Drones and Artificial Intelligence (AI) Enhance Marine Megafauna Surveys in the Saudi Arabian Red Sea
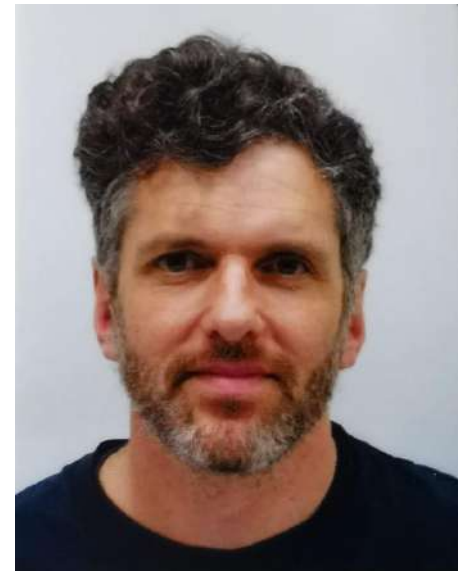
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https://innovation.kaust.edu.sa/beacon-development/

DRONES AND AI ENHANCE MARINE MEGAFAUNA SURVEYS IN THE SAUDI ARABIAN RED SEA

KAUST
Beacon Development
المنـارة للتطـويـر
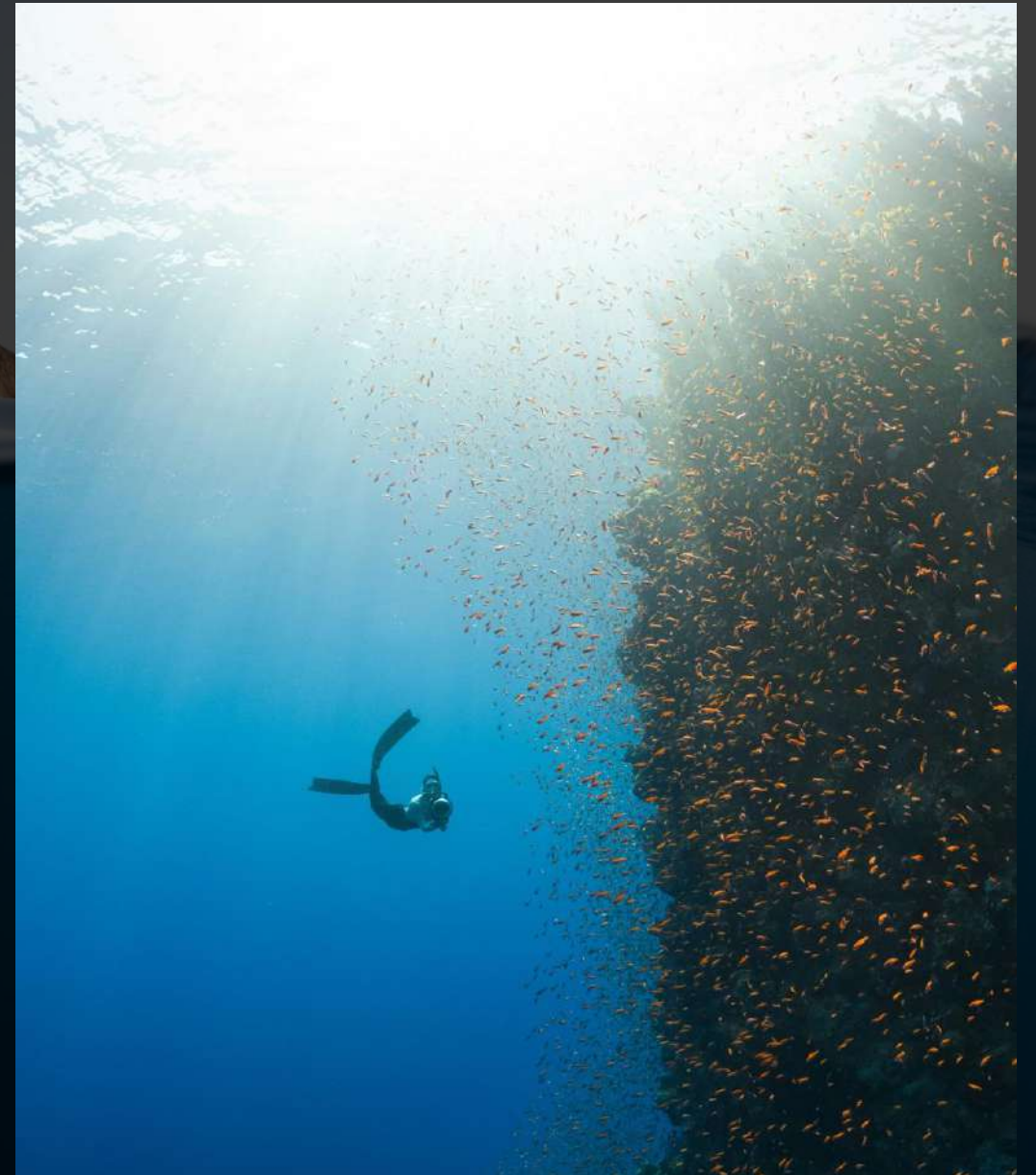
INTRODUCTION

NEOM NATURE RESERVE

NEOM: Where Progress Meets Preservation

- A world-class marine environment spanning 4000 km^2 of clear waters in the Red Sea and Gulf of Aqaba, with 41 islands.

- 95% designated for conservation.

WHAT IS NEOM?

LOCATED IN NORTHWEST
SAUDI ARABIA, NEOM COVERS 26,500 KM^2

NEOM Boundary.

SINDALAH ARCHIPELAGO
TOPOGRAPHY AND HABITATS

Ecologically complex site comprised of varying bathymetry and several islands.

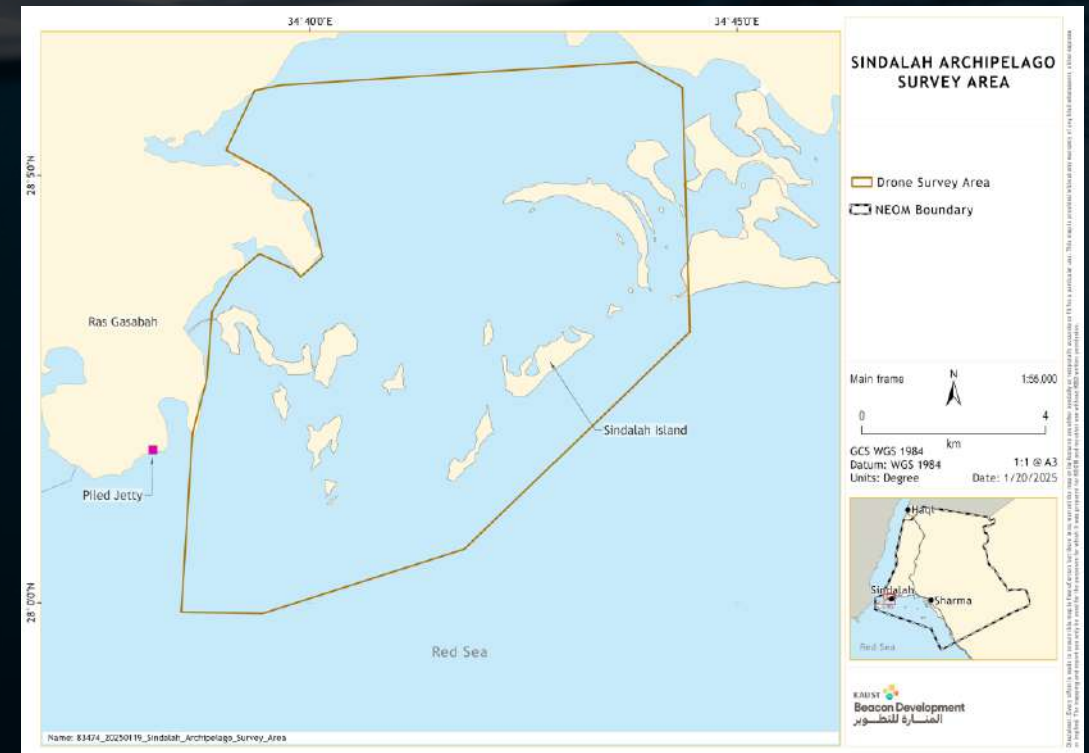Identified critical marine habitats:

Coral Reefs

➤ Rich food source for large predators.

Seagrass Beds

➤ Foraging habitats for marine herbivores.

The Sindalah Archipelago supports several threatened marine megafauna species contributing to high biodiversity across the region.

Sindalah Archipelago Survey Area.

PROJECT OBJECTIVES
OVERALL MISSION

NEOM SINDALAH ARCHIPELAGO

MARINE MEGAFAUNA SURVEYS

PHASE I (JANUARY 2024 – JUNE 2024)

➢ Robust **data collection** and **analysis.**

➢ Develop **dugong photo-ID** catalogue.

➢ Comprehensive **risk assessments.**

Dugong mother-calf pair in NEOM waters.

DRONES AND ARTIFICIAL INTELLIGENCE
ADVANCED PROCESSING TOOLS

SPATIO-TEMPORAL RESOLUTION PREVIOUSLY LIMITED FOR AERIAL PILOTED SURVEYS.

➤ **Drone technology provides a financially and logistically viable technique for scaling up surveys.**

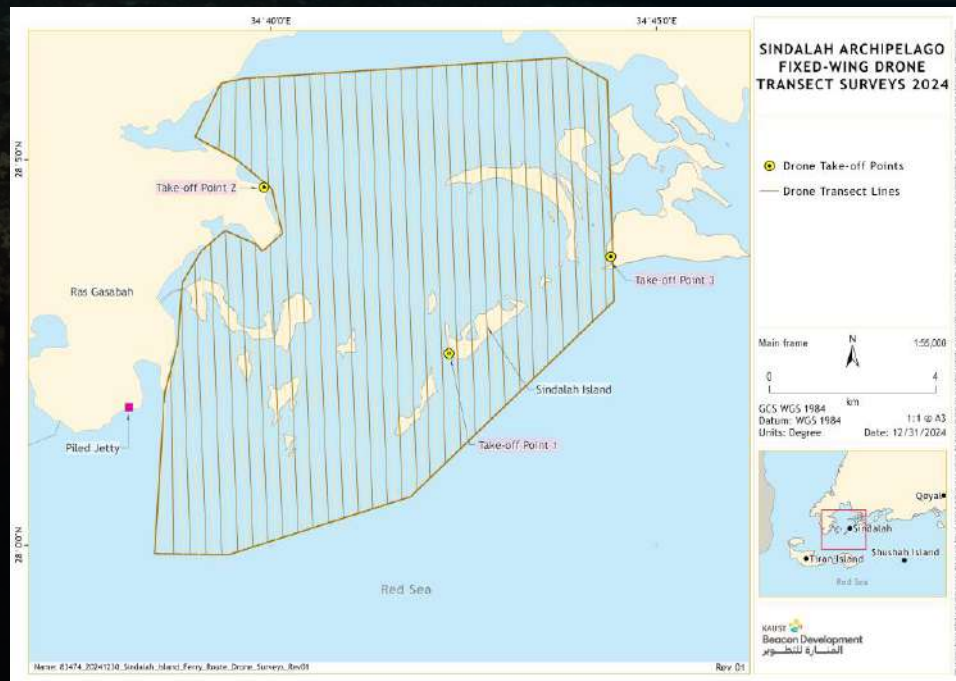| Drone Transect Surveys	Drone Focal Searches
Drone Model: Trinity F90+ (fixed-wing, 42 MP camera, up to 100km per flight).	**Drone Model**: DJI Matrice M30T (multi-rotor, 45MP camera, up to 7 km per flight).

DRONES AND ARTIFICIAL INTELLIGENCE
METHODS: DRONE SURVEYS

DRONE TRANSECT SURVEYS

Purpose: Collect **unbiased survey data** of marine megafauna weekly.

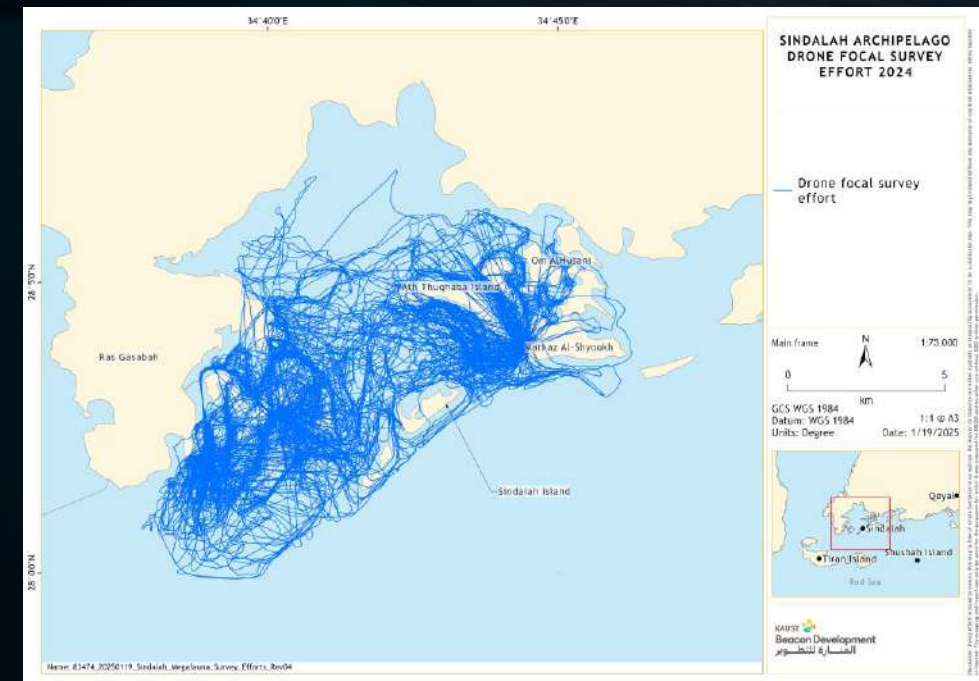Operation: **Still images** (70% overlap) captured for post-processing and analyses.

DRONE FOCAL SEARCHES

Purpose: Identify marine megafauna & **photo-ID** of **dugongs.**

Operation: Live-feed imagery for **real-time identification** and video / still image capture.

Fixed-wing Transect Lines.

Focal Survey Effort.

DRONES AND ARTIFICIAL INTELLIGENCE

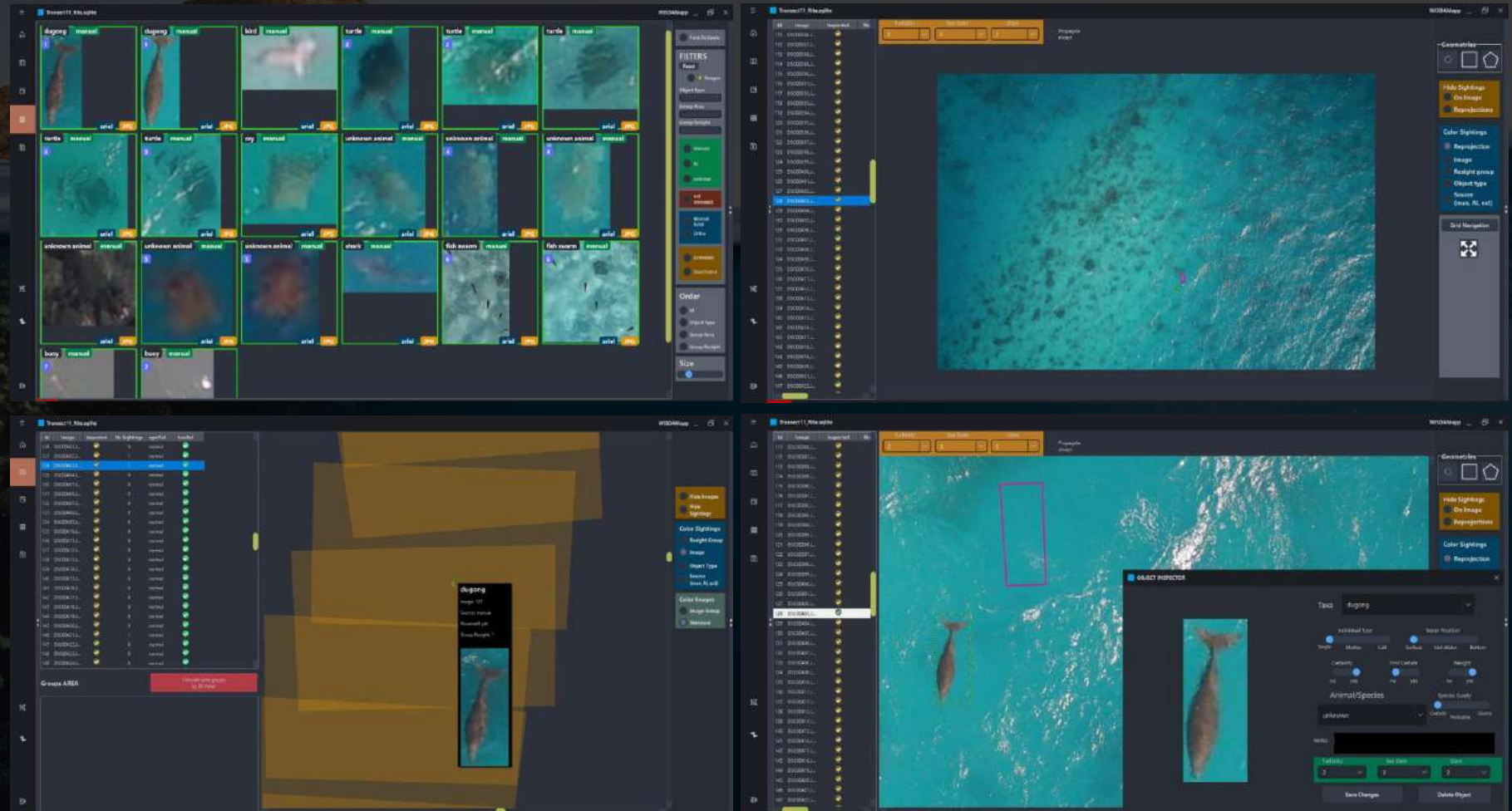## METHODS: IMAGE ANALYSIS

Software:

➢ <u>WISDAM:</u> Improved efficiency of image review.

Attributes recorded:

➢ Species, identification certainty, and environmental conditions.

Artificial Intelligence (AI):

➢ <u>AI</u> Marine Animal Detector Version 2 (MADv2).

➢ <u>184,000 images</u> processed.

Screenshots of WISDAM Software used to Process Drone Images (Courtesy of Edith Cowan University, Australia).

SURVEY RESULTS
MARINE MEGAFAUNA SPECIES

Home to many species of <u>economic</u> and <u>ecological</u> importance such as dugongs, dolphins, sharks, rays, and sea turtles.

➢ All species play a **key ecological role** in NEOM waters, forming a **highly diverse community structure**.

Groups	Species name	Common Name	IUCN Red List Status
Sea Turtles	*Eretmochelys imbricata*	Hawksbill Turtle	Critically Endangered
	Chelonia mydas	Green Turtle	Vulnerable
Marine Mammals	*Sousa plumbea*	Indian Ocean Humpback Dolphin	Endangered
	Dugong dugong	Dugong	Vulnerable
	Tursiops aduncus	Indo-Pacific Bottlenose Dolphin	Near Threatened
Sharks and Rays	*Aetobatus ocellatus*	Spotted Eagle Ray	Endangered
	Mobula alfredi	Reef Manta Ray	Vulnerable
	Carcharhinus melanopterus	Black Tip Reef Shark	Vulnerable
	Pastinachus sephen	Cowtail Ray	Near Threatened
	Galeocerdo cuvier	Tiger Shark	Near Threatened

Marine Megafauna Species Regularly Occurring in the Sindalah Archipelago and their Conservation Status.

SURVEY RESULTS

DRONE FOCAL SEARCHES: OTHER MARINE MEGAFAUNA SPECIES

HIGH-QUALITY IMAGERY (STILL PHOTOS AND VIDEOS)

High diversity and abundance of species listed as **conservation concern.**

Tiger Shark **(NT)**

Reef Manta Ray **(VU)**

Hawksbill Turtle **(CR)**

Spotted Eagle Ray **(EN)**

Cowtail Ray **(NT)**

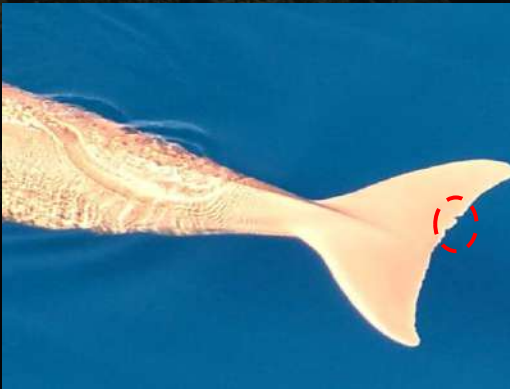Indian Ocean Humpback Dolphin **(EN)**

SURVEY RESULTS

PHOTO-ID ANALYSIS: DUGONGS (VU)

114 SIGHTINGS OF DUGONGS

TOTAL INDIVIDUALS IDENTIFIED: MINIMUM 7

Notable Resights:

➤ At least **five individuals resighted** up to **three times.**

➤ Likely **resident** localised population of dugongs.

Resighted Individual Based on Fluke Notches (*Distinctive Notches on Both Images).

SURVEY RESULTS
SPECIES DENSITY & DISTRIBUTION

DRONE DUGONG SIGHTING ANALYSIS

Weekly surveys over 6 months, covering approximately 84 km².

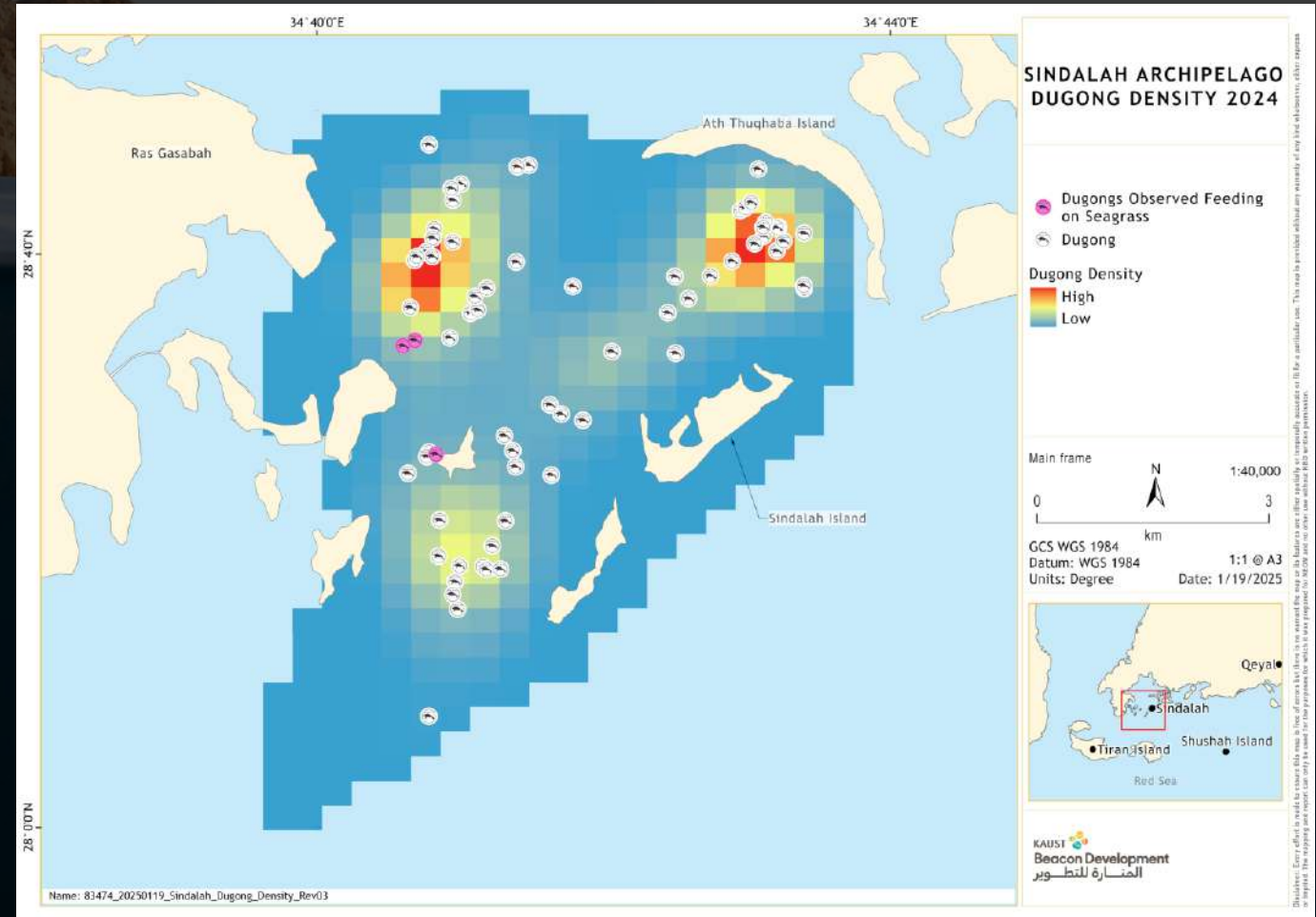➢ **184,000 images** processed using **AI model.**

One person full manual processing = ~16 weeks

AI model can be run overnight

One person verifying AI processing = ~5 weeks

➢ **Surface density modelling** = areas of high usage.

➢ Sightings data for **future mitigation measures.**

Dugong Density & Distribution.

KEY OUTCOMES
DATA-DRIVEN INNOVATION USING DRONES AND AI

ACCELERATING CONSERVATION THROUGH ADVANCEMENTS IN GLOBAL BEST PRACTICE

1. Enhanced **efficiency** and **spatiotemporal resolution.**

2. Solid foundation for **environmental impact assessments (EIAs).**

3. Facilitated **data-driven decision-making** processes.
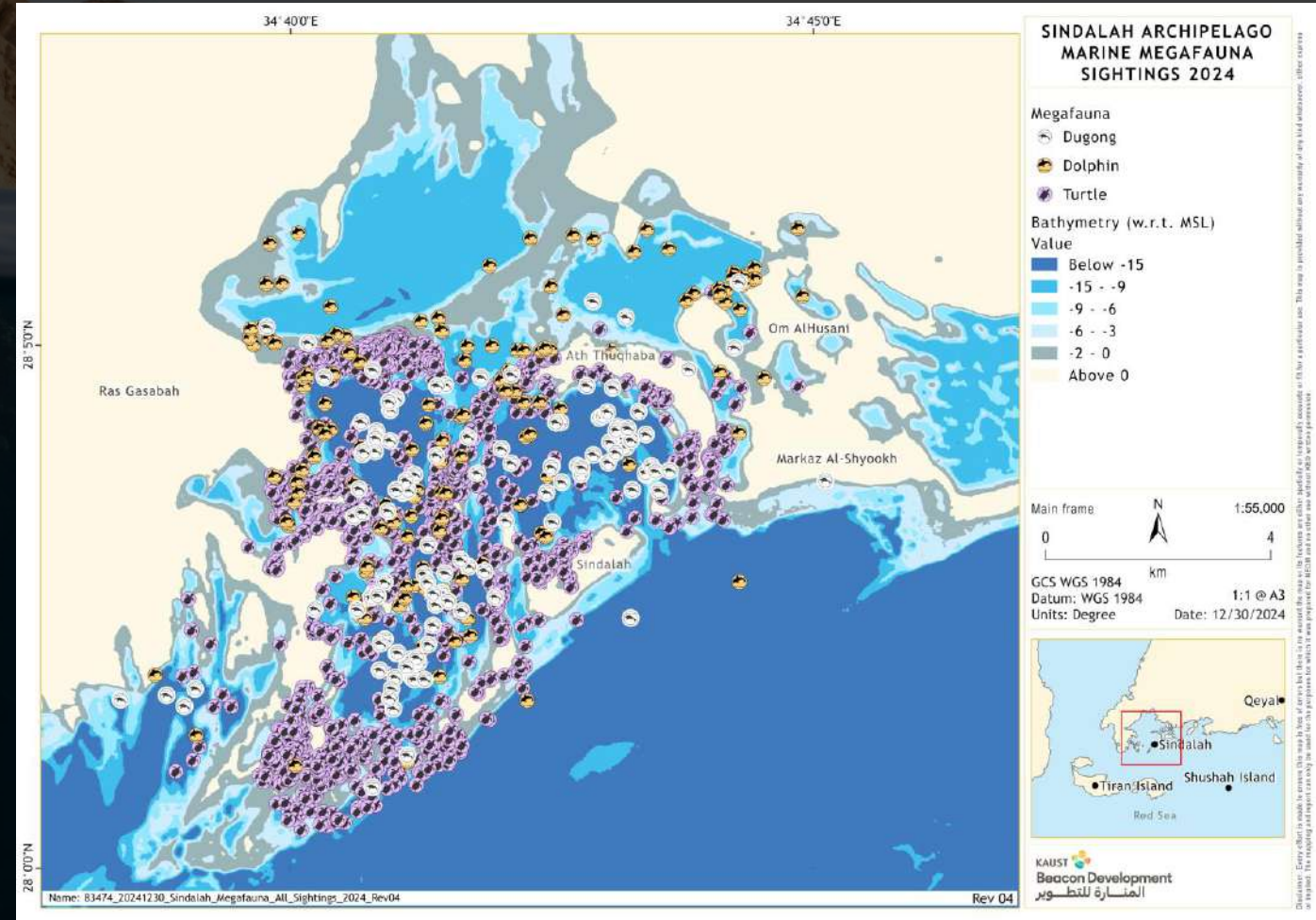
Marine Megafauna Species Distribution.

ON-GOING RESEARCH
PHASE II DRONE SURVEYS

REGULAR LIVE-FEED DRONE SURVEYS

➢ **Real-time, onboard AI** image processing.

➢ **Early Warning System** of marine megafauna sightings.

SINDALAH ARCHIPELAGO SURVEYS PHASE II

JULY 2024 – JANUARY 2025

1. Development of dugong **photo-ID catalogue.**

2. Expanded **spatiotemporal data collection.**

3. Continuation of **high-quality imagery** for year-round coverage.

SAFEGUARDING MARINE LIFE, PRESERVING OUR SEAS

THANK YOU
شكراً

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Let's continue the conversation!

Message me your questions or comments in the IAIA25 app.

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