

> White Paper No. 2

Vigía

Marine Conservation Intelligence for the Bahía de Todos Santos
World Surfing Reserve

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Platform vigia.esoteriaai.com

Division Public Intelligence

Region Bahía de Todos Santos, Ensenada, Baja California

Data Source Global Fishing Watch – AIS, SAR, Optical

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Executive Summary

Vigía is a public maritime intelligence platform that monitors vessel activity in and around the Bahía de Todos Santos World Surfing Reserve — a protected marine area off the coast of Ensenada, Baja California. The platform aggregates Global Fishing Watch satellite data against the reserve's geographic boundaries and surfaces vessel behavior, incursion events, and anomalies in a single public interface.

Understanding what is happening in a protected marine area requires querying satellite datasets, interpreting AIS transponder data, identifying vessels without active AIS signals, and cross-referencing geographic boundaries — work that requires data science expertise and specialized tooling. Vigía does that work automatically, continuously, and publicly.

Built and operated by Esoteria as part of its Public Intelligence division, Vigía is live at vigia.esoteriaai.com. No registration required. No expertise required. The platform answers one question:

Are vessels behaving in ways that threaten this protected area — and what is the evidence?

The Bahía de Todos Santos World Surfing Reserve

The Bahía de Todos Santos World Surfing Reserve is one of a small number of designated World Surfing Reserves globally — a recognition by the Save The Waves Coalition of exceptional surf ecosystems that warrant formal protection. The reserve encompasses the bay off Ensenada, Baja California, including internationally recognized surf breaks and the marine ecosystem that sustains

them.

The reserve faces ongoing pressure from industrial vessel traffic. Cargo ships, tankers, and commercial fishing vessels transit and loiter within and adjacent to the protected zone. Dark vessel events — satellite detections of vessels without active AIS transponders — occur at a rate consistent with deliberate signal suppression. The bay's proximity to the Port of Ensenada means vessel traffic is persistent and varied.

Prior to Vigía, understanding the scope and pattern of vessel activity in the reserve required manual querying of Global Fishing Watch's public datasets — a process accessible only to researchers and organizations with data science capacity. The conservation community, local advocates, and the public had no direct visibility into what was happening in the bay.

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The Platform

Vigía ingests vessel activity data from the Global Fishing Watch API, stores it against the reserve's configured geographic polygon, runs detection logic against behavioral thresholds, and presents the results through a public map interface updated on a six-hour ingestion cycle.

What Vigía Detects

> Vessel Incursions

Vessels entering the World Surfing Reserve boundary polygon are logged as incursion events. Each event receives a severity score of 0–100 based on vessel class, duration, depth of penetration into the polygon, and behavioral indicators.

> Dark Vessel Events

SAR and optical satellite detections of vessels without concurrent AIS broadcasts are flagged as dark vessel events. In the 90-day validation period, 64% of SAR detections in the study area had no AIS match — a rate consistent with deliberate signal suppression.

> Loitering Behavior

Vessels present within or adjacent to the reserve boundary for more than two hours at speeds below three knots are flagged as loitering. This pattern is associated with anchoring, fishing activity, and unauthorized extended presence.

> Vessel Class Anomalies

Cargo ships, tankers, and certain non-fishing vessel classes operating within the reserve polygon are flagged regardless of duration. Vessel flag composition is tracked — flags of convenience associated with industrial shipping are monitored.

> Traffic Pattern Intelligence

Aggregated vessel presence data over rolling 90-day windows surfaces traffic patterns, peak activity periods, and repeat-offender vessels with three or more prior incursion events.

The Map Interface

The primary interface is a dark-base map showing the reserve boundary polygon, a 5km detection buffer zone, vessel position layers color-coded by class, incursion event markers scored by severity, and dark vessel event markers with distinct visual treatment. A time range selector allows filtering across 24-hour, 7-day, 30-day, and full historical windows.

The interface is designed to communicate the situation at a glance to a first-time visitor — a conservation advocate, a journalist, a community member — without requiring any background in maritime data or satellite imagery.

Technical Architecture

Vigía is built as a modular monorepo with shared packages for data ingestion, detection logic, and map components — designed for deployment across multiple reserve instances without modifying the core engine.

> Data Source

Global Fishing Watch API v3. Three datasets: AIS vessel presence (public-global-presence:latest), SAR detections (public-global-sar-presence:latest), and apparent fishing effort (public-global-fishing-effort:latest). All requests authenticated via Bearer token. 6-hour ingestion cycle via GitHub Actions scheduled workflow.

> Database

Neon (PostgreSQL) with schema-per-instance isolation. Instance 01 runs on the `ensenada` schema. Tables: `vessels`, `positions`, `incursions`, `dark_events`, `ingest_log`. PostGIS-compatible for spatial queries.

> Detection Engine

Shared TypeScript package. Point-in-polygon intersection against configured study area. Incursion scoring model weighted across vessel class (30%), duration (25%), depth of penetration (20%), AIS dark period (15%), and speed (10%). Flags: `loitering`, `dark_vessel`, `restricted_class`, `high_traffic`, `repeat_offender`.

> Frontend

Next.js App Router + TypeScript. Leaflet + react-leaflet for map rendering. Tailwind CSS for styling. Dark map base. Mobile-readable — designed for field use by NGO partners and coastal advocates.

> Deployment

Vercel for frontend. GitHub Actions for ingestion cron independent of deployment. Instance configuration isolated in a single config file — adding a new reserve instance requires only a new config file and database schema, no engine code changes.

> **Monorepo Structure**

Turborepo + pnpm. Shared packages: gfw-client (API wrapper), detection-engine (scoring and classification), ui-components (map and chart components). Instance-specific apps in apps/ directory.

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Data Validation — Bahía de Todos Santos

Before building the full platform, Esoteria validated GFW data availability and quality for the Bahía de Todos Santos study area. The following findings from the validation phase informed the platform's detection thresholds and scoring model.

> **AIS Vessel Presence**

11 AIS vessel records returned for a 30-day window. MEX flag dominant at 723 hours of presence. MHL and PAN flags of convenience present — 164 hours and 49 hours respectively — consistent with industrial shipping activity.

> **Dark Vessel Rate**

7 of 11 SAR detections (64%) over a 90-day window had no AIS match. This rate is consistent with deliberate AIS signal suppression — a pattern associated with vessels seeking to avoid monitoring.

> **SAR Detection Coverage**

11 total SAR detections over 90 days. 7 unmatched (dark). Coverage confirms satellite detection capability for the study area.

> **Fishing Effort**

Low apparent fishing effort — 3.5 hours across 2 grid cells over 90 days. Expected for a designated surf reserve. Baseline established for anomaly detection.

> **Polygon Validity**

Bounding box polygon for the study area produces meaningful results. Official Save The Waves / CONANP boundary polygon sourced before detection engine deployment.

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Governance Principles

Vigía operates under Esoteria's public intelligence governance framework. These principles define what the platform is — and equally, what it is not.

> Evidence and Awareness — Not Enforcement

Vigía outputs are public awareness and evidentiary record — not enforcement actions. The platform does not direct law enforcement, report vessels to authorities, or take any action beyond surfacing data. What communities and advocates do with that information is their decision.

> Public Data Only

All vessel data is sourced from Global Fishing Watch's public datasets. No private vessel tracking, proprietary AIS feeds, or non-public data sources are used. Methodology is fully reproducible from public sources.

> Aggregation Over Attribution

Traffic intelligence outputs focus on patterns, volumes, and behavioral trends — not on identifying individual vessel operators or crew. Vessel registry data (MMSI, IMO, flag) is displayed as provided by GFW public datasets, which is itself public record.

> Transparent Methodology

Detection thresholds, scoring weights, and flag definitions are documented publicly in this white paper and on the platform's about page. There are no opaque algorithmic decisions. Every scored event is traceable to the rule that produced it.

> Not a Real-Time Tracking System

GFW data has inherent latency. Vigía is a monitoring tool, not a live vessel tracker. The 6-hour ingestion cycle means position data reflects recent history, not current location.

Expansion Model

Vigía's architecture is designed for multi-instance deployment. The Bahía de Todos Santos instance is Instance 01. Any protected marine area with GFW data coverage can become a new instance without modifying the core platform.

Adding a new instance requires: a new configuration file defining the study area polygon, detection thresholds, and display copy; a new database schema; and a new deployment. No new engine code. No new data pipeline architecture.

Target Expansion Contexts

> World Surfing Reserves

Additional designated WSRs globally where vessel pressure is documented and conservation partners are active.

> Marine Protected Areas

Biosphere reserves, marine sanctuaries, and protected coastal zones in Mexico and Latin America where industrial vessel activity is a documented threat.

> Coastal Conservation Corridors

Non-designated but ecologically significant coastal areas where vessel monitoring supports advocacy and research without formal protected status.

Who This Platform Serves

> The General Public

Anyone who wants to know what is happening in the Bahía de Todos Santos reserve. No expertise required. No registration required. The map is the product.

> Conservation Organizations

NGOs, surf conservation bodies, and marine advocacy organizations that need documented vessel activity data for advocacy, grant reporting, and partner engagement.

> Researchers & Journalists

Investigators who need structured, time-series vessel activity data for pattern analysis, anomaly reporting, and accountability journalism.

> Save The Waves Coalition & Partners

The organization that designated the Bahía de Todos Santos WSR and its network of conservation partners monitoring reserve health globally.

> Coastal Communities

Residents, surfers, and local advocates in Ensenada and the surrounding area with a direct stake in the health of the bay.

> Future Reserve Partners

Conservation organizations managing other protected marine areas interested in deploying a Vigía instance for their own reserve.

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Conclusion

Marine protected areas cannot defend what they cannot see. The vessel activity threatening the Bahía de Todos Santos World Surfing Reserve is not hidden — it is recorded in public satellite datasets. What was missing was the infrastructure to make that data visible to the people who need it.

Vigía is that infrastructure. It collapses the distance between satellite data and public awareness — converting raw AIS and SAR datasets into a legible, continuously updated intelligence interface that any conservation advocate, journalist, or community member can use without technical expertise.

Built on the same governance-first principles as all Esoteria public intelligence work, designed for the specific ecological and operational context of Bahía de Todos Santos, and architected for

expansion to any protected marine area with GFW coverage — Vigía is not a tool. It is infrastructure.

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For conservation partnerships, new reserve deployments, or research access, contact Esoteria directly through esoteriaai.com/contact.