Environmental Education. October 2025

Executive Summary

This plan is focused on the conservation, management, and protection of the Central American River Turtle, (*Dermatemys mawii*), also known locally as Hicatee and Tortuga Blanca, one of the 25 most endangered turtles in the world¹ and classified by the IUCN as “Critically Endangered.”

1. Turtle Conservation Coalition, 2025



The present range of *D.mawii* is limited to southern México, eastern Guatemala, and throughout most of Belize with the major exception of the Maya Mountain Massif. Within Belize these turtles are found in the Rio Hondo, New River and lagoons and smaller coastal rivers, southward into the Belize River up to the Macal River, a major branch of the Belize River, the lower Sibun River at least up to Gracie Rock, Lower Mullins River, Northern Lagoon, Southern Lagoon, Sittie River, and from

bulk of adult and juvenile diets in some populations. They also consume emerged, floating, and submerged aquatic plants, as well as leaves, flowers, and fruits falling into the water from riparian trees and shrubs.

Known for its cream colored to white plastron, this fully aquatic turtle falls prey to Coatimundi, Racoons, Limpkins, Rails, Herons, Crocodiles, Jaguars, and Neotropical River Otters. Yet, humans are their primary predator. Hicatee have been consumed by humans at least since the Ancient

Their ability to extract oxygen from water through the tissue lining their buccal cavities allow them to remain on lagoon and river bottoms for long periods of time

Golden Stream south to Sarstoon River. Northern Belize appears to harbor populations with the highest densities. *D.mawii* typically inhabit lower reaches of large, deep, slow moving, healthy rivers, and associated oxbows lakes and floodplain lagoons, accessing riparian and floodplain forests and wetlands during periods of high water. They have also been observed in faster flowing rivers, smaller streams, and estuaries.

During the day, particularly in the dry season when they are confined to deeper pools, adult and juvenile turtles spend time resting on river and lagoon bottoms, often beneath limbs and logs and buried in sand and leaf deposits. Their lack of need for basking and their ability to extract oxygen from water through the tissue lining their buccal cavities allow them to remain on lagoon and river bottoms for long periods of time. They nest along river and lagoon edges from September to December during the wet season, with a second nesting period during January and February, the early dry season. Typically, the only time female turtles leave the water is to lay eggs, the number of eggs laid depending on body size and other factors, with clutches ranging from 2 to 20 eggs. *D.mawii* take 15–17 years to reach sexual maturity and may live up to 50 years in the wild.

Central American River Turtles are herbivores, only accidentally consuming animal protein in the wild. They rely on a community of microbes, protozoa, and micro-invertebrates to digest their heavy cellulose food. *Paspalum paniculatum*, a semi-aquatic grass growing in mats over the water to upland areas, has been reported to comprise the

Maya and perhaps by Paleo-Amerindian tribes.

Today, Hicatee are being harvested in growing numbers with unsustainable harvest rates as illegal fishers raid rivers and lagoons, often free-diving and using gill nets, to supply an illegal market. *D.mawii* populations continue to decline despite increasingly strict legislation protecting the turtles. Beyond over-hunting, turtles are affected by riparian deforestation, heavy sedimentation, agricultural chemicals, nutrient loading of rivers, and overall water pollution.

This draft plan is based on a broad perspective of conservation and management of *D.mawii*. It considers: 1) what is known about *D.mawii*'s biology and the impact of fishing pressures on turtle populations, 2) the ecology of *D.mawii* within interconnected ecosystems of the landscape in which riparian/aquatic corridors are embedded, and 3) the history, culture, and livelihoods of human communities sharing these corridors.

Fishers, farmers, youths, and concerned citizens are vital partners in ensuring the survival of *D.mawii* into the future—a theme tightly woven into this conservation, management, and action plan. Successful conservation of *D.mawii* requires full engagement and empowerment of riverside communities and those communities where fishers live. This plan focuses heavily on fishers, farmers, women, and youth involved in community-based management throughout the *D.mawii* range. When focusing on the conservation of wildlife and fish food resources, food sovereignty and community livelihoods must be a high priority.

Vision, Mission, & Goals

The creation and implementation of a collaborative, inclusive, research-guided, and community-grounded conservation, management, and action plan.

Vision

There are viable self-sustaining populations of *D.mawii* living in the wild throughout Belize.

Mission

To ensure the long-term survival of ecologically relevant populations of *D.mawii* in Belize through a combination of legislative action, strategic law enforcement, community participation, protection of key habitats, population monitoring and augmentation, and essential natural history research.

8 Goals

The 2020-2022 preparation meetings and workshops resulted in the development of eight goals, identified the problems and causes leading to their necessity, and provided proposed actions to reach each goal.

Those goals are:

1. Minimize the illegal collection and trade of *D. mawii* through improved public awareness of the laws and effective enforcement.
2. Enhance existing regulations to better align with the long-term sustainability of the species.
3. Increase appreciation for *D. mawii* as a critical member of Belize's rivers and a national emblem of Belize rather than strictly a food source.
4. Maintain an assurance colony and conduct research on reproductive biology and nesting ecology through a captive management program.
5. Augment declining and extirpated populations through reintroductions of captive raised *D. mawii*.
6. Develop comprehensive knowledge about the species including population assessments, natural history, current status, and human interactions.
7. Identify, protect, and conserve at least five self-sustaining robust populations in Belize of *D. mawii* in perpetuity.
8. Protect and restore aquatic and riparian *D. mawii* habitat.

58 Actions

To achieve these goals, fulfill the mission and realize the vision of the *D. mawii* conservation within Belize, 58 actions were developed within eight programmatic areas. Each action identified a priority, timeframe, action status (discussed, planned, ongoing), action scale (local, national, international), and the entity(s) committed to implementation. About 55% of these actions are already within the planning and implementation stages, indicating the amount of work already in progress. A list of persons involved in research and conservation of *D. mawii* contains 60+ names, indicating the number of people who are concerned with the future of this species. Equipped with a new conservation and management plan supported by the Government of Belize, years of documented research, a solid foundation of community support, and the dedication of 60 scientists and conservationists, there is a strong likelihood for the long-term survival of this iconic species.

Current Assessment

Taxonomy

Class: **Reptilia (reptiles)**

Order: **Testudines (turtles)**

Suborder: **Cryptodira**

Superfamily: **Kinosternoidea**

Family: **Dermatemydidae**

Genus: **Dermatemys**

Species: **mawii**

Species Description

The English name is the *Central American River Turtle*, *Tortuga Blanca* in Spanish, and *Hicatee* or *Hickatee* in Belizean Kriol. The Dermatemydidae fossil records reaches back to the Cretaceous 65 million years ago (Gaffney 1975), ranking it among the oldest families of the suborder Cryptodira (Carr et al. 1981), with *Dermatemys mawii* being the only surviving species.

D. mawii was derived from radiation out of North America and into Central America where it has been confined to sections of the Yucatán Peninsula (Carr et al. 1981). Genetic studies show present populations may have diverged within large watersheds during the Pliocene–Pleistocene and experienced demographic changes afterwards. Translocation of genetic lineages by humans since at least the Ancient Maya increased mixing of *D. mawii* populations after genetic bottlenecking occurred (González-Porter et al. 2011). The present range is limited to southern México, eastern Guatemala, and throughout most of Belize with the major exception of the Maya Mountain Massif (Iverson and Mittermeier 1980). Figure 1, adapted from Vogt et al. (2011), shows the turtle's historical distribution. The family Kinosternidae (musk and mud turtles) is related to Dermatemydidae (Carr et al. 1981, Frair 1964, Gaffney 1975, Zug 1966), considered to be the basal clade of Kinosternidae (Carr et al. 1981, Zug 1971).

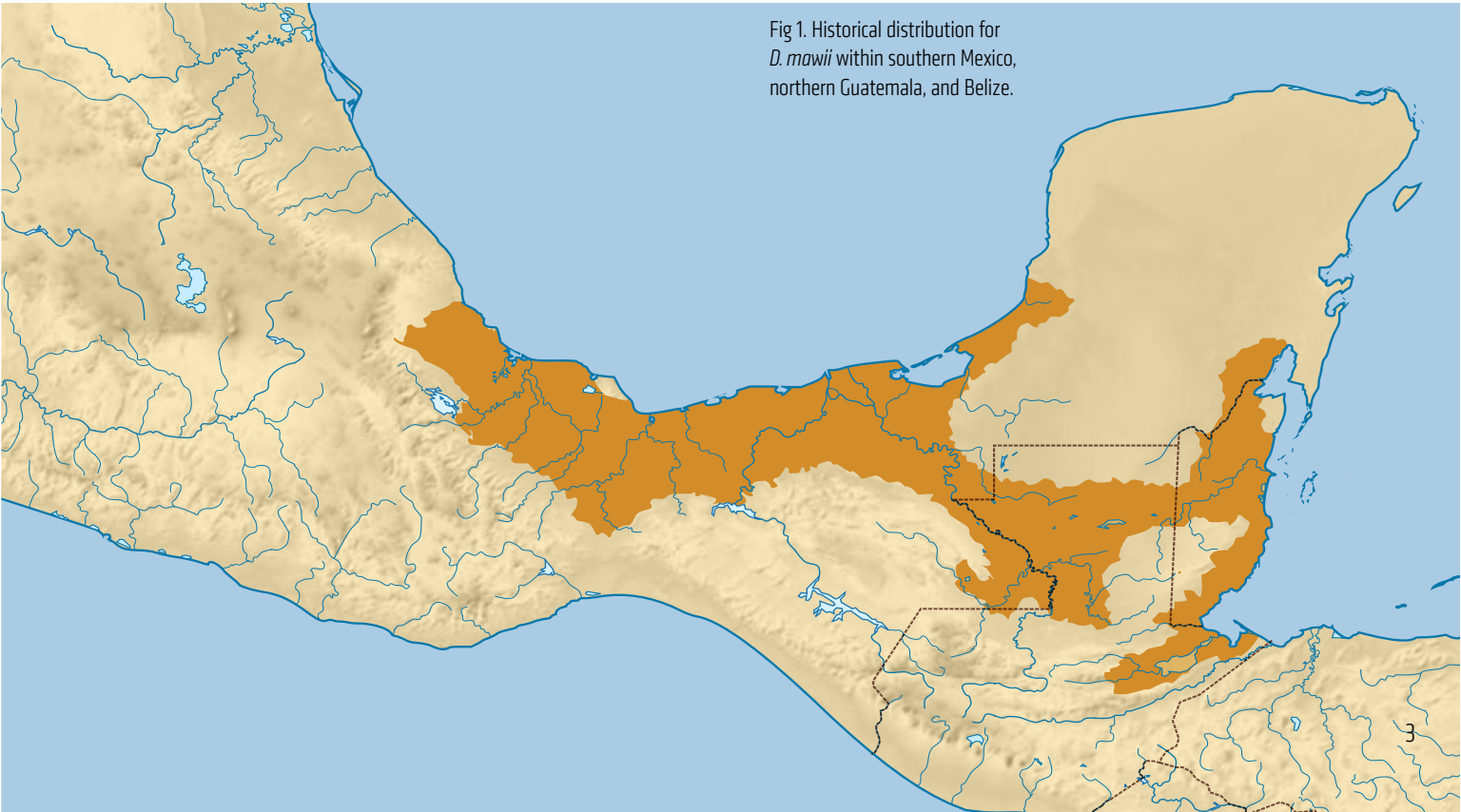


Fig 1. Historical distribution for *D. mawii* within southern Mexico, northern Guatemala, and Belize.

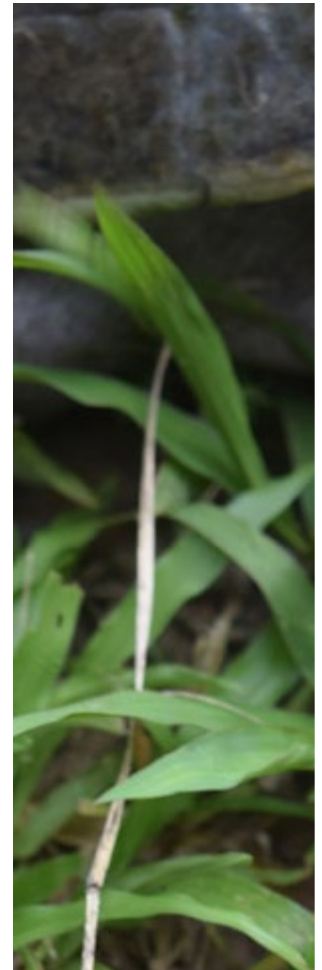
Current Assessment *Cont.*

D. mawii maximum carapace length (CL) recorded is 660 mm and a maximum weight of 22 kg (Lee 1996), with average carapace lengths for males ranging from 330 to 450 mm and females from 340 to 480 mm. Weight ranges from 10 to 15 kg for males and females (see Briggs-Gonzalez et al. 2019 for an overview of the species; Polisar 1995; Rainwater et al. 2012; Rangel-Mendoza et al. 2009). Average values for hatchlings range from 50 to 58 mm CL and 18 to 35 g body mass. The cream to white plastron has earned *D. mawii* the name Tortuga Blanca (Figure 2). The carapace is wide and smooth, with shell color ranging from dark brown to olive or gray (Figure 3). The general color of the skin and scutes are affected by the type of habitat used (Polisar 1992, Vogt et al. 2011).

Fig 2. Plastron of a mature *D. mawii*



Fig 3. Carapace of adult *D. mawii*



Hatchlings have orange snouts that gradually turn yellow in about two years (Figure 4). Hatchlings also have a predominate yellow post-orbital stripe, (Vogt et al. 2011), the carapace has a base color of greenish-yellow to olive brown, is covered with dark flecks varying in number from a few to > 100 (Figure 5) and exhibits a low median keel. At hatching, the bones of the carapace are unfused and each marginal scute

displays a whitish edge. (Platt et al. 2019). When mature, the top of a male turtle's head is usually yellow to yellow orange (Figure 6), also affected by habitat type (Polisar 1992). Females typically lack bright colored heads (Figure 7) but sometimes have a very light-yellow tint on the top of the head (Vogt et al. 2011).



Fig 4. Hatchling with an orange snout and pale yellow orbital stripe behind the eye.

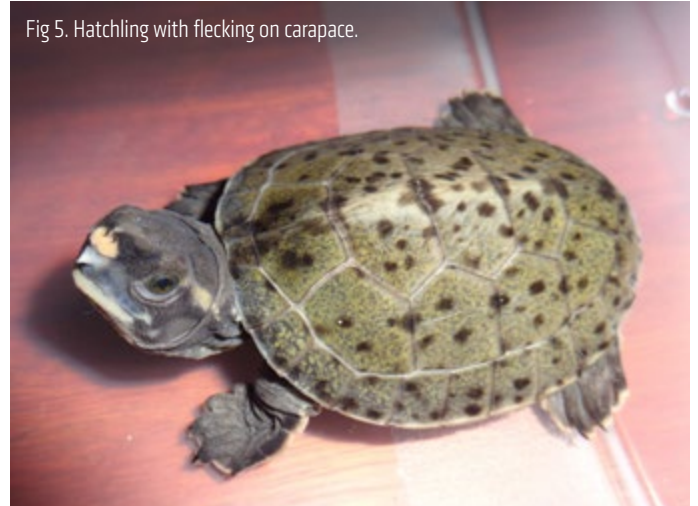


Fig 5. Hatchling with flecking on carapace.



Fig 6. Adult male *D. mawii* with a characteristic yellow head



Fig 7. Adult female *D. mawii* with brown/olive head.

Current Assessment *Cont.*

The shell structure consists of an indentation in the posterior lobe of the plastral margin, 11 or 12 plastral scutes, 3 to 6 inframarginals, and 12 marginals on each side (see Figure 2). In some turtles the gular scutes are divided and in others it is single (Vogt et al. 2011). The carapace of juveniles is keeled (Figure 8), and plastrons are rounded (Figure 9), becoming more oblong as turtles grow (Morales et al. 2009). Studies in Guatemala indicate shell morphology varies among different river systems (Morales et al. 2009).



Fig 9. Juvenile with a round, wide plastron.



Fig 8. Juvenile *D. mawii* with a wide, keeled carapace.



Serrated labial ridges and tooth-like ridges on the maxilla alveolar surfaces aid in tearing leaves (Vogt et al. 2011) (Fig 10). The vascular tissue of the pharyngeal lining enables *D. mawii* to absorb oxygen from water, allowing turtles to stay on the water bottom for an extended time (Rhodin et al. 2011).

Their feet have webbed toes equipped with long claws and large scales along foot margins (Lee 1996) (Fig 11). The tails of male turtles are long and muscular, reaching past carapace, and in at least some cases are prehensile (Fig 12), while female turtles have smaller, weaker tails (Fig 13) (Mendyk and Eisele 2016).



Fig 10. Serrated labial ridges and maxilla alveolar ridges .



Fig 11. Webbed foot with long claws and large scales.



Fig 12. Large tail of an adult male.



Fig 13. Small tail of an adult female.

The International Union for Conservation of Nature (IUCN 2016) lists *D. mawii* as critically endangered. Under the US Endangered Species Act (USFWS 1983) it is listed as endangered. The Convention on International Trade in Endangered Species of Wild Fauna and Flora lists *D. mawii* on Appendix II (CITES 2017).

Laws and regulations in Belize for *D. mawii* fall under the Fisheries Act of the Laws of Belize and is under the responsibility for enforcement by the Belize Fisheries Department. The Government of Belize has recognized the importance of this turtle and laws have been implemented to restrict the unsustainable harvesting of large quantities from the wild. There are currently seven laws to protect *D. mawii* in Belize as follows:

1. It is *Illegal* to *Buy or Sell* a Hicatee
2. No person shall have in his *possession more than three turtles* at any given time.
3. It is *illegal* to catch Hicatee between the *1st of May* and the *31st of May*.
4. No person shall *transport more than five turtles* in any vehicle.
5. There are *size limits*: caught *females* must be between 15.2 inches and 17.2 inches (carapace length). Holding the turtle securely, stretch measuring tape from the top edge of the shell (head region) down the center of the shell (carapace) to the bottom edge (tail region).
6. No person shall *possess or use a net* to take Hicatee.
7. It is *illegal* to capture Hicatee in the following *areas*: Belize River: Beaver Dam Creek to Labouring Creek, New River: Irish Creek to Water Bank, Rio Bravo: Upstream from Dos Bocas Dam, also Booth's River, Cox and Mucklehany Lagoons, headwaters of Mussel Creek, Northern and Southern Lagoons and tributaries (Manatee Lagoons and Manatee River), and Sibun River: between Ferguson Bank and Sibun Bar.

Historically *D. mawii* ranged through southern Mexico, most of Belize (except for the Maya Mountain Massif), and parts of northern Guatemala (Alvarez del Toro 1982, Iverson 1992, Vogt et al. 2011), occurring in lowland freshwater bodies of the Yucatan Peninsula (Lee 1996) (see Figure 1). Continual harvest of *D. mawii* for meat and eggs (Moll 1986; Polisar 1992, 1995) has greatly reduced or eliminated wild Guatemalan and Mexican populations and locally reduced many Belize populations.

Within Belize, *D. mawii* are found in the Rio Hondo, New River, and lagoons and smaller coastal rivers and southward into the Belize River up to the Macal River, a major branch of the Belize River. In central Belize *D. mawii* is found in the lower Sibun River at least up to Gracie Rock (Garel 1998; Barbour 2018), and in the Northern Lagoon, and the Southern Lagoon. *D. mawii* populations occur in southern Belize within Mullins River (personal communication with fishers), Sittee River, and from Golden Stream to Sarstoon River (Méndez 2012). Population densities seem higher in northern Belize, with low densities found from Dangriga to Punta Gorda in southern Belize with most rivers in the south being shallow and fast-flowing and therefore not offering ideal habitats. In the early 1980s a mean density of 2 turtles/ha was found from 22 sites, with New River Lagoon having the highest density of 8.7 turtles/ha (Moll 1986). Observations recorded from the 1940s show *D. mawii* populations to be much higher, even in those areas where more recent surveys found few to no turtles (Moll 1986, Waight 1983). Density declines are consistently associated with human population growth (Collins 1999, Garel 1998, Moll 1986, Rainwater et al. 2012). Based on a country-wide 2010 survey, *D. mawii* populations continued to decline despite legal protections (Rainwater et al. 2012).

Natural History



Fig 14. Large, slow creeks and rivers.



Fig 15. Lagoons with aquatic plants.

General Habitat Characteristics

D. mawii is a fully aquatic, neo-tropical, freshwater turtle inhabiting the lower reaches of large, deep, slow moving, healthy rivers, and associated oxbow lakes and floodplain lagoons, accessing riparian and floodplain forests and wetlands during periods of high water (Moll 1986, Vogt et al. 2011, Rhodin et al. 2011). Figures 14 through 17 show examples of different habitats. *D. mawii* have been observed in faster-moving rivers and estuarine waters (Moll 1986, Rainwater et al. 2012), and sometimes seen in Corozal Bay within Belize. They are found in waters ranging from dark and rich in tannins, such as New River (Figure 14), to predominately groundwater-fed water bodies such as Whitewater Lagoon (Polisar 1992, Rainwater et al. 2012, Vogt and Flores-Villela 1992a) (Figure 17). Riparian areas of inhabited rivers include open and pine savannas, broadleaf forests, freshwater swamps, and mangroves. Habitats include those with emerged, floating, and/or submerged aquatic plants or little to no aquatic vegetation.

During the day, particularly during the dry season when they are confined to deeper pools, adult and juvenile turtles spend time resting on river and lagoon bottoms, often beneath limbs and logs and buried in sand and leaf deposits (Vogt et al. 2011). Juvenile turtles are often found among submerged vegetation along riverbanks, and during high water within inundated riparian vegetation of rivers and lagoons, while adult turtles prefer deeper waters (2.5 m to 6 m) (Vogt et al. 2011). Juveniles can often be seen climbing onto branches of riparian trees submerged during the wet season to reach leaves (personal communication with Mr. Gabriel Tun and Mr. Wilhelm Casasola, Jr.).



Fig 16. Tannin rich waters of deep, slow rivers.



Fig 17. Groundwater fed artesian lagoon.

Mating

In Belize females mature at a 400 mm carapace length (CL) in rivers and 410–420 mm within lagoons, and males mature at 370 mm CL within rivers and 380–390 mm within lagoons (Polisar 1992, Rhodin et al. 2011, Vogt et al. 2011). *D. mawii* inhabiting lagoons and slow-moving creeks and rivers tend to become sexually mature at larger sizes and reach larger maximum sizes than *D. mawii* in faster-flowing rivers. The mating season starts from March to April and runs to September (Polisar 1992, 1996). A study at the HCRC with captive *D. mawii* showed that male and female *D. mawii* begin sexual maturation at approximately 38.0 cm and 40.0 cm straight-line carapace length, respectively. Ages associated with these sizes were estimated at 13.5–16.9 years (males) and 13.6–17.3 years (females). (Bishop et al. 2021).



Fig 18. Nest of *D. mawii* along a riverbank.

Nesting

Nesting happens from September to December during the wet season (Polisar 1995, Vogt et al. 2011), with a second nesting period during the early dry season; January and February (Vogt et al. 2011). Captive turtles at the HCRC are reported nesting from November–April (Marlin. pers. com). Nesting in the wild has also been documented in March and April (Lee 1969, Moll 1986). Eggs are laid along shorelines, including riparian forest and savannas, in moist soil up to 3 m from the water with nests becoming



Fig 19. Eggs at the HCRC showing banding.

submerged during the wet season (Vogt et al. 2011) (Figure 18). One incident of possible communal nesting has been reported for New River Lagoon (Jennings et al. 2020). Large, resilient, hard-shelled eggs are laid in single nests (Polisar 1995) and can survive underwater for over a month (Polisar 1996, Polisar and Horwich 1994) and continue developing when water levels drop. Fertile eggs develop distinct bands shortly after laying (Figure 19). An increase of nest moisture with rains in June and July initiate hatching in the wild (Polisar 1992, 1995), with hatching in captivity occurring from late May—early July with June being the peak of the hatching season. (Marlin. pers. com.). Clutch sizes within Belize range from 2 to 20 eggs with a reported mean of 10.98 eggs per clutch with female turtles producing an average of 2.05 clutches per year and up to 47 total eggs per year in Belize (Polisar 1995). The number of eggs increases with increased body size of females (Polisar 1992, 1996). Incubation lasts from 115 to 300 days (Polisar 1992, Rhodin et al. 2011, Vogt and Flores-Villela 1992b). Sex determination is dependent on temperature, with ambient incubation temperatures in laboratory settings above 28 C resulting in females, 25–26 C yielding males, and 28 C producing both sexes (Vogt and Flores-Villela 1992b). The mean size of wild hatchlings was found to be 31 g and 54 mm CL (Polisar 1995) and 29.1 g and 50.2 mm CL in captive reared hatchlings at HCRC (Platt et al. 2019).

Foraging & Diet

D. mawii is herbivorous with *Paspalum paniculatum*, a semi-aquatic grass growing in mats over the water to upland areas, comprising the bulk of adult and juvenile diets investigated (Alvarez del Toro 1972, 1982; Alvarez del Toro et al. 1979; Lee 1969; Moll 1989). Turtles gather on *P. paniculatum* mats at night to feed and are typically not seen on mats during the day (Moll 1989). *Nymphaea ampla* or White-Water Lilly mats are an important forage in northern Belize. The rest of the diet is made up of leaves, flowers, and fruits falling into the water from riparian trees and shrubs or being accessed by turtles during high water. In estuarine environments, *D. mawii* will eat mangrove leaves and floating vegetation (Moll 1989, Polisar 1992). Cellulose digestion of plant material occurs in the foregut through the work of microbiota. Hatchlings feed on adult feces for the first few days after hatching to inoculate their guts with microbial communities and grow 30% faster than hatchlings not able to feed on adult feces (Vogt et al. 2011). Growth rates are linked to food availability and the conditions of habitats, with growth being faster during the wet season when food resources are abundant (Moll 1989, Vogt et al. 2011).

Behavior & Habits

Daily activity is based largely upon seasonal water levels and food availability. *D. mawii* are nocturnal and are infrequently observed at the water's surface during the day, as adults are lying on the bottom of large river pools, lagoons and slow-flowing reaches, often beneath sand, leaf deposits and sunken logs. Juveniles can be found hiding beneath drift line detritus and vegetation along the edge of the water (Vogt et al. 2011). *D. mawii* abilities include being able to 1) extract oxygen from water through their buccopharyngeal mucosa (Winokur 1988), 2) function at a lower temperature than many other aquatic reptiles, and 3) not having to bask which allows these turtles to remain on the water bottom for long stretches of time. While young juveniles sometimes climb riparian tree limbs that they can reach from the water to eat the leaves, females leave the water to lay their eggs, and turtles occasionally make short crossings over land to escape drying ponds, for the most part, they are totally aquatic. *D. mawii* seem to move around much less during the dry season, sometimes being isolated in the deeper parts of drying pools (García-Anleu et al. 2010), often buried

in the mud. Movements increase appreciatively during the wet season, probably a factor of food availability. They forage on riparian leaves during high water periods. In the lower, coastal-influenced reaches with salt wedge estuaries, turtles also move in response to tidal cycles, often feeding on floating plant debris brought in with the rising tides day or night (Moll 1989, Polisar 1992). *D. mawii* living in areas with adequate food resources were shown to move less distance during the day than turtles living in less productive areas (Legler and Vogt 2013).

Predators & Parasites

D. mawii are preyed upon throughout all life stages, but mostly during the early stages. Egg predators include Coatimundi (*Nasau narica*), Racoons (*Procyon lotor*), Limpkins (*Aramus guarauna*), Wood rails (*Aramides cajanea*), and herons (Family Ardeidae) (Moll 1986). Hatchlings and young to medium size juveniles are highly vulnerable to the forementioned predators. Young and intermediate-sized turtles are preyed upon by crocodiles (*Crocodylus moreletii* and *C. acutus*) (Moll 1986, Smith and Smith 1980). Neotropical Otters (*Lutra longicaudis*) have been documented eating juvenile and subadult *D. mawii* (García-Anleu et al. 2010, Platt and Rainwater 2011). The most intensive predator on adult *D. mawii* are humans, who often take large numbers of females with eggs in the dry season months (Moll 1986; Polisar 1990; Rainwater et al. 2010a, 2010b; Vogt et al. 2011). Parasitism by leeches is common and sometimes occur in large numbers but without any obvious, noticable health impairment (Rangel-Mendoza et al. 2009). A study conducted in southern Mexico found intracellular hemoparasites (*Haemogregarina* sp.) in all wild turtles tested and higher parasite loads during the wet season (Rangel-Mendoza et al. 2009). Hemoparasites are common parasites in reptiles and are usually non-pathogenic. Overall, wild populations tested were healthier than captive reared turtles, even though all wild turtles carried hemoparasites and none were found in captive turtles sampled (Rangel-Mendoza et al. 2009). A new Coccidian has recently been reported from *D. mawii* within Belize (Jacobson et al. 2022).

Causes of Decline

Cultural Significance

Over-harvesting is by far the main cause of decline for *D. mawii*. The most intensive over-harvesting is illegal fishing, using gill nets and masks with snorkels to catch large numbers of turtles for the market. This situation occurs due to lack of effective enforcement of current legislation protecting this species, involving illegal fishers, merchants who buy from these fishers and sell to the public, and the consumers willing to pay a high price for a traditional cultural dish. Given the high harvest rates (sometimes reaching 50 turtles per night for a group of illegal fishers) and the slow generation time of 15–17 years, the IUCN (2016) has predicted a rapid decline in *D. mawii* populations over the next few decades, edging the species toward extinction (Vogt et al. 2006).

Other factors contributing to population declines include habitat loss through riparian deforestation and drainage of wetlands, representing loss of nesting areas and food resources. Degradation of aquatic systems is occurring through contamination by sediment loads, pesticides, fertilizers, household and industrial chemicals, sewage, and hormones. Increased nutrient loading has created eutrophic conditions during the dry season, impacting all aquatic life in the New River and other systems. Introduced species, including pathogens and parasites, and species such as armored catfish that undermine riverbanks and tear out aquatic plant beds, are also expected to have an impact.

Sand and gravel excavation from rivers disrupts river bottoms and creates bed erosion. Washing sand and gravel on the riverbank adds to the sediment load created by riparian deforestation, creating heavy siltation of lower reach riverbeds, eliminating *D. mawii* from reaches they previously occupied (Rainwater et al. 2010a, 2012). Disruption of connectivity among water bodies used by *D. mawii* can disrupt movement and genetic flow.

D. mawii is culturally significant throughout its present-day range. This turtle contributed to the diets of pre-Classic Maya populations that settled in the Yucatan Peninsula (Gonzales-Porter et al 2011). Today, *D. mawii* is hunted for meat and eggs throughout most of its current range, having been extensively over-hunted in México and Guatemala (Campbell 1998, Moll 1986, Polisar 1994; 1995, Rainwater et al. 2012). Heavy harvest of *D. mawii* occurs to supply markets around Lent and Easter, but also at other times of the year. Considered to be a special traditional dish, it is often sold by vendors to riverside crowds within the Belize River Valley during the La Ruta Maya canoe race. However, increased enforcement of the law over the past few years has greatly reduced the open sale of live *D. mawii* and its meat. The sale of *D. mawii* in local markets within towns and cities and out of select grocery freezers is still profitable and commonly practiced (Holman 1964, Moll 1986, Polisar 1995, communication with local fishers, pers. com, Boles). Females with eggs are particularly sought because they fetch a higher price at the market. Fishing methods include free diving, harpooning, fishing with line and hook baited with fruit, and gill nets. Free diving is one of the most effective capture methods, particularly during the dry season when the waters are clearer (Polisar 1995). Gill nets are stretched across a river or lagoon and turtles driven toward the nets by shaking heavy chains within the water column, or herding turtles by teams of free divers, a practice now widely used and representing the most significant threat to this species. Fishes, and other river fauna used as food within a reach are also usually taken, leaving the river length barren.

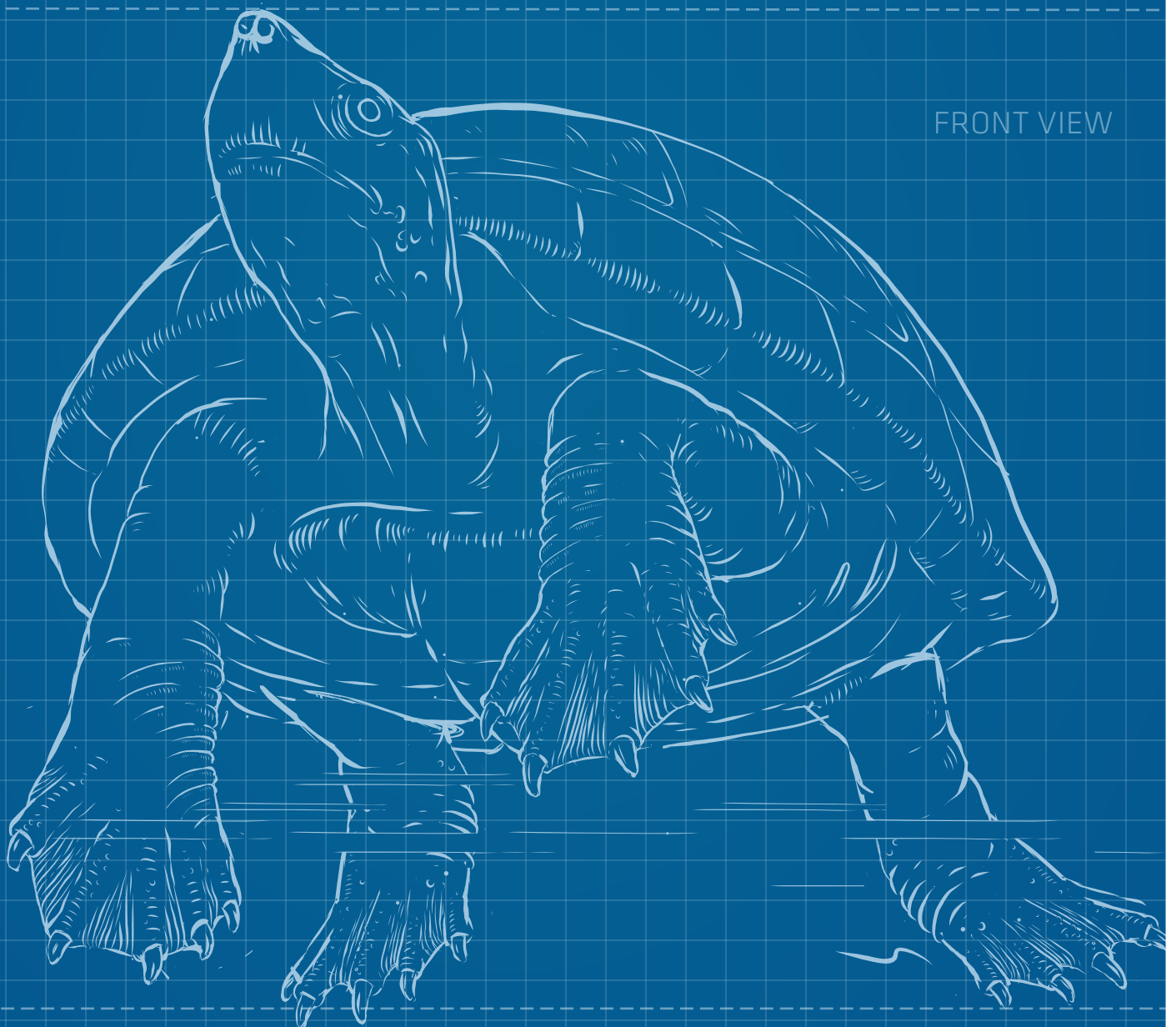
The IUCN Species Survival Commission Action Plan for the Conservation of Tortoises and Turtles considers *D. mawii* to be a high priority species given its low population numbers and hunting pressures (IUCN 2016). This helps give local to international attention to this species and access to funding to directly and indirectly contribute to the survival of *D. mawii*. The GoB legislated protection of *D. mawii* in 1993 based on recommendations from field assessments (Polisar 1992, 1994). Limits included the number of turtles one could have in possession, a one month closed hunting season in May, and established protected zones. Legislation included year-round possession limits, a brief non-hunting season (1–31 May), protected areas within northern Belize, and prohibition on marketing *D. mawii* (Vogt et al. 2006). The National Hicatee Conservation and Monitoring Network (HCMN) created in 2010 called for a revision of the legislation in 2011 (Briggs-Gonzalez et al. 2018). As a result, the May 1st to 31st closed season was established, possession limit was set at three turtles per person and five turtles per vehicle, females had to be between 38 and 43 cm in length, *D. mawii* could not be sold or bought, and use of gill nets was prohibited for catching *D. mawii* (Government of Belize, Regulation 14:02, Fisheries Amendment No. 2, Chapter 210, July 2011). No-take zones were identified in areas of the Rio Bravo, New River, Belize River, Mussel Creek (Cox Lagoon and Mucklehany Lagoon), Sibun River, Northern Lagoon, Southern Lagoon, and tributaries of these lagoons. (Government of Belize, Fifth Schedule Regulation 12:02[e]). In 2016 HCMN called for a legislation update and requested an additional review. Rio Hondo is a priority *D. mawii* conservation area (Calderón-Mandujano 2008, Calderón-Mandujano et al. 2017). Poaching for the market remains a severe threat to the species, even as enforcement and growing involvement of traditional fishers and their riverside communities increase. Harvest rates have been unaffected as Rainwater et al. (2012) reported a decade ago, or even increasing with current Facebook videos showing takes of 50 turtles per night.

The Hicatee Conservation and Research Center (HCRC) was established in 2014 at BFREE in southern Belize along the upper Bladen River (Marlin 2012; Marlin and Barrett 2014). Within one-year turtles nested and eggs started hatching (BFREE 2018). The captive rearing facility currently has three fenced ponds housing 46 adult turtles (17 males and 29 females) and is hatching and rearing from 250 to 350 juveniles per year, with numbers increasing each year. The BFREE HCRC has begun releasing captive reared turtles in nine different aquatic systems in Belize where much of its breeding stock originated (Barrett 2020). To date, over 1000 captive bred and reared *D. mawii* have been introduced into natural habitats representing seven cohorts.

During the last 15 years active research has been ongoing within all three countries. This includes population structure, status, and distribution in Guatemala (Barahona and Lopez 2015; García-Anleu et al. 2007, 2010; Juarez et al. 2009; Morales 2009), México (Calderón-Mandujano 2008; Calderón-Mandujano et al. 2017; Guichard-Romero 2006; Ruiz et al. 2010; Solis et al. 2010; Zenteno 2007, 2011; Zenteno et al. 2010), and Belize (Briggs-Gonzalez et al., unpublished data; Requeña et al. 2015; Rainwater et al. 2010a, 2012, Ligon et al., unpublished data). Population genetics within the *D. mawii* range has also been studied, showing long term movement and translocation related to trade (González-Porter et al. 2011, 2013; Syed et al. 2007).

Goals

Seven initial goals, the problems and causes leading to the need for each goal, and a set of proposed actions to reach each one.



During 2020 through 2021, preparatory small workshops and meetings hosted by BFREE were held to lay the groundwork for the creation of a conservation, management, and action plan for *D. mawii*. The meetings resulted in the identification of seven initial goals, the problems and causes leading to the need for each goal, and a set of proposed actions to reach each goal. This initial outline led towards two strategic remote planning workshops, the 3rd Hicatee Conservation Forum and Workshop held on May 17, 2022, and the 4th Hicatee Conservation Forum and Workshop held on December 1, 2022. During the May 17th workshop, over thirty-five experts attended to review, discuss, modify, and refine the initial outline, providing rich discussions supporting acceptance and/or modification of goals and actions that resulted in a first draft plan. The December 1st workshop brought together an equal number of experts to review, modify, and validate the first draft, as well as identify commitments from experts to implement specific actions in the plan. A final workshop was held January 31st, 2025 to validate the plan. Additional information is provided below that summarizes discussions during the workshops.

1 Minimize the illegal collection and trade of *D. mawii* through improved public awareness of the laws and effective enforcement.

Problem: Lack of sufficient manpower to implement necessary enforcement.

Cause: Belize Fisheries Department is underfunded and understaffed.

Workshop Discussion Summary: The Fisheries Department cannot protect *D. mawii* populations from over-exploitation without help. The two most critical sources of help are from the riverside communities, especially resident fishers, and from NGOs and CBOs that manage protected areas within *D. mawii* ranges. Fisheries officers must include education and awareness as part of their job, as mandated through legislation, even while they are making inspections and arresting people. There is a point in the

enforcement/awareness paradigm, where awareness overtakes enforcement as compliance with laws is normalized as they become accepted by the society. Currently, there is little to no enforcement, so minimal threat of prosecution or punishment exists for the public engaged in these illegal activities.

2 Enhance existing regulations to better align with the long-term sustainability of the species.

Problem: Current laws and regulations regarding the lawful harvest of *D. mawii* are not in alignment with the species' biology.

Cause: When the current legislation was drafted there was insufficient information on the natural history of the species.

Workshop Discussion Summary: Courtship and breeding in captive populations occurs from July to September, with egg-laying season running from October through April. Existing regulations are inadequate to protect the species during this critical reproductive season. A full assessment of *D. mawii* needs to be made based on the most up to date science that will inform the development of revised laws and regulations by allowing the natural biological cycle of reproduction to continue and restore the species to healthier previous numbers.

3 Increase appreciation for *D. mawii* as a critical member of Belize's rivers and a national emblem of Belize rather than strictly a food source.

Problem: The plight of the species remains unknown to most of the public.

Cause: Natural history of the species lends itself to being overlooked.

Workshop Discussion Summary: The Hicatee is a culturally engrained resource, that has both meaning for sustenance, but also celebration. A general trend is that older members of communities still eat *D. mawii* while the younger people tend to be moving away from those traditions. People who have moved away from the villages some time ago for jobs in towns and cities want to buy turtles during Easter

time, for cultural and religious reasons. Since 2011, there have been a variety of outreach initiatives by numerous entities to increase awareness about the plight of *D. mawii* in Belize including the production of a short documentary, songs, media pushes, as well as the establishment of Hicatee Awareness Month. There has also been an effort to lobby for *D. mawii* to become the National Reptile of Belize. Current recommendations include a more targeted focus on adults within the communities where *D. mawii* is heavily hunted and educating consumers, including restaurant owners and food-stall venders, as to the laws and their impact from buying and selling *D. mawii*.

4 Maintain an assurance colony and conduct research on reproductive biology and nesting ecology through a captive management program.

Problem: Historically there has been a paucity of data on the reproductive biology and nesting ecology of the species.

Cause: Due to the secretive nature of the species, reproductive biology and nesting ecology is difficult to research in the wild.

Workshop Discussion Summary: An assurance colony in captivity is vital to safeguard the species from possible extinction. Captive breeding is essential to provide offspring for rewilding into populations that have been depleted but can also serve as opportunities for research on reproductive biology, nesting ecology, egg incubation, and behaviors, all are aspects of their biology that are difficult to study in the wild.

5 Augment declining and extirpated populations through reintroductions of captive raised *D. mawii*.

Problem: Wild populations are not self-sustaining.

Cause: Recruitment is too low to compensate for the current harvest rates.

Workshop Discussion Summary: The biology of *D. mawii*, with its long generation time, and current rates of unsustainable harvest is not conducive to population rebound. As such, human mediated population augmentation is needed to kick start these recovery actions. The HCRC was founded to refine the techniques needed to breed, hatch, and headstart the species. Significant progress has been made in the captive breeding of *D. mawii* from eggs to juveniles

ready for release. A major concern expressed was the release of captive-bred and reared turtles into populations that are genetically different from the wild turtles. TSA has access to cutting-edge genetic analysis, allowing for the modeling of gene flow between watersheds and between the upper and lower end of aquatic corridors to be mapped. Assessment of founder individuals is required to maintain high genetic diversity and prevent inbreeding. Each distinct population of wild turtles in need of augmentation requires captive-reared turtles from parents genetically representative of the population into which their offspring will be released, and occasional wild turtles from the same population introduced into the captive population to maintain genetic viability. This will require formulating a “*D. mawii* captive breeding manual.”

6 Develop comprehensive knowledge about the species including population assessments, natural history, current status, and *D. mawii* human interactions in Belize.

Problem: Comprehensive knowledge on the natural history and human-species interaction is lacking.

Cause: *D. mawii* ecology and human-species interactions haven’t been well-studied in Belize.

Workshop Discussion Summary: Little is known about specific distribution, population sizes, and natural history of *D. mawii* throughout Belize. Villagers/fishers/locals should be included as active participants in these assessments to encourage participation and inform understanding of the historic and current threats in the region. This collaborative effort will aid in tailoring threat abatements in the region. Beyond biology, ecology, and genetics research, extensive social science research is needed throughout riparian aquatic corridor communities and the entire range of *D. mawii*. Population assessments must be conducted around the country to plan for *D. mawii* population management, using standard methods for comparison across research teams.

7 Identify, protect, and conserve at least five self-sustaining robust populations of *D. mawii* in perpetuity.

Problem: Few known healthy *D. mawii* populations exist in Belize.

Cause: Protected areas in Belize are not specifically focused on the long-term conservation of the species.

Workshop Discussion Summary: Some potential areas to consider for protection include: The New River Lagoon, The Belize Maya Forest, the Maya Forest Corridor that includes Cox Lagoon, Whitewater Lagoon, the lower Sibun River including Freetown Sibun Village, and southern Belize including the Rio Grande. Sites need to be classified by location, importance, level of current protection, particularities of the ecosystems such as invasive species, and social aspects and interests of local community members to make decisions as to where protection investment should be made. A site may not have the healthiest populations but still may have the highest potential for successful protection, and ultimately restoration. Outside of conservation action research, community-based conservation efforts are essential and must involve fishers, youth, and women. That support must inform and engage other communities about current conservation initiatives led by several key communities to protect traditional fishing areas from illegal fishers. A prime example of this is the landscape scale opportunity that exists in the lower Belize River riparian/aquatic corridor, the stronghold of *D. mawii* populations within Belize, to form a functioning network among the six different NGOs and CBOs sharing common goals of conserving and protecting the ecological integrity of the lower Belize River Valley ecosystems and wildlife.

8 Protect and restore aquatic and riparian *D. mawii* habitat.

Problem: Aquatic systems that support *D. mawii* populations are becoming degraded.

Cause: Unsustainable land use practices, including agriculture, riparian deforestation, and gravel mining are negatively impacting the health of aquatic systems.

Workshop Discussion Summary: Riparian forests and wetlands provide vital services critical to *D. mawii* populations, sustaining bank areas used as nesting sites, providing food resources and access during high water conditions, contributing nutrients that keep aquatic systems viable, and capturing and filtering terrestrial runoff by removing many pollutants before they enter streams, rivers, and lagoons.

Conservation & Management Actions

The following table of *Conservation & Management Actions* is proposed to address the goals described on the previous pages. Fifty-eight actions are listed under eight action categories. Out of these, thirty-five actions are currently in some state of activity. Each of these actions have been categorized as to the goal or goals they support (listed as 1 through 8), the action year or years within the timeframe of the five year plan (1–5) during which each goal should be implemented, status of the action (whether it is being discussed, proposed, or implemented), and the geographical scale of the project (local communities, national, international). Eight of these actions have been rated as very high priority and are in red; those actions considered to be of critical importance in addressing the most immediate threat to the species. The right-hand column lists those organizations involved and/or committed to focus on each specific action. Several actions listed in the Action Table have already been implemented. Many other actions can be implemented as projects taken on by competent individuals such as graduate students and short-term contracted individuals. These offer great opportunities for local, qualified youths and adults to become involved, trained, and supported in the implementation of some of these actions. There is also an opportunity to inject money into the local economy through alternative jobs. Some of these actions are multi-organization undertakings and require planning and coordination among groups of institutional management teams and representatives.

Conservation & Management Actions



List of 58 actions needed to achieve the conservation goals with proposed years to be implemented, status, action scale and involved/committed organizations. **Actions in red are very high priority.**

Key for acronyms
under flap on inside back cover.

1. LAW ENFORCEMENT	Goal	Years	Status	Scale	Involved & Committed
1.1 Strengthen the Fisheries Department's institutional capacity to adequately enforce <i>D. mawii</i> regulations and secure an operational budget through strategic funding sources.	1	4–5	Discussed	National	Fisheries Dept.
1.2 Create community watch/riverkeeper programs (an observation, alert, and awareness network) and a junior riverkeeper program.	1	2–5	Discussed	National	Fisheries Dept., BFREE, SFS, BMFT, CBS WCG, TREES, Relevant community groups
1.3 Train and empower select members of the communities as special constables to be rangers who enforce the laws, following established criteria for designation.	1	2–5	Discussed	Local	Fisheries Dept., TSA, WCS
1.4 Develop a strong working relation with the local Police Officers through their central command as well as face-to-face and on-the-ground/on-site meetings.	1	1–5	Active	Local	WCS, BWRC, TREES
1.5 Coordinate targeted BDF patrols with Fisheries Department personnel, gaining experience on waterways.	1	1–5	Planned/ Proposed	Local	Fisheries Dept., BDF
1.6 Promote and support a sense of community ownership of and responsibility for the ecosystems where <i>D. mawii</i> live, especially among fishers.	1,7	1–5	Planned/ Proposed	Local	Fisheries Dept., WCS, CBS WCG, BMFT, TREES
1.7 Address the major threats by poachers from outside of the communities and protected areas.	1,7	1–5	Active	Local	Fisheries Dept., WCS
1.8 Set up patrols focused on protecting key recovering <i>D. mawii</i> populations from poachers.	5,7	1–5	Active	Local	WCS, BMFT
1.9 Establish community-agreed bans on illegal harvest gear and practices.	1	1–5	Active	Local	Fisheries Dept.
1.10 Establish “no-take” zones within community and GoB protected areas where full protection is provided.	1,7	1–5	Active	Local	Fisheries Dept., Relevant community groups
1.11 Apply existing regulations to restaurants and other components of the black-market purchasing <i>D. mawii</i> meat for sale to the public.	1	1–5	Active	National	Fisheries Dept., Police Dept.

2. LAWS & REGULATIONS		Goal	Years	Status	Scale	Involved & Committed
2.1	Conduct a review of current literature and other sources of information including experts and develop a proposed revision of Fisheries regulations based on new information.	2	1	Active	International	BFREE, SFS, RE:wild, Fisheries Dept.
2.2	Identify and enlist the support of Civil Society (conservation minded fishers inclusivity) having an eye for the future to promote appropriate changes in the law.	2	1–5	Discussed	National	WCS, CBS WCG, TREES
2.3	Encourage the Fisheries Department to develop and implement strategies for enhanced legislation based on community consultations.	2	1–2	Active	National	Fisheries Dept., BFREE
2.4	Encourage the recognition of traditional fishing grounds and the right of communities to protect their fishing grounds against poachers, sand and gravel miners, illegal loggers, and improper development.	1,7	1–5	Discussed	National	Fisheries Dept., Forest Dept., DoE, Mining Unit, Relevant community groups
3. COMMUNITY OUTREACH & EDUCATION						
3.1	Identify priority communities to engage.	3	1–2	Active	Local, National	BFREE, SFS, WCS, BMFT, TREES
3.2	Develop and implement community engagement strategies that are targeted to the selected communities.	3	2–5	Active	Local, National	BFREE, SFS, WCS, BMFT, TREES
3.3	Use head-started turtles for outreach and education during release events.	3	2–5	Active	National	BFREE, SFS, WCS, BWRC
3.4	Implement the National <i>D. mawii</i> Awareness Campaign annually.	3	1–5	Active	Local, National	BFREE, LFRC, SFS, WCS, BWRC, TREES, IJC
3.5	Develop installation of a <i>D. mawii</i> exhibit at the Belize Zoo.	3	2–3	Discussed	Local	BFREE, SFS, Belize Zoo, BWRC
3.6	Advocate for <i>D. mawii</i> to be identified as the National Reptile of Belize.	3	1–5	Discussed	National	BFREE, SFS, BMFT, BWRC, TREES
3.7	Develop and conduct social surveys to inform community outreach objectives.	3	2	Planned/Proposed	Local, National	BFREE, WCS, BMFT, TREES
3.8	Assess the effectiveness of community outreach efforts.	3	2–5	Planned/Proposed	National	BFREE, WCS, BWRC, TREES
3.9	Assess harvest rates and patterns through community consultation.	1,3,6	2–5	Discussed	National	CBS WCG, TREES, UB/ERI

Conservation & Management Actions *Cont.*

4. CAPTIVE MANAGEMENT	Goal	Years	Status	Scale	Involved & Committed
4.1 Maintain an assurance colony.	5,6	1–5	Active	National	BFREE, BWRC
4.2 Produce head-started turtles for reintroduction efforts.	5	1–5	Active	National	BFREE, BWRC
4.3 Conduct conservation related research with captive bred turtles.	6	1–5	Active	Local	BFREE, BWRC, SFS
4.4 Produce a manual on captive husbandry, best management practices, and release methods.	4	3	Discussed	Local	BFREE, BWRC, TSA
4.5 Access the viability, economics, and policy of farming <i>D. mawii</i> .	1,6	4	Discussed	Local	BFREE, Fisheries Dept.
5. REINTRODUCTIONS					
5.1 Study populations containing reintroduced turtles to help inform conservation efforts/refine reintroduction strategies.	4,5,6	1–5	Active	National	BFREE, SFS, TREES
5.2 Augment wild populations with head started turtles pending the determination of its efficacy for the species.	5	1–5	Active	National	BFREE, SFS, TSA, TREES
5.3 Develop new populations with head started turtles based on the determination of appropriateness for each potential location.	5	2–5	Discussed	National	BFREE, BWRC, SFS, TSA, TREES
5.4 Post-reintroduction monitoring of head-start turtles.	5	1–5	Active	National	BFREE, SFS, TREES, WCS
5.5 Collaborate with/involve traditional fishers within release areas.	5	2–5	Planned/ Proposed	Local, National	BFREE, SFS

6. RESEARCH	Goal	Years	Status	Scale	Involved & Committed
6.1 Develop a collaborative up-to-date list of researchers with their contact information and locations of their respective study sites.	4	1–5	Active	International	BFREE
6.2 Update the bibliography of published and gray literature on <i>D. mawii</i> initiated by Briggs-Gonzales et al. (2018).	4	1–5	Active	International	BFREE, RE:wild
6.3 Develop and maintain a full electronic archive of <i>D. mawii</i> documents in PDF format accessible to researchers, students, and the general public.	4	1–5	Active	International	BFREE, Re:wild, National Library Service
6.4 Host/support Dermatmys conference that moves among Belize, Mexico, and Guatemala.	5	1,3,5	Planned/Proposed	International	BFREE, TREES, TSA
6.5 Build stronger and more interconnected <i>D. mawii</i> research consortium supported by graduate student exchanges and similar initiatives.	4,6	1–5	Active	International	BFREE, LFRC, SFS
6.6 Establish standardized measurements and survey protocols for studies range-wide.	4,6	1	Active	International	BFREE, LFRC, SFS, WCS, TREES
6.7 Engage selected, career-focused youth in helping gather culturally sensitive information from fishers and others, and recruit and train Belizeans, including youth, in sound research methodology.	4,6	1–5	Planned/Proposed	Local, National	BFREE, BMFT, LFRC, SFS, TREES
6.8 Assess sizes and demographics of <i>D. mawii</i> populations.	4,6,7	1–5	Active	Local, National	BFREE, BMFT, LFRC, SFS, TREES, WCS
6.9 Conduct country-wide surveys in Belize (involves several organizations working within different areas of the country).	4,6,7	1–5	Active	Local, National	BFREE, LFRC, SFS, TREES, ZNE
6.10 Conduct comparative population genetics studies.	4,5,6,7	1–5	Active	National	BFREE, LFRC, SFS, TSA, WCS
6.11 Conduct in-situ disease monitoring studies.	5,6	1–5	Active	National	BFREE, BWRC, LFRC, SFS
6.12 Conduct movement and habitat assessments.	5,6,7	1–5	Active	Local, National	BFREE, BMFT, LFRC, SFS, TREES, WCS
6.13 Conduct comprehensive life history studies.	5,6,7	1–5	Active	Local, National	BFREE, BMFT, LFRC, SFS, TREES
6.14 Engage select fishers as active and vital members of research teams.	4,6,7	1–5	Active	Local, National	BFREE, SFS, TREES

Conservation & Management Actions *Cont.*

7. CONSERVATION IN SITU	Goal	Years	Status	Scale	Involved & Committed
7.1 Conduct a feasibility assessment to identify locations of robust, healthy populations of <i>D. mawii</i> for long-term conservation, or at least the five best sites with the highest probability for long-term conservation.	7,4,6	1–5	Active	National	BFREE, BMFT, LFRC, SFS, TSA, WCS
7.2 Secure critical sites through appropriate measures, such as has occurred with Cox Lagoon.	7	1–5	Planned/ Proposed	National	BFREE, WCS
7.3 Assist in the development of a regional <i>D. mawii</i> management plan and more specific local management plans/strategies for local populations.	1,3,4, 5,6,7	1–5	Discussed	Local, National, International	Fisheries Dept., BFREE, BMFT, LFRC, SFS, TSA
7.4 Investigate the source of poachers from within and outside of the local communities involved in overseeing the <i>D. mawii</i> populations in their area.	1,3,7	1	Active	National	BFREE, CBS WCG, BWRC, TREES, Fisheries Dept.
7.5 Help build a protected riparian/aquatic corridor among all six protected areas co-managers and associated GoB agencies within the lower BRV where harvesting is a carefully managed activity and conservation focused on <i>D. mawii</i> is an overriding concern.	1,3,4, 6,7	1–5	Discussed	Local	Fisheries Dept., DoE, Forest Dept., NBio, CBS WCG, BRVPAs, BMFT
7.6 Help guide the development of the next generation of <i>D. mawii</i> researchers, conservation officers, fishers, and managers through engaged, field-focused youth programs and research/assessment/ monitoring activities.	1,3,4	1–5	Active	National	BFREE, BMFT, LFRC, SFS, WCS, TREES
8. HABITAT RESTORATION & CONSERVATION					
8.1 Identify organizations working to improve livelihoods and food sovereignty within each area where populations of <i>D. mawii</i> are being conserved and protected.	1	1	Active	Local	BRVPAs, Ministry of Agriculture, WCS
8.2 Identify organizations working to restore, conserve, and protect riparian forests and wetlands within each area where populations of <i>D. mawii</i> are being conserved and protected.	7	1	Active	Local	Forest Dept., CBS WCG
8.3 Meet with the management and administration of each organization identified, including those co-managed protected areas to identify and discuss common interests.	1, 7	1	Active	Local	BRVPAs, NBio
8.4 Support the work of organizations working to reduce impact of agriculture and development and to protect and restore riparian forests and wetlands, financially and/or through projects of mutual interest, promoting efforts that directly/indirectly benefit local <i>D. mawii</i> populations.	1	1–5	Planned/ Proposed	National	WCS, CATIE, IICA, Ministry of Agriculture, Forest Dept.

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Colophon

Book design and underwater *D. mawii* Illustrations on cover, inside front cover, pages vi and 14 by Andrew McKinley. Text is set in *Livory* by Hannes von Döhren and Livius Dietzel from HVD and tables are set in *Klavika* by Eric Olson from Process Type Foundry.

Names & Acronyms

BDF	Belize Defense Force (GoB)
BFREE	Belize Foundation for Research & Environmental Education
BMFT	Belize Maya Forest Trust
BRVPA's	Belize River Valley Protected Areas
BWRC	Belize Wildlife & Referral Clinic
Belize Zoo	The Belize Zoo & Tropical Education Center
CATIE	El Centro Agronomico Tropical de Investigacion y Ensenanza
CBSWCG	Community Baboon Sanctuary Women's Conservation Group
DoE	Department of the Environment (GoB)
DRCC	Dermatemys Research & Conservation Community
ECOSUR	El Colegio de la Frontura Sur
Fisheries Dept.	Fisheries Department (GoB)
Forest Dept.	Forest Department (GoB)
GoB	Government of Belize
IJC	Independence Junior College
IICA	Inter-American Institute for Cooperation on Agriculture
LFRC	Lamanai Field Research Center
Mining Unit	Mining Unit (GoB)
Ministry of Agriculture	Government of Belize
SFS	Savannah Field Station
NBio	National Biodiversity Office (GoB)
National Library Service	Government of Belize
PfB	Programme for Belize
RE:wild	FKA Global Wildlife Conservation
TREES	Toucan Ridge Ecology and Education Society
TSA	Turtle Survival Alliance
UB/ERI	University of Belize Environmental Research Institute
UNDP GEF	United Nations Development—Global Environmental Facility
WCS	Wildlife Conservation Society
ZNE	Zoo New England

TURTLE SURVIVAL ALLIANCE (TSA)

A global action-oriented partnership dedicated to preventing the extinction of tortoise and freshwater turtle species through science-based conservation. Founded in 2001 in response to the Asian turtle crisis, the organization works across five continents to restore wild populations, protect habitats, and manage assurance colonies.



BELIZE FISHERIES DEPARTMENT

The government body established in 1965 to sustainably manage and develop the nation's aquatic resources through, among others, the Fisheries Act of 1948. It focuses on managing marine protected areas and implementing sustainable fishing regulations to protect resources, including the significant queen conch and spiny lobster industries.

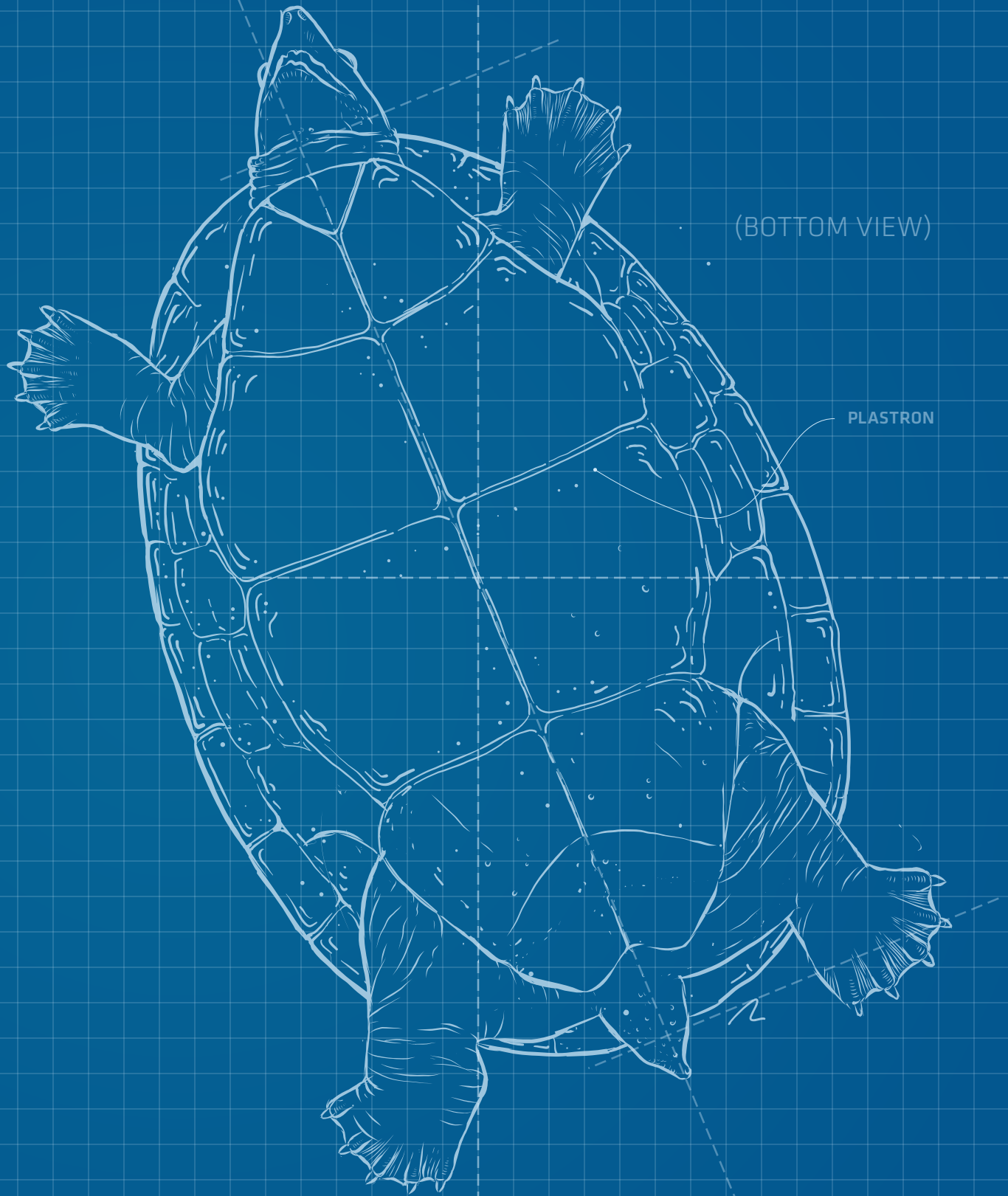
BELIZE FOUNDATION FOR RESEARCH & ENVIRONMENTAL EDUCATION (BFREE)

A field station and non-profit dedicated to conserving tropical biodiversity through scientific research and environmental education. Their 1,153-acre private reserve protects critical habitat while supporting the recovery of endangered species like the Hicatee turtle.



ZOO NEW ENGLAND

Operator of the 72-acre Franklin Park Zoo in Boston and the 26-acre Stone Zoo in Stoneham MA, USA, focusing on education, conservation, and engaging wildlife experiences. These accredited institutions offer diverse exhibits, including tropical forests, African experiences, and local New England species, to inspire visitors to protect the natural world.



(BOTTOM VIEW)

PLASTRON