

Using Citizen Science and Machine Learning to Identify and Track Individual Sea Turtles in the Florida Keys



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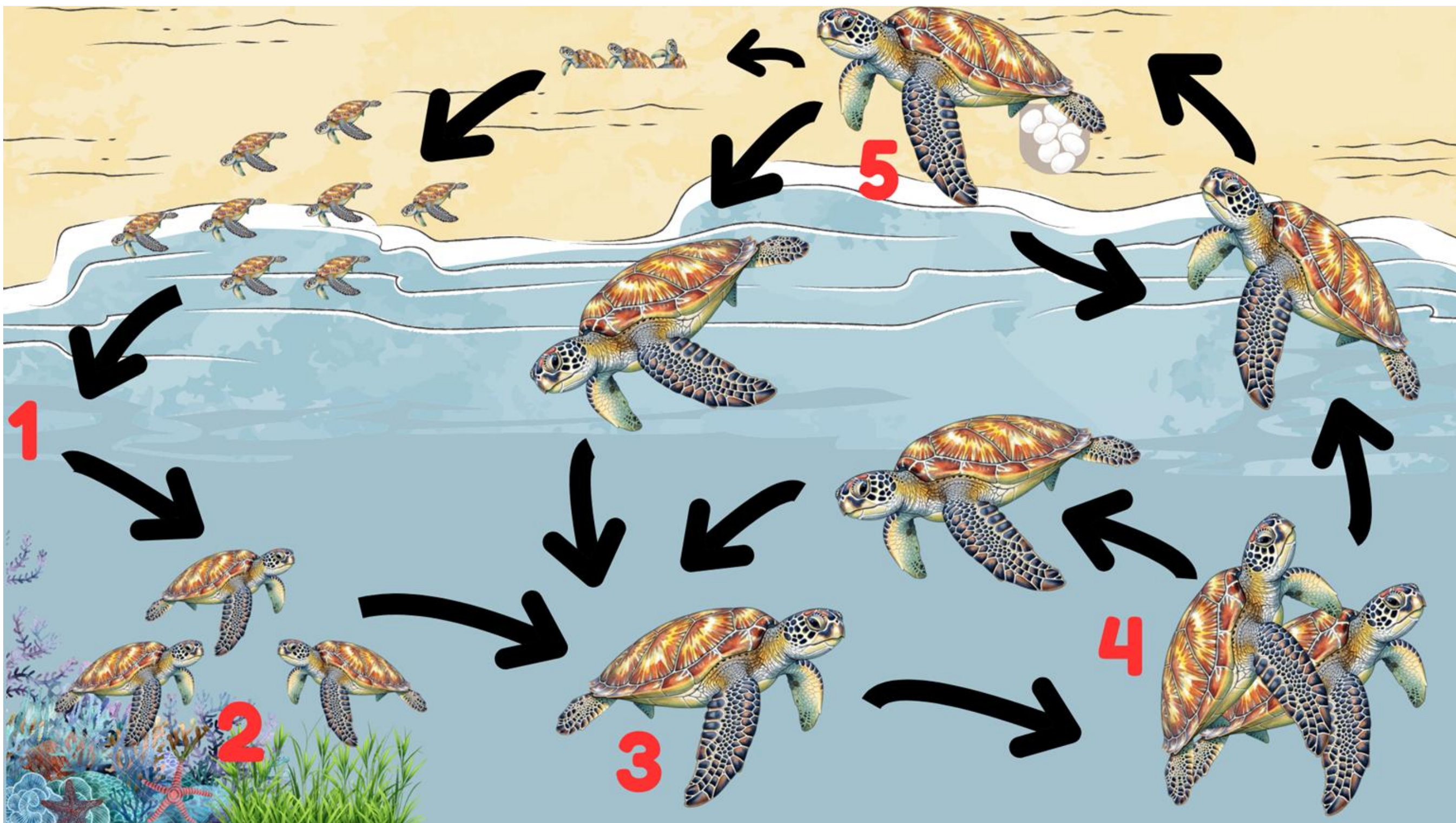


Figure 1. Generalized life cycle of the green sea turtle (*Chelonia mydas*) illustrating major ontogenetic stages and associated habitats. After an early oceanic dispersal phase (1), juveniles recruit to neritic habitats such as coral reefs, seagrass beds, and coastal hard-bottom (2), where they forage and grow through their sub-adult stages. Adults undertake long-distance migrations between neritic foraging grounds (3), breeding areas (4), and nesting beaches (5).

METHODS

- We solicited divers, snorkelers, and marine professionals throughout the Florida Keys for photographs and videos of marine turtles observed on the Florida Reef Tract.
- Submissions were considered usable if they included:
 - A clear view of facial scutes (left or right head profile)
 - Date of observation
 - Location of observation (GPS coordinates or name of dive site)
- Images were processed to maximize contrast and crop as needed. Final images were uploaded to the FL Keys Photo ID Sea Turtle Project on the Internet of Turtles platform. All available metadata accompanied each submission.
- The platform applies computer vision and machine learning (scute pattern recognition, head topology) to generate candidate ID matches against the existing database.
- Candidate matches were verified by visual inspection: confirmed matches were assigned to an existing individual ID, while unmatched turtles were given a new ID.
- Each match indicates a unique encounter for a known individual. Repeated sightings of the same individual across spatial and temporal scales allow us to explore movement, residency, and site fidelity on the reef.

INTRODUCTION

- Sea turtles are long-lived, highly migratory species that connect oceanic, coastal, and reef ecosystems, making them important ecological links across habitats.
- After dispersal from the pelagic zone, juveniles often recruit to neritic habitats such as coral reefs, where they undergo an ontogenetic shift in diet, behavior, and habitat use.
- Coral reefs in the Florida Keys provide important foraging and refuge habitats for juvenile and sub-adult hawksbills, greens, and loggerheads, but their fine-scale residency and movements across reefs remain poorly described.
- Understanding how turtles move within and among reef patches is essential for interpreting habitat use, site fidelity, and the role of reefs in supporting early life-history stages.
- Traditional approaches like telemetry have provided valuable insights but are limited in sample size and duration; photo-identification offers a powerful, non-invasive tool to document individual reef use and movement over time.
- Here, we use photo-ID of juvenile and sub-adult turtles in the Florida Keys to characterize their reef-scale movements and habitat use, providing new insight into this understudied life stage.

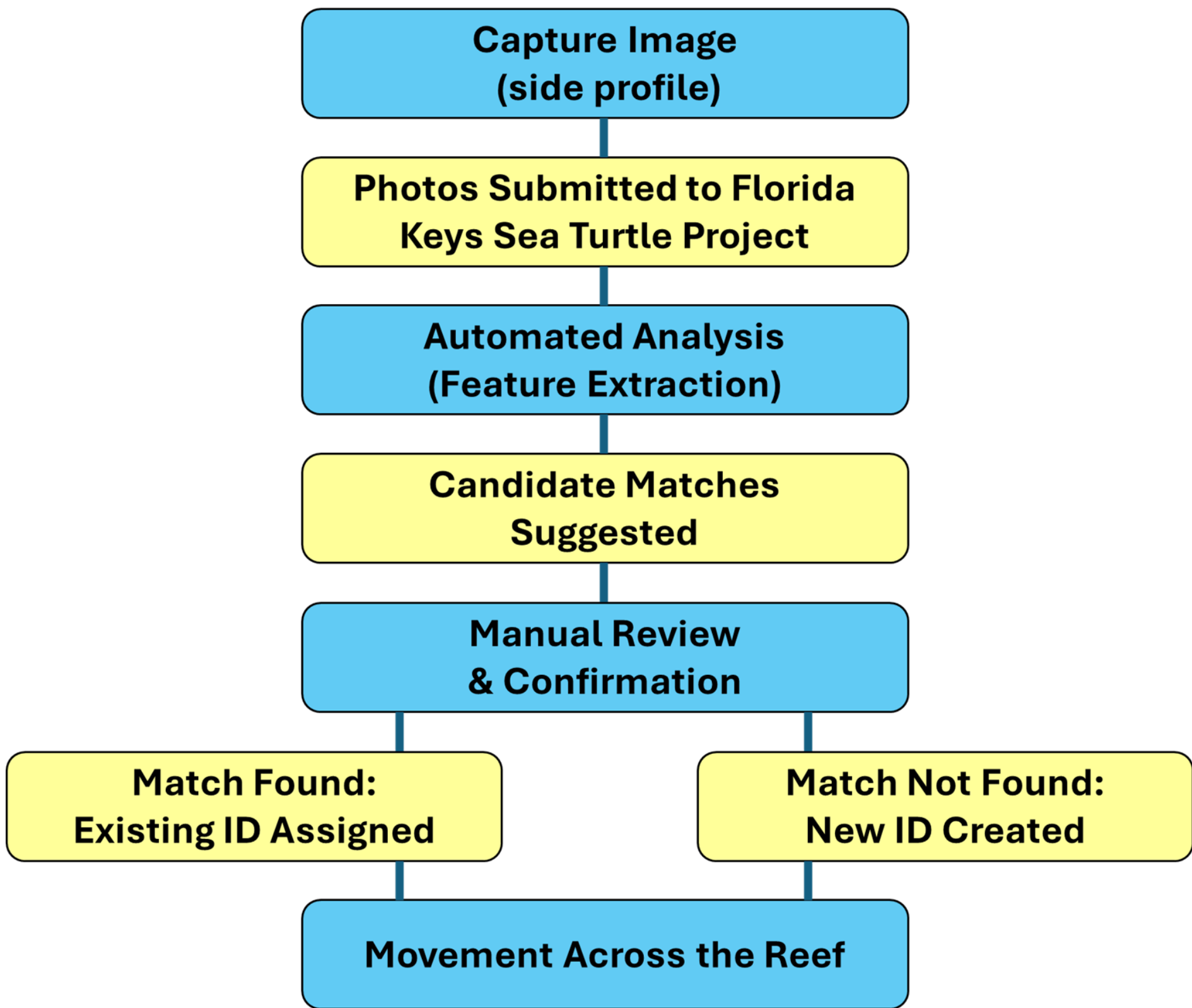


Figure 2. Overview flowchart of the methods used for the FL Keys Photo ID Sea Turtle Project.

Preliminary Takeaways

Submissions	128
Encounters	100
Individuals	53
Single Encounters	47
Recaptures	6

<i>Chelonia mydas</i>	39
<i>Caretta caretta</i>	8
<i>Eretmochelys imbricata</i>	5
<i>Lepidochelys kempii</i>	1

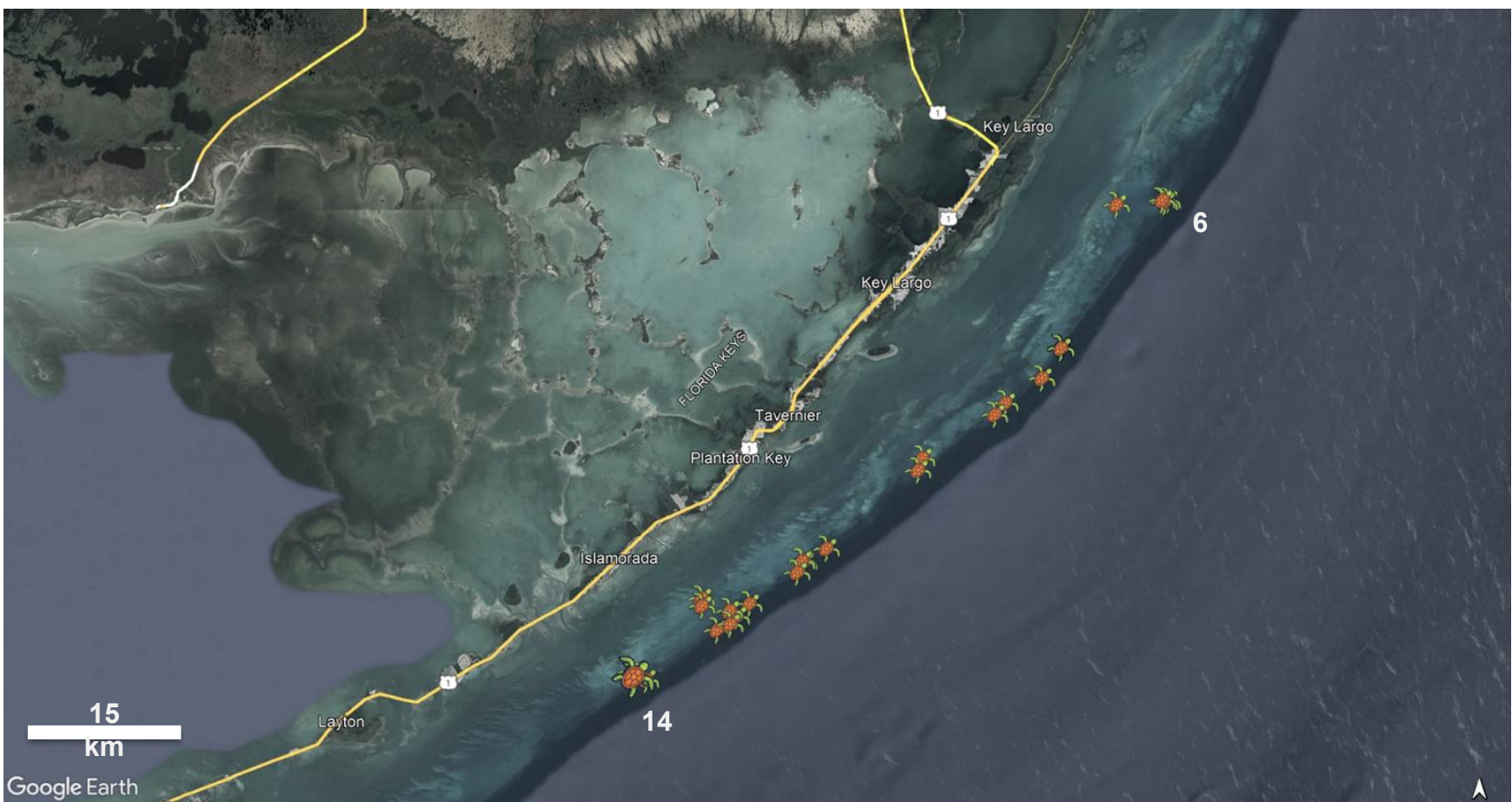


Figure 3. We have identified 53 unique individuals from 100 encounters between Key Largo and Islamorada.

- Photo ID and machine learning algorithms are a valid tool for identifying individual turtles, and offer the potential to discover how sea turtles utilize the FL Reef Tract during their juvenile and sub-adult life stages.
- Initial analysis indicates some turtles may have multi-year residency while others may only stay short term

A big thank you to all of the snorkelers, divers, and marine professionals that have submitted photographs. Please continue sending photos!!!

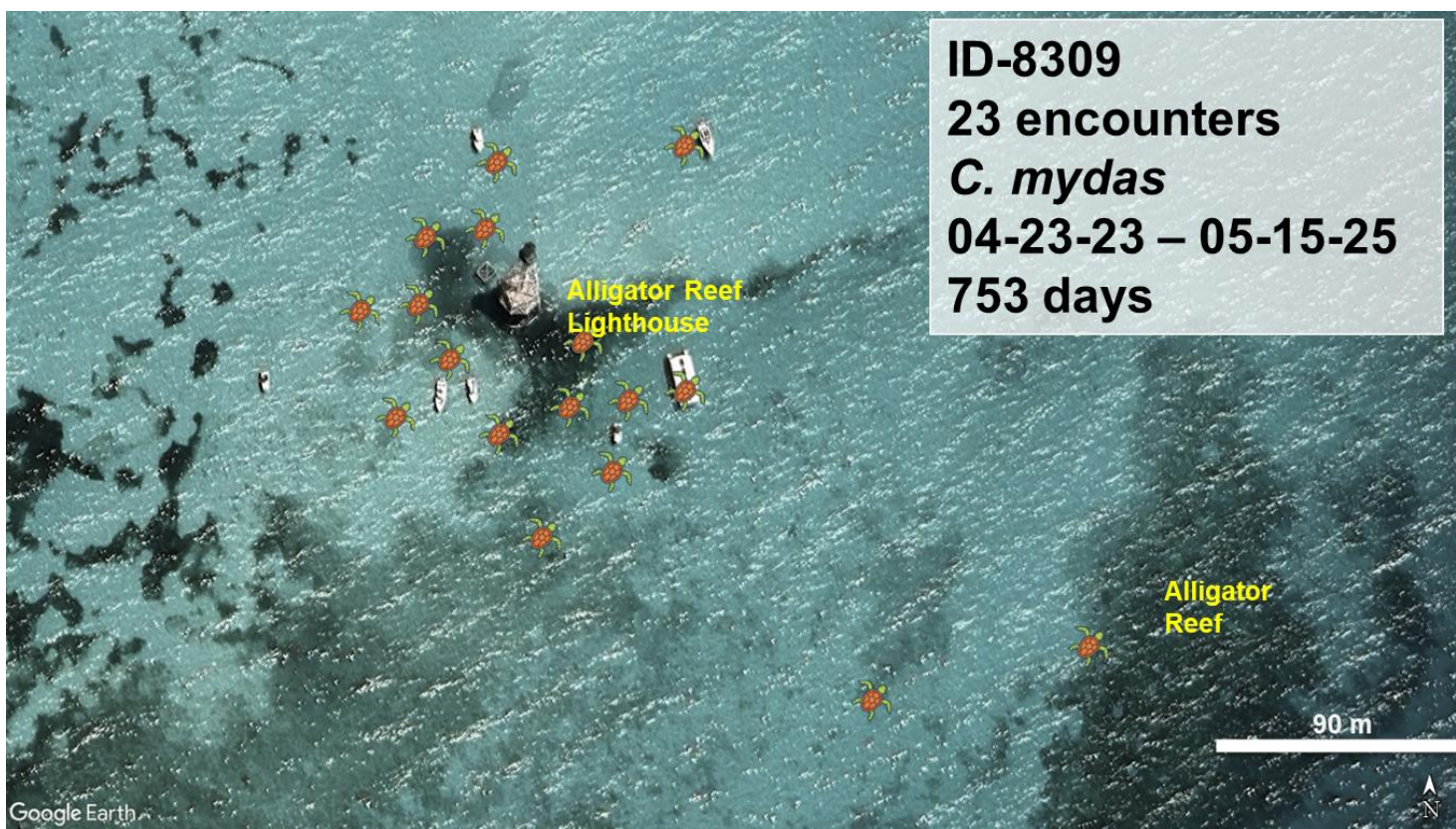


Figure 4. Turtle ID-8309 has been photographed 23 times between April 2023 and May 2025 around Alligator Reef.

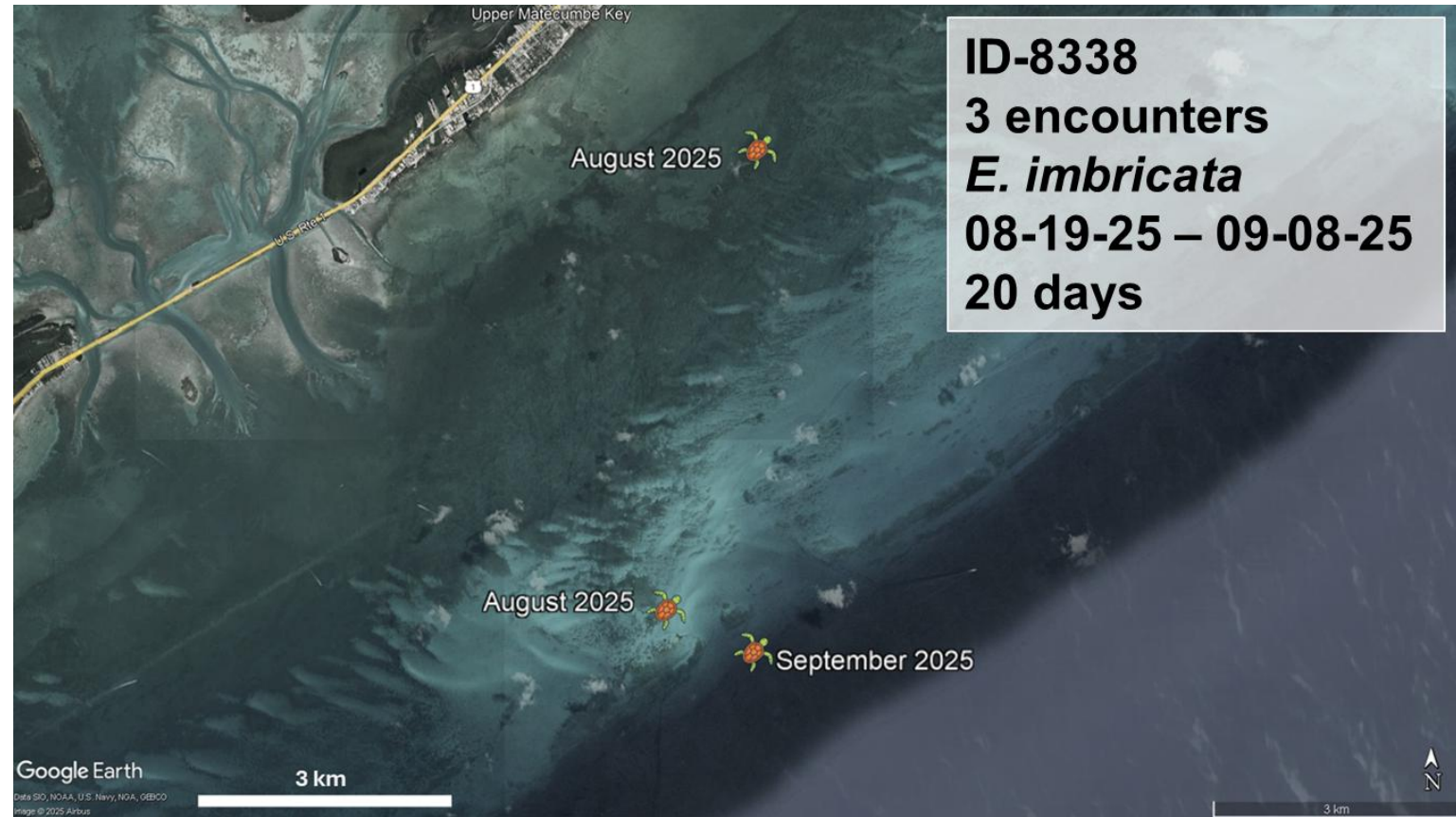


Figure 5. Turtle ID-8338 was photographed only weeks apart in two locations approximately 5 km apart.