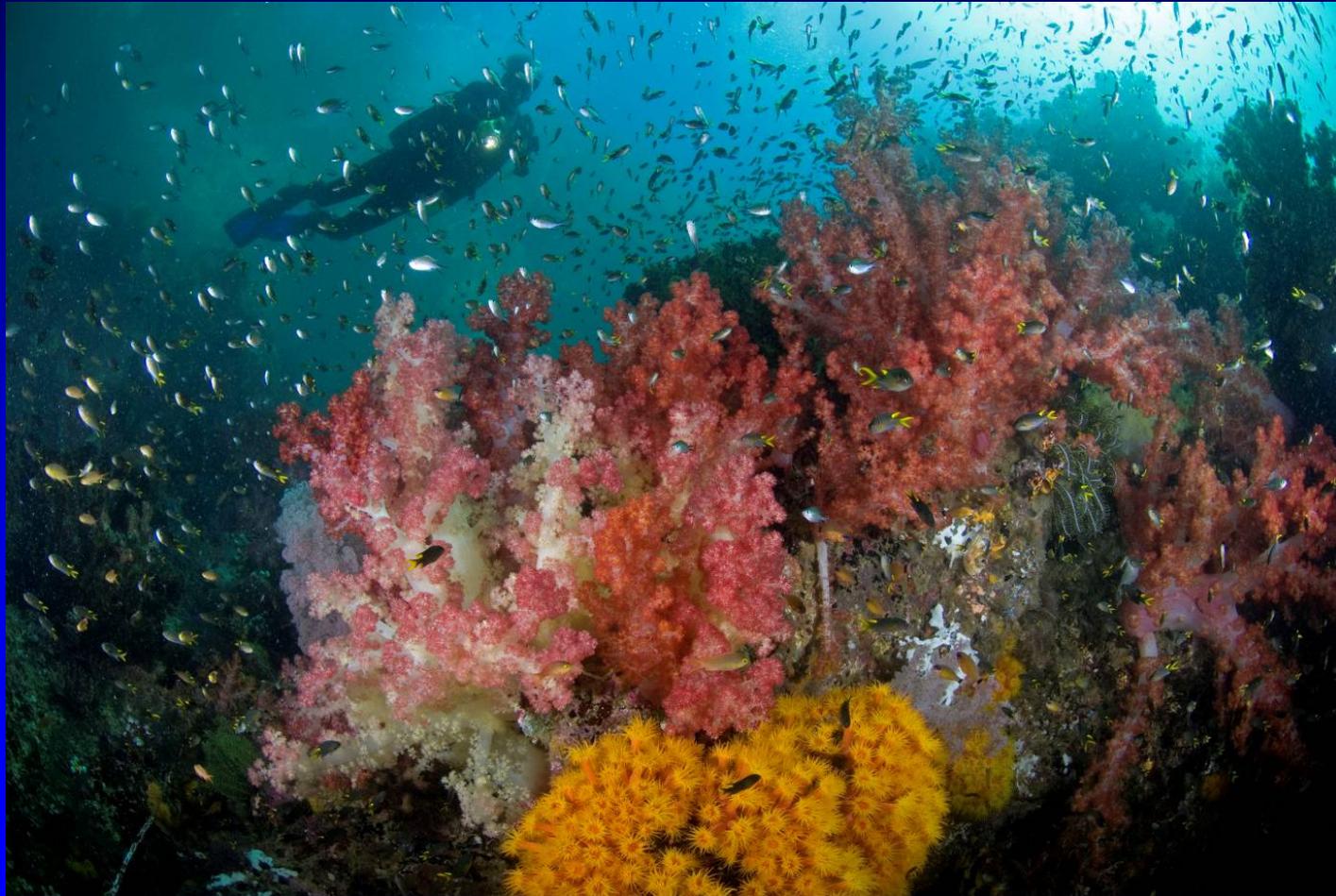


DEFINING GEOGRAPHIC PRIORITIES FOR MARINE BIODIVERSITY CONSERVATION IN INDONESIA

Hasil Sementara

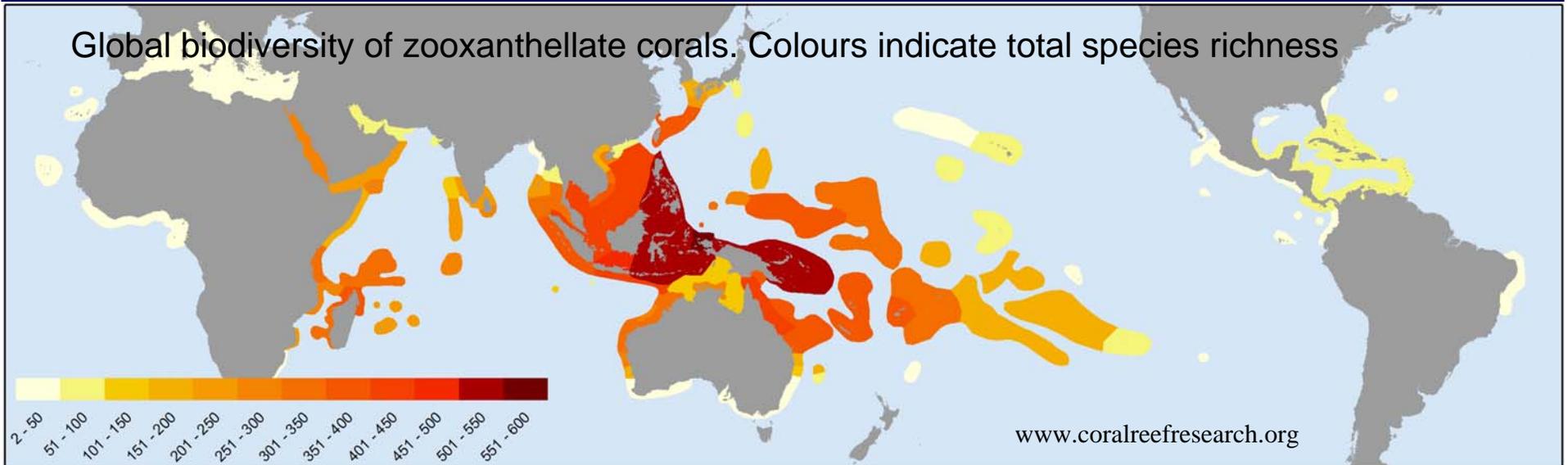


MV Erdmann and C Huffard

PRESENTATION OVERVIEW

- **BACKGROUND ON PRIORITIZATION IN CONSERVATION PLANNING**
- **2009 INDONESIAN PRIORITIZATION EXERCISE**
- **PRELIMINARY RESULTS OF PRIORITIZATION**
- **PRELIMINARY GAP ANALYSIS (MPA COVERAGE, DATA DEFICIENCY BY ECOREGION)**

BACKGROUND ON PRIORITIZATION IN CONSERVATION PLANNING



- Indonesia has long been known to be in the global epicenter of marine biodiversity.
- While the causes of this are fiercely debated, the need to prioritize regions for conservation investment is a basic tenet of conservation planning

BACKGROUND ON PRIORITIZATION IN CONSERVATION PLANNING

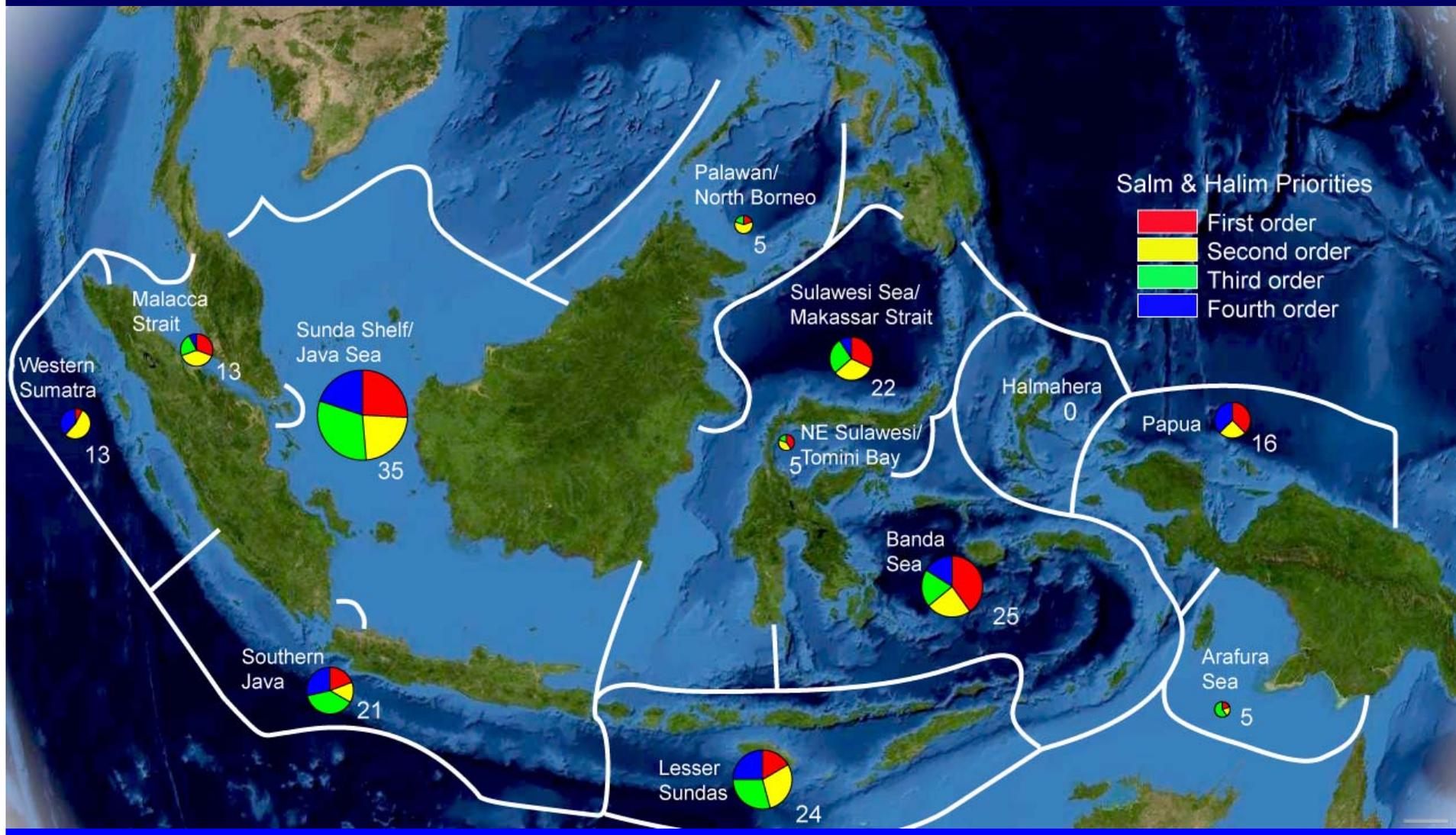


- Many conservation prioritization methodologies in practice; however, almost all use a combination of the following measures to rank sites/regions:
 - *Irreplaceability* (degree of endemism, taxonomic uniqueness, presence of rare species/habitats, etc)
 - *Vulnerability* (different methodologies prioritize either low risk regions or highly threatened regions)
 - *Representativeness* (particularly when a planning unit such as a country's national boundaries cross biogeographic realms)

HISTORY OF PRIORITIZATION IN INDONESIAN MARINE CONSERVATION PLANNING

- IUCN/WWF Marine Conservation Data Atlas for PHPA (Salm and Halim 1984) first identified 179 marine sites in Indonesia (1°-4° priority) to form basis of national system of MPAs
 - *To safeguard critical habitats of commercial species*
 - *To safeguard critical habitats of threatened species and rebuild stocks of those that are depleted*
 - *To preserve the value of at least 1 marine site near each major urban center and at least 1 marine site in each province for tourism*
 - *To preserve the biotic diversity of Indonesia's marine resource heritage*
 - *To protect sites with high value for research and education*
- This prioritization has largely served as the basis for marine conservation planning in Indonesia for the past 3 decades

SALM AND HALIM, 1984



HISTORY OF PRIORITIZATION IN INDONESIAN MARINE CONSERVATION PLANNING

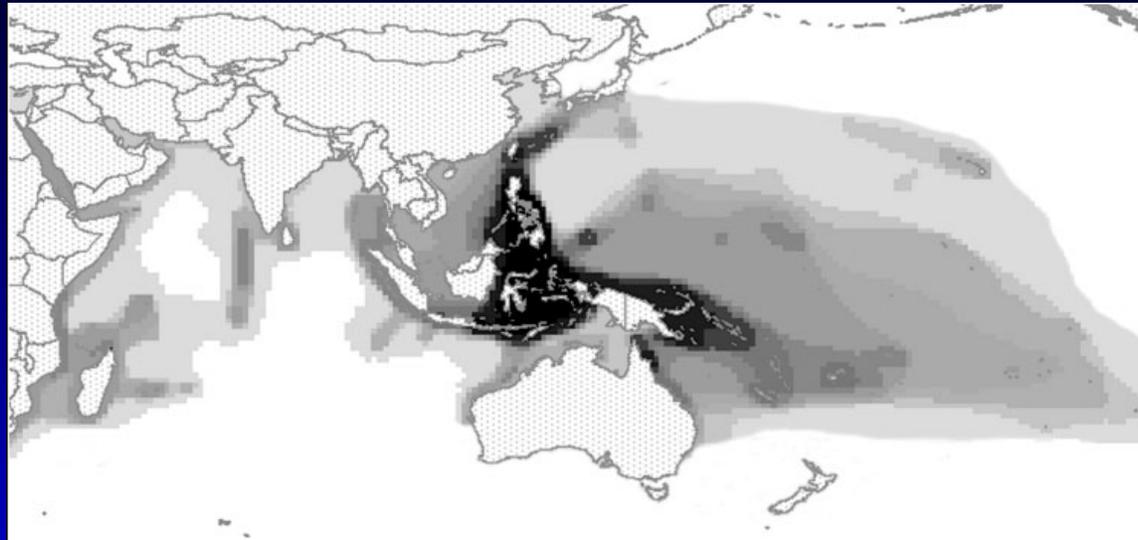
- Djohani (1989) refined this list to focus on 17 sites to help government meet its goal of 10 million ha of MPAs by 1993
 - *First Priority*: Togian Islands, Aru Islands, Teluk Cendrawasih, Wakatobi/Tukang Besi
 - *Second Priority*: Taka Bone Rate, Bunaken, Kei Islands, Raja Ampat, Komodo, Karimunjawa
 - *Third Priority*: Riau, Karimata, Halmahera (Pulau Widi), Pulau Pombo/Kassa/Banda, Teluk Maumere, Pulau Seribu, Bali Barat

TIME TO REVISIT INDONESIA'S PRIORITIZATION!



- GoI (DKP/PHKA) reached its goal of 10million ha of MPAs in 2009, but now must redouble its efforts to reach 20million ha by 2020. But where to focus efforts?
- USAID and other donors to the Coral Triangle Initiative are also keen to understand top priorities for conservation investment (both for new MPAs and solidifying effective mgmt in existing ones)

TIME TO REVISIT INDONESIA'S PRIORITIZATION!

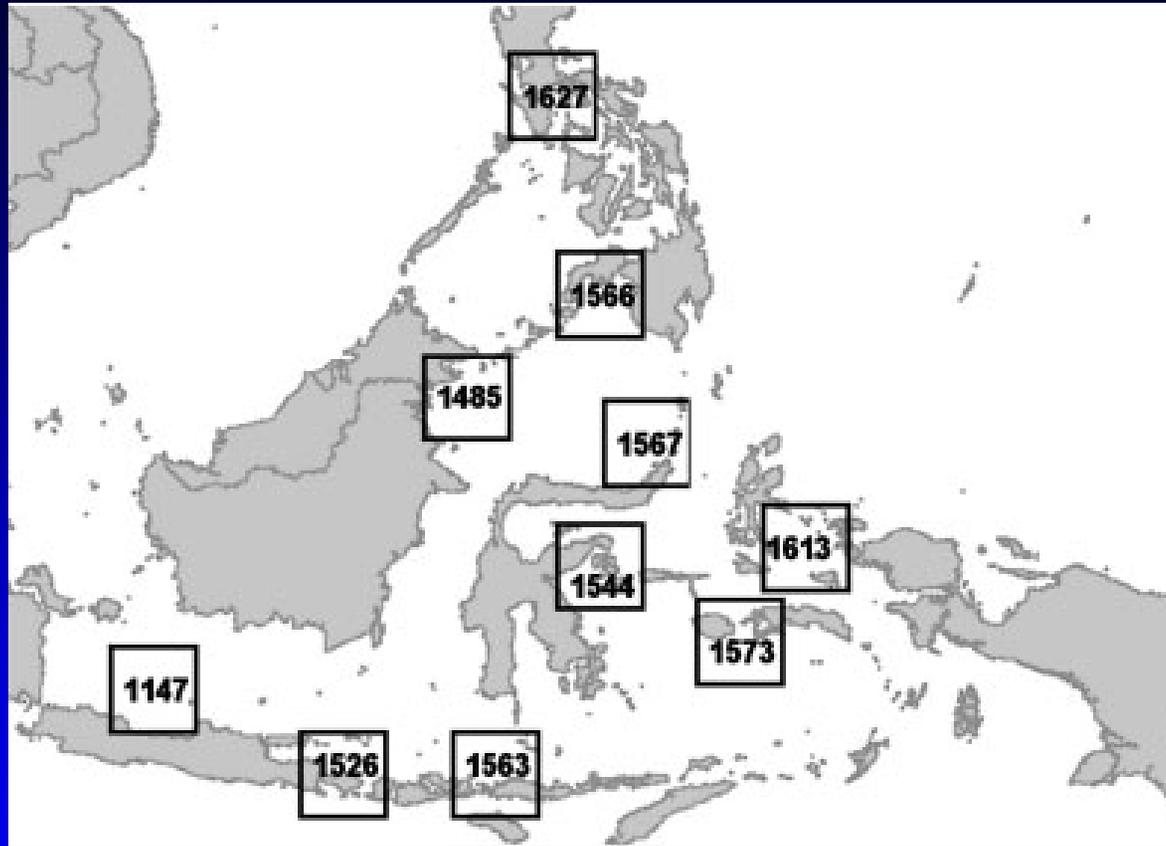


- With no significant comprehensive review of Indonesia's marine geographic prioritization for nearly 3 decades, the time is now ripe to revisit, especially in light of:
 - New data and new global/regional prioritizations
 - Realization of the importance of factoring in resilience to climate change in prioritization

RECENT GLOBAL/REGIONAL PRIORITIZATION EFFORTS

- Olson and Dinerstein (2002) “Global 200 Priority EcoRegions”: identified 3 Indonesian marine ecoregions (Sulu-Sulawesi Seas, Banda-Flores Sea, and Bismarck Solomon Seas) in top 43 marine conservation priorities globally
- Roberts et al (2002) “Marine Hotspots”: identified Sunda Islands as the 3rd most important marine conservation priority globally

RECENT REGIONAL PRIORITIZATIONS



- Allen (2008) “conservation hotspots of biodiversity and endemism in Indo-Pacific reef fishes”: Indonesia ranks first globally for diversity and second for endemism; Raja Ampat, Maluku, North Sulawesi top 3 areas for spp richness and Papuan Bird’s Head and Lesser Sundas are top areas for endemism

MAY09 CTSP RANKING EXERCISE

Priority Marine Regions of Indonesia

Marine Region or Seascape	Composite Ranking			
	Score	Percent of Total	Possible Score	Percent of Possible
1 West Papua	13.0	17.3%	14.0	92.7%
2 Lesser Sunda	13.0	17.3%	14.0	92.7%
3 East Kalimantan	8.3	11.0%	14.0	58.9%
4 West Kalimantan (South China Sea)	7.9	10.5%	14.0	56.3%
5 West Sumatra	7.5	10.0%	14.0	53.4%
6 Southeast Sulawesi	7.3	9.8%	14.0	52.4%
7 Spermonde Archipelago	7.1	9.4%	14.0	50.6%
8 North Sulawesi	4.8	6.4%	14.0	34.3%
9 Maluku/Aru	3.6	4.7%	14.0	25.4%
10 Sunda Islands (East Sumatra)	1.0	1.3%	14.0	7.1%
11 Tomini Bay (Central Sulawesi)	0.8	1.1%	14.0	6.0%
12 Banggai (Sula Spur, Central Sulawesi)	0.8	1.1%	14.0	6.0%
	75.0	100.0%		

- 11 expert conservation practitioners from DKP, IUCN, UNHAS, TNC, WCS, WWF and CI
- Based upon an expert opinion survey tool
- “Regions” not rigorously defined, qualitative

JULY09 PRIORITIZATION EXERCISE



- DKP/USAID request that CTSP host a scientifically defensible geographic prioritization using a two-step process:
 - Quantitative ranking exercise using inputs of independent, national and international marine taxonomic experts (based largely on biodiversity parameters)
 - Refinement of prioritization using inputs from government officials and conservation practitioners based on considerations of vulnerability and conservation opportunities and constraints

JULY09 PRIORITIZATION EXERCISE

- Objectives:
 - To solicit input to establish what constitutes essential marine biodiversity for Indonesia
 - To identify scientific justifications for specific geographic areas that need to be brought under effective management to protect the marine biodiversity of the selected areas
 - To identify areas lacking in the effective management of marine protected areas
- **IMPORTANT:** Require a standardized geographical delineation to allow ranking by experts; should optimally focus at the scale at which ecologically-connected networks of MPAs will be defined and implemented

SPALDING ET AL 2007 "MEOW" MARINE ECOREGIONS



- 12 Marine Ecoregions defined within Indonesia, based largely upon Green and Mous (2004) expert workshop to delineate Coral Triangle

SELECTION OF TAXONOMIC EXPERTS



- Requirements:

- Have conducted extensive field observations/taxonomic research that spans the entire Indonesian Archipelago (i.e., optimally from Sumatra to Papua, Bali to North Sulawesi).
- Are able to complete the ecoregion ranking questionnaire based upon their own observations and datasets, and reference those datasets as necessary within the questionnaire.
- Are recognized internationally as an expert on a specific component of Indonesian marine biodiversity and have a strong publication record in this regard

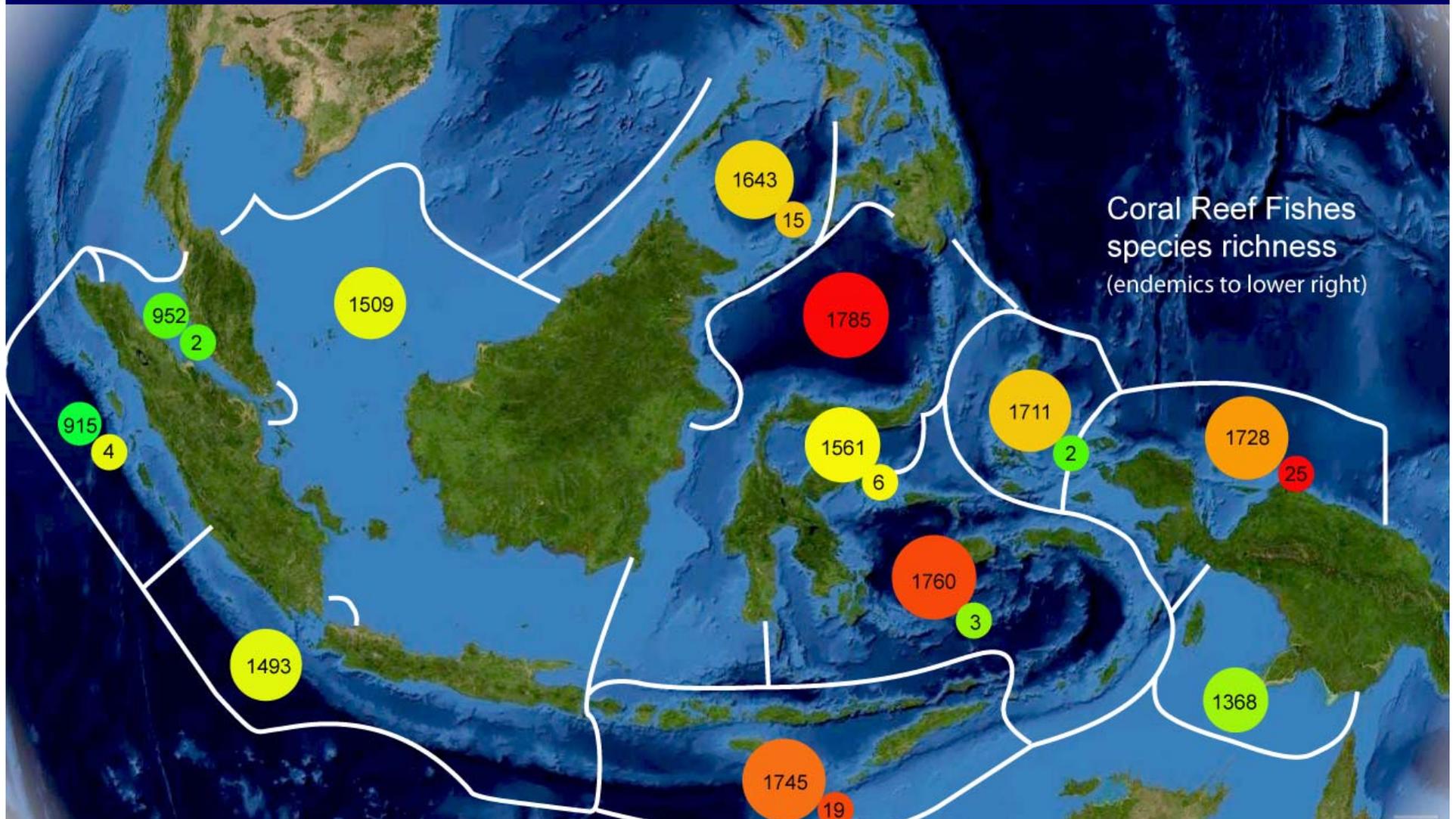
RESPONDENTS AND TAXONOMIC COVERAGE

- **16 Questionnaires:** Dr. Suharsono, *Dr. Kasim Moosa*, Dr. Malikusworo Hutomo, Dr. Matheus Halim, Dr. Yus Noor, Tetha Hitipeuw/Dr. Guswindia, Ketut Sarjana Putra, Dr. Gerald Allen, Dr. Lyndon Devantier, Dr. Bert Hoeksema, Emre Turak, Dr. Paul Barber, Benjamin Kahn, Dr. Mark Erdmann, Dr. Stuart Campbell
- **Additional inputs:** Dr. Rod Salm, Dr. Jack Randall, Dr. Carden Wallace, Dr. Charlie Veron
- **Inputs from major comprehensive databases:** LIPI, Leiden Museum, Coral Geographic, Wetlands International, Gerry Allen Indo-Pacific Fish Distribution Mapping Program
- **Taxonomic coverage:** Reef fishes, Reef corals, Fungiid corals, Mangroves, Reef stomatopods, Other Crustaceans, Sea turtles, Cetaceans, Anguillid eels, Waterfowl, Crocodiles/Dugongs, Seagrasses. Also, marine population genetic data on 25 taxa.

SELECT DATA INPUTS

REEF FISH RICHNESS/ENDEMICISM

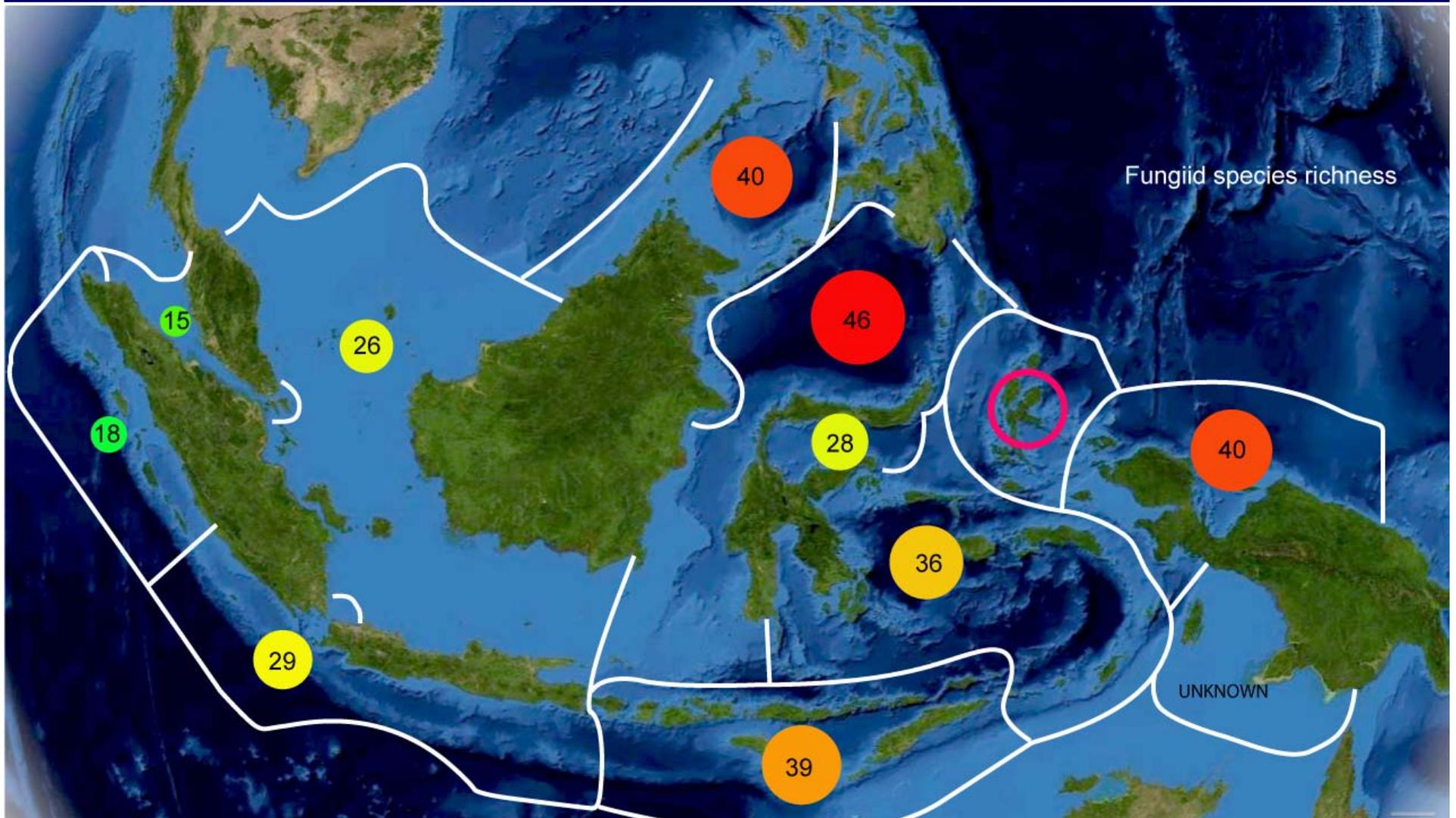
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SELECT DATA INPUTS

FUNGIID CORAL SPP RICHNESS

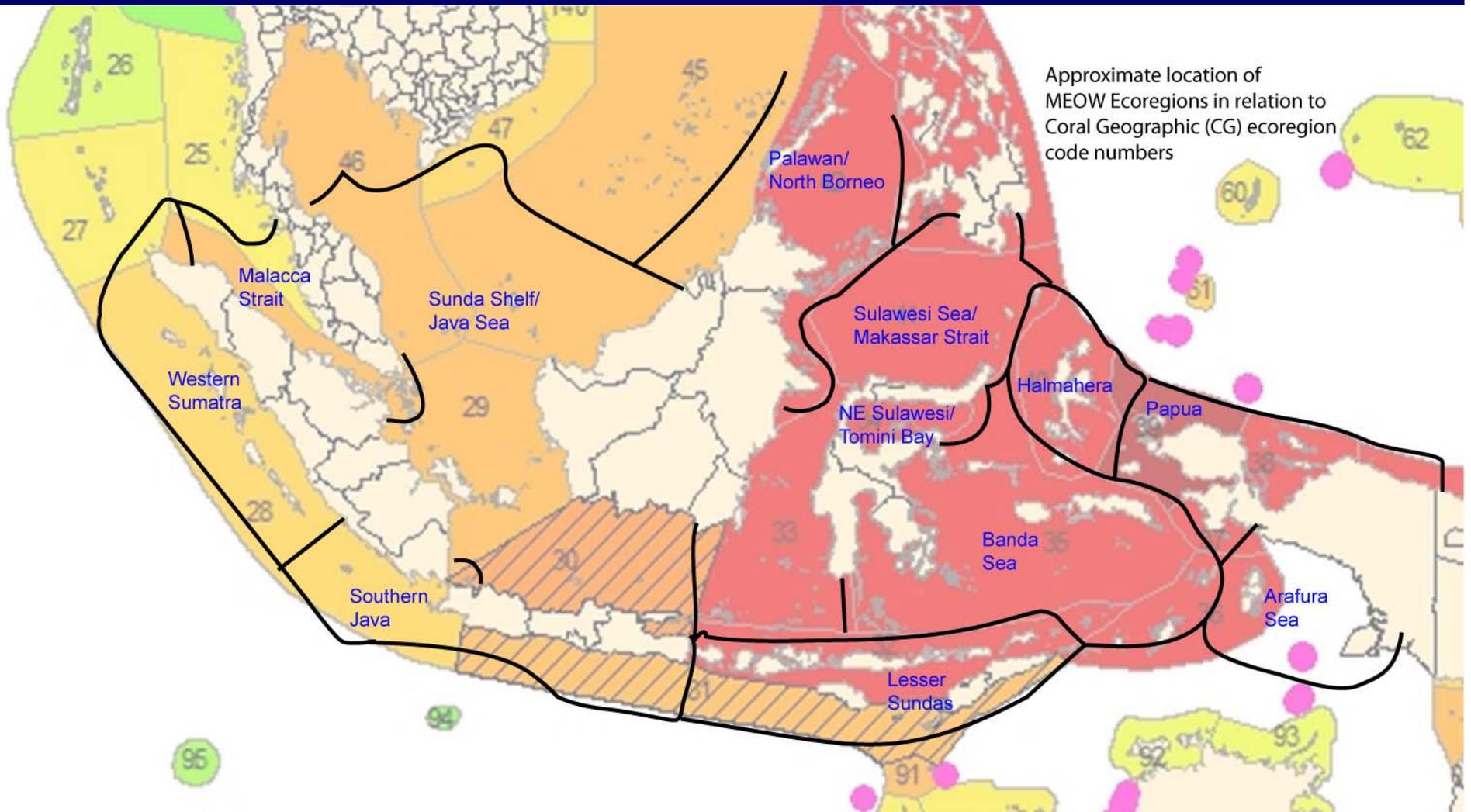
B HOEKSEMA, SUHARSONO



SELECT DATA INPUTS

HARD CORAL SPP RICHNESS

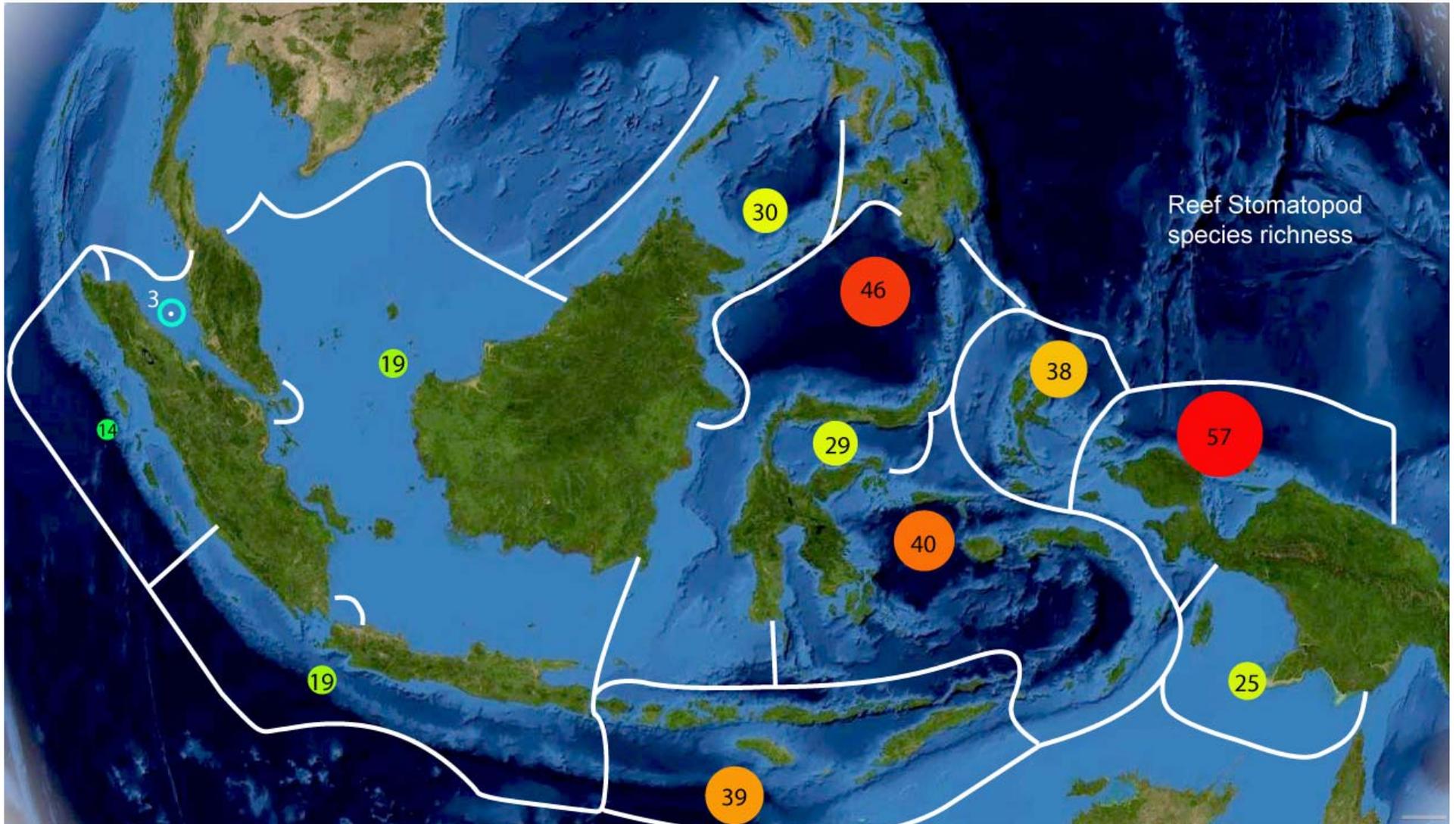
C VERON, L DEVANTIER, E TURAK, SUHARSONO



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REEF ASSOCIATED STOMATOPODS

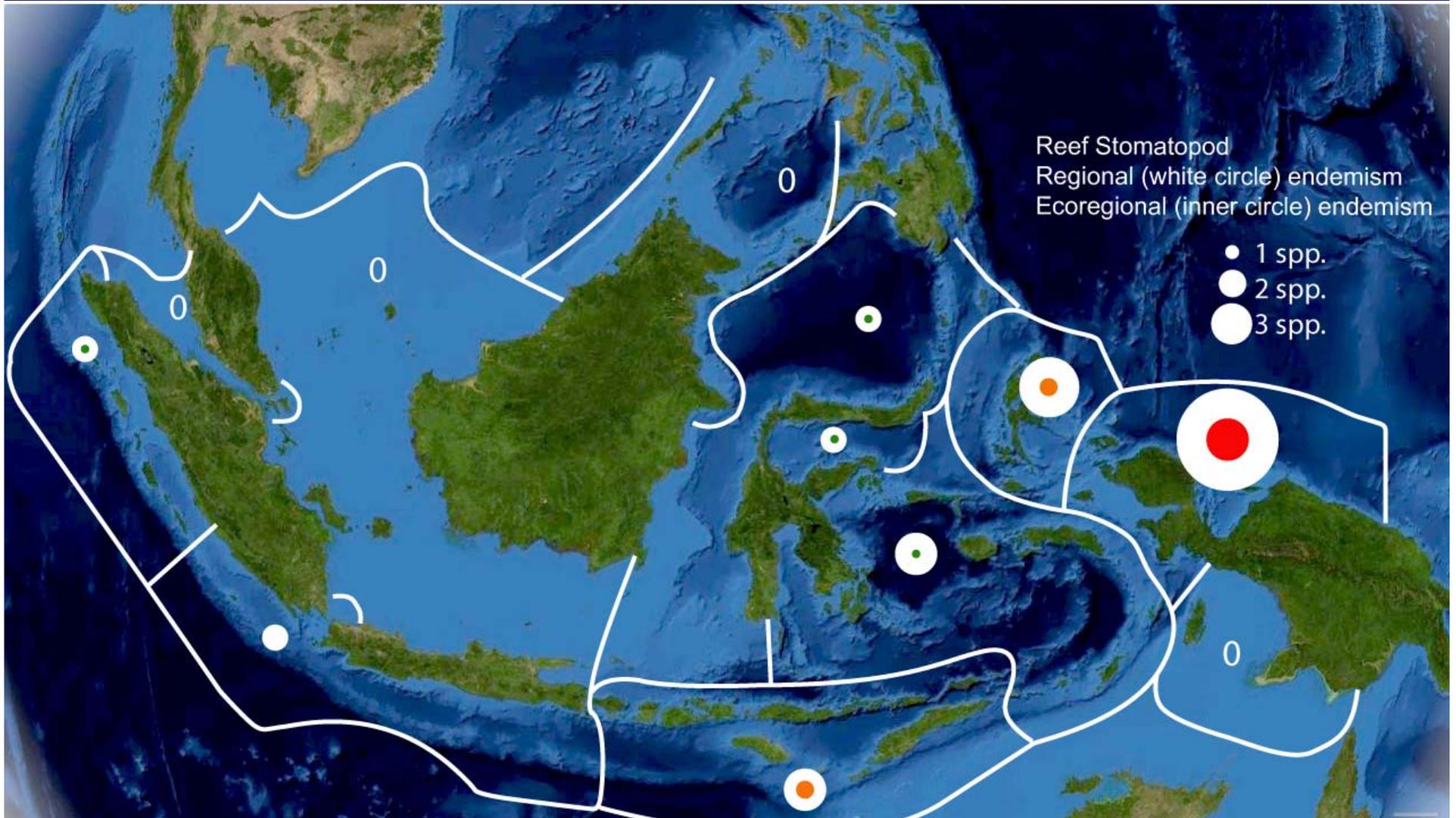
MV ERDMANN, MK MOOSA, PH BARBER



SELECT DATA INPUTS

REEF STOMATOPOD ENDEMICISM

MV ERDMANN, MK MOOSA, PH BARBER

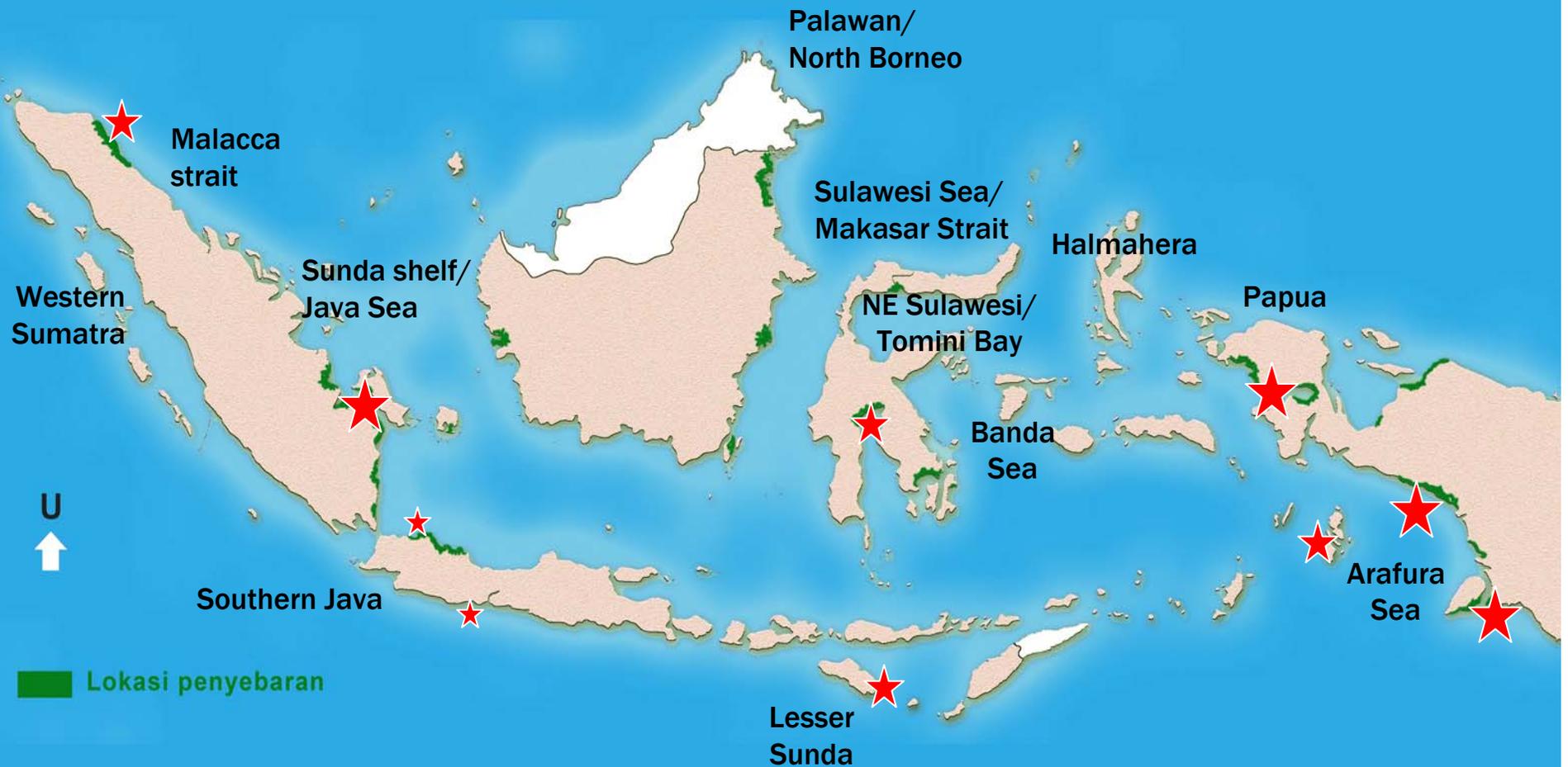


SELECT DATA INPUTS

MANGROVE AREAS OF SPECIAL CONCERN

Y Noor

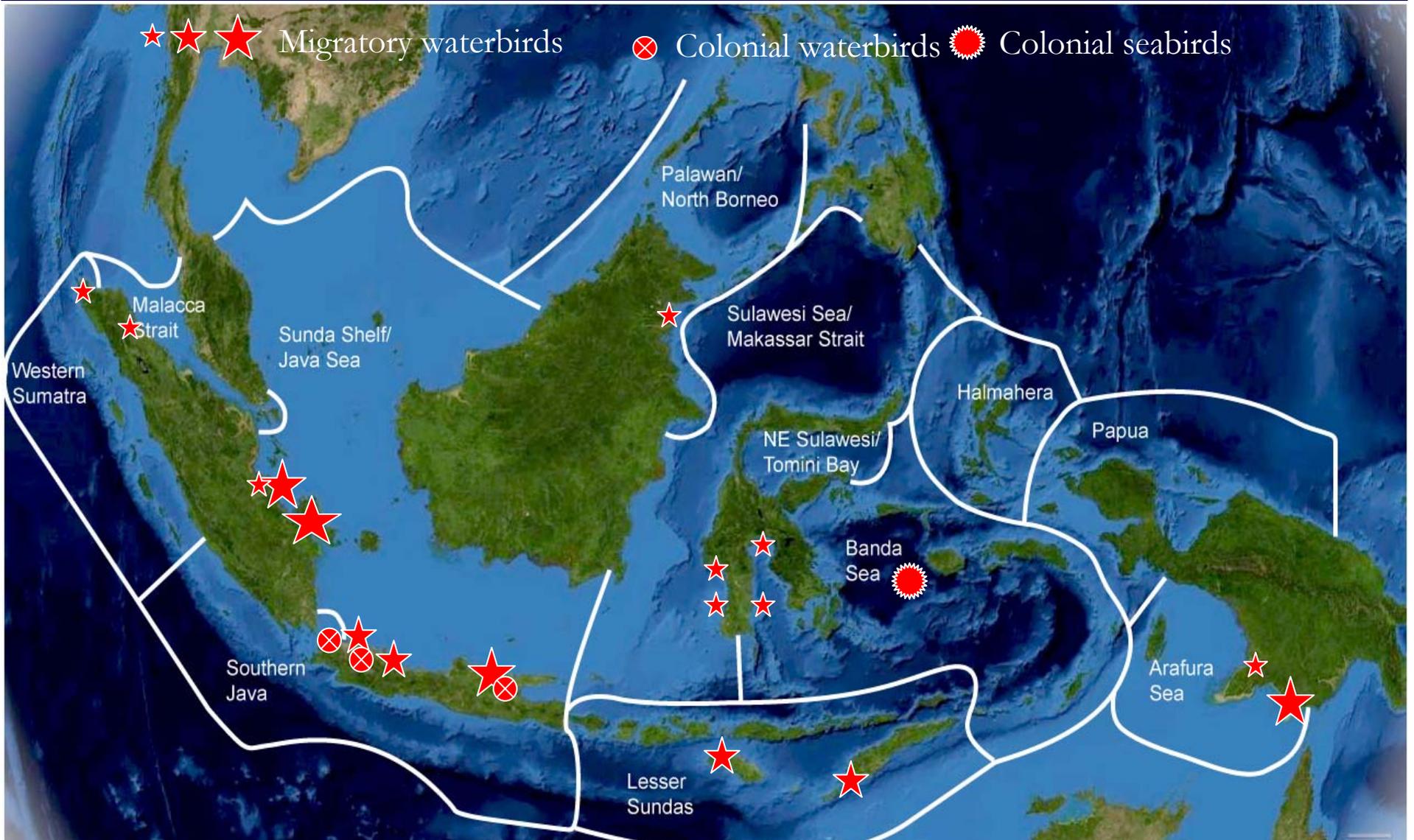
★ ★ ★ Mangrove areas of concern



SELECT DATA INPUTS

COASTAL AND MANGROVE AVIFAUNA

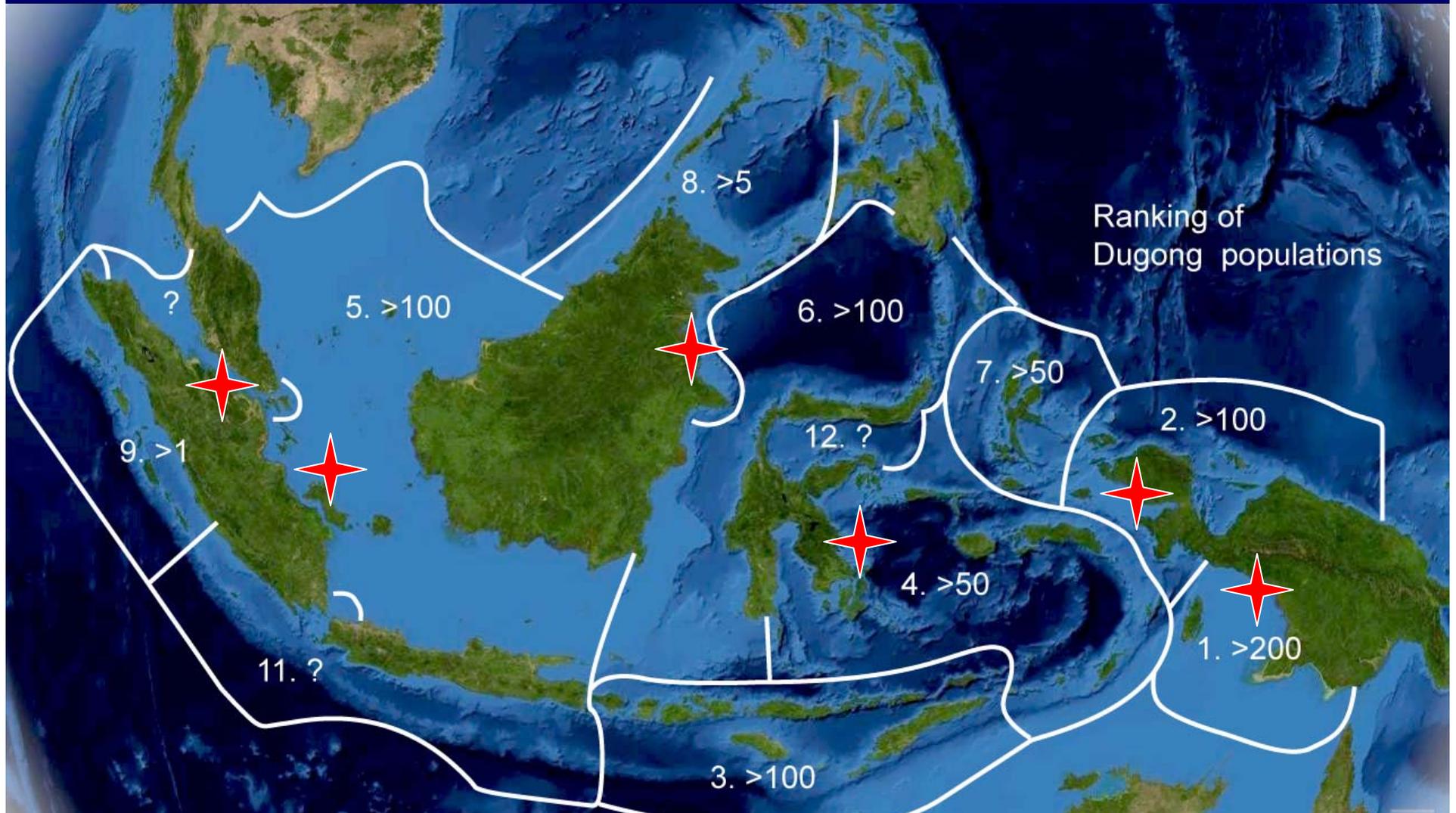
Y Noor



SELECT DATA INPUTS

DUGONG/CROCODILE POPULATIONS

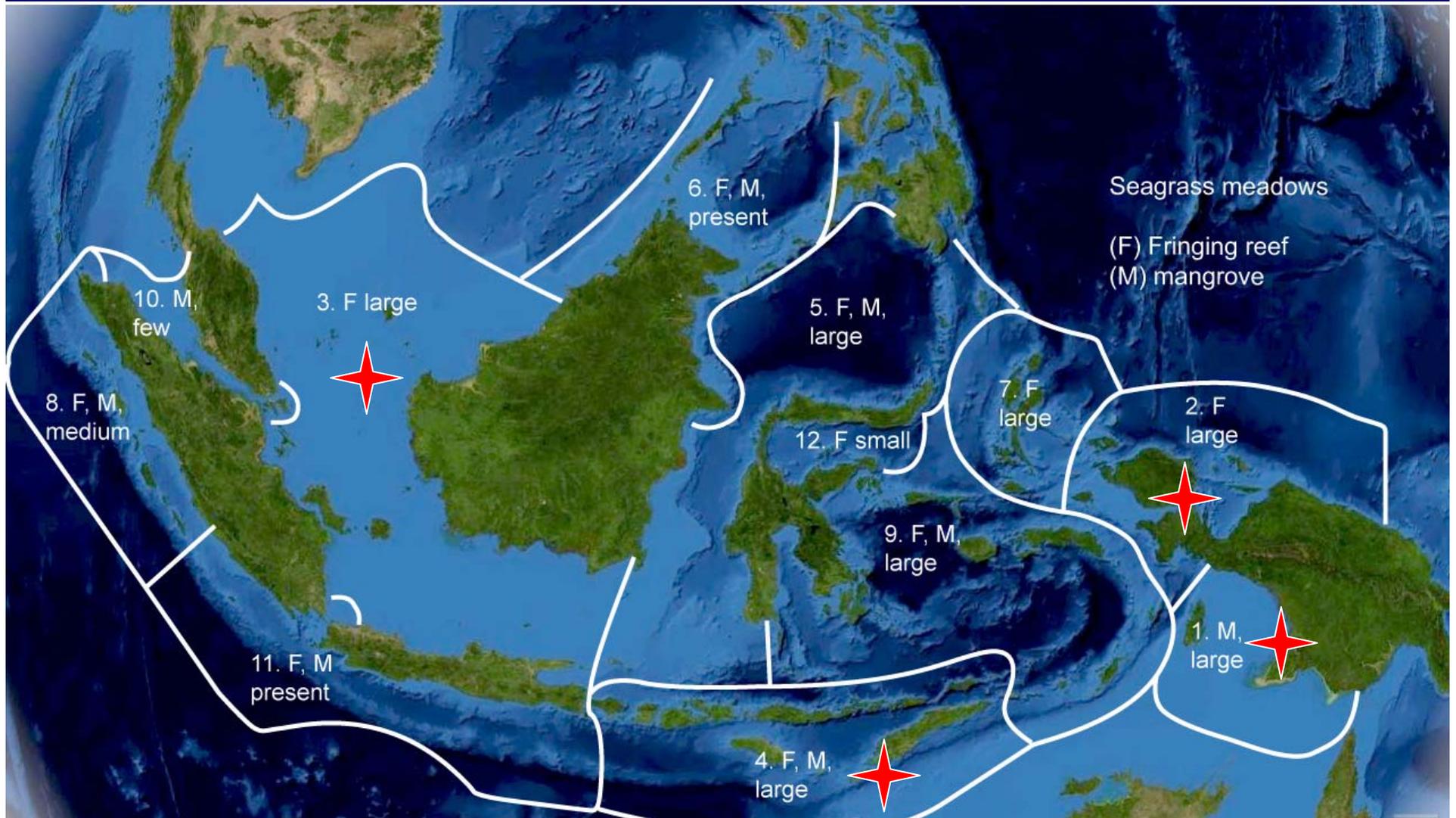
S CAMPBELL, Y NOOR, M HUTOMO



SELECT DATA INPUTS

IMPORTANT SEAGRASS AREAS

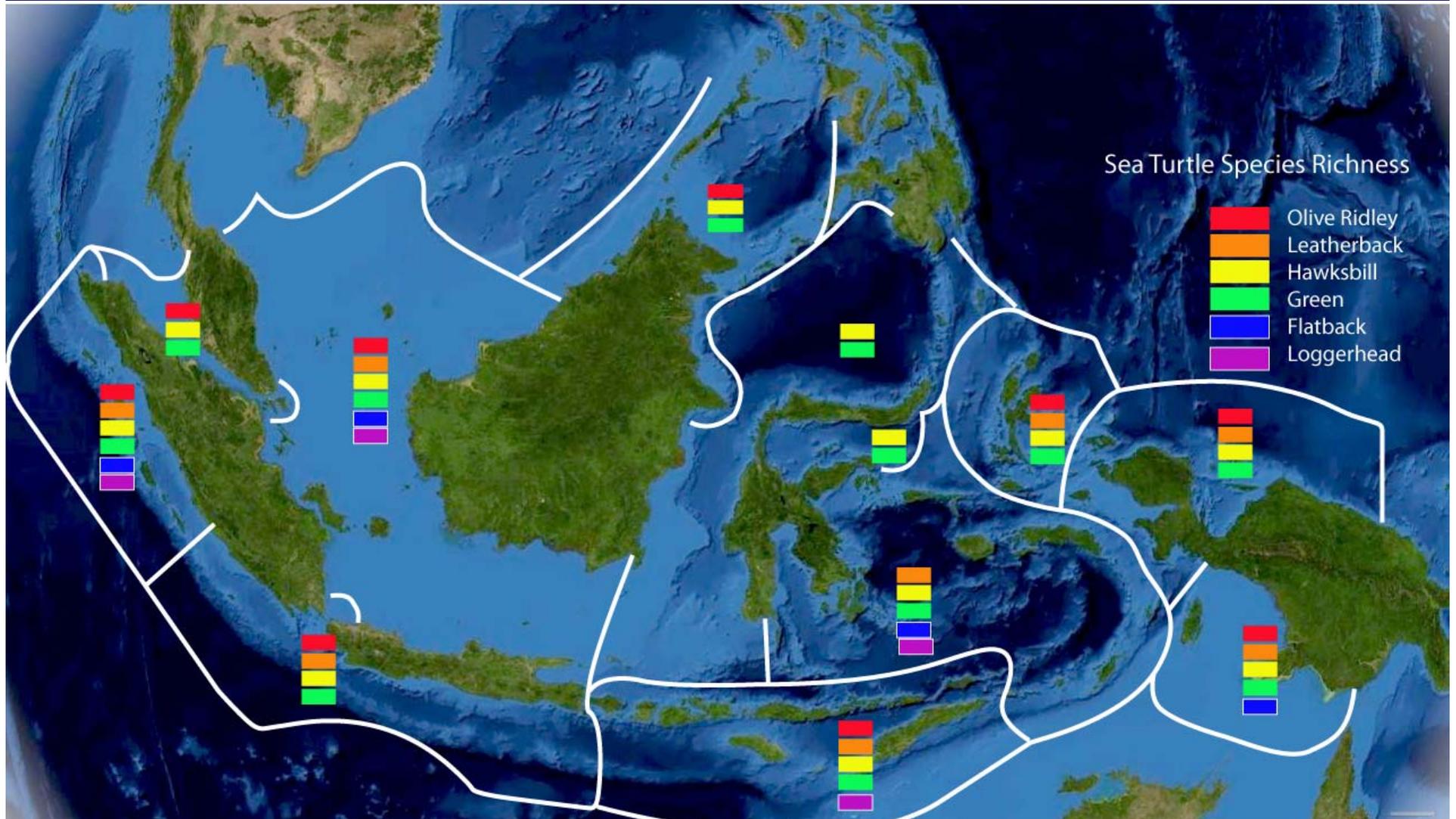
S CAMPBELL, M HUTOMO



SELECT DATA INPUTS

SEA TURTLE

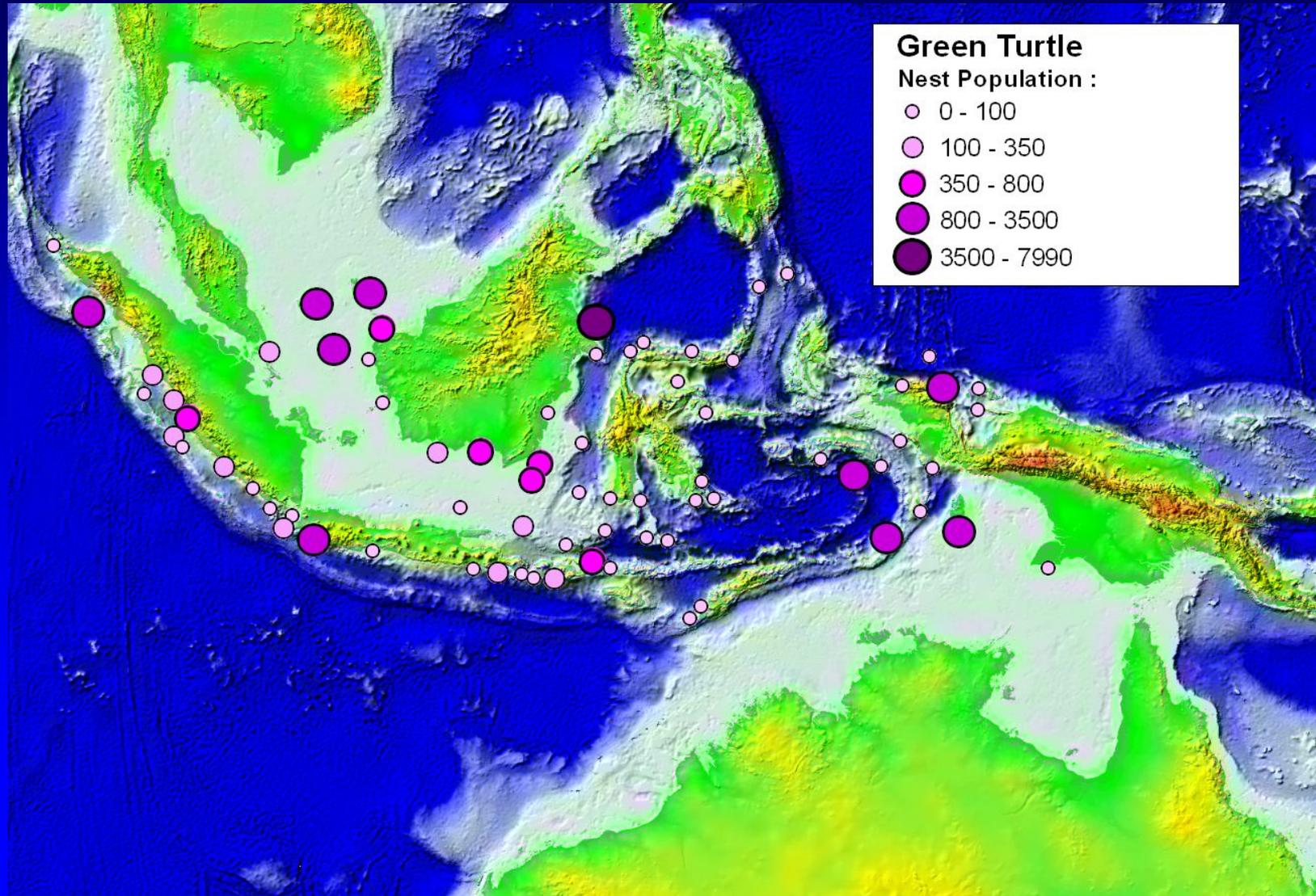
M HALIM, KS PUTRA, C HITIPEUW, GUSWINDIA



SELECT DATA INPUTS

GREEN TURTLE ROOKERIES

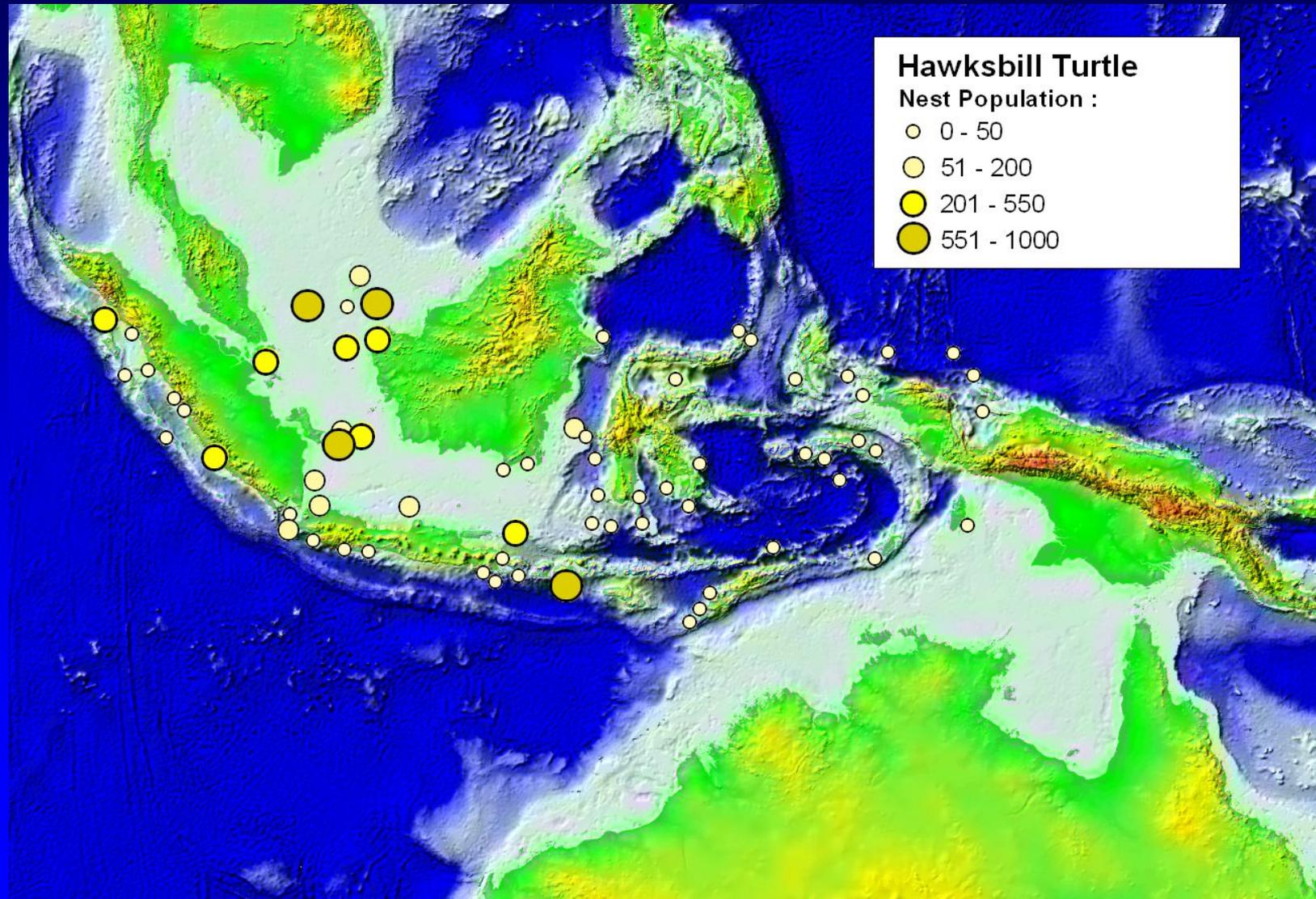
M HALIM, KS PUTRA, C HITIPEUW, GUSWINDIA



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HAWKSBILL ROOKERIES

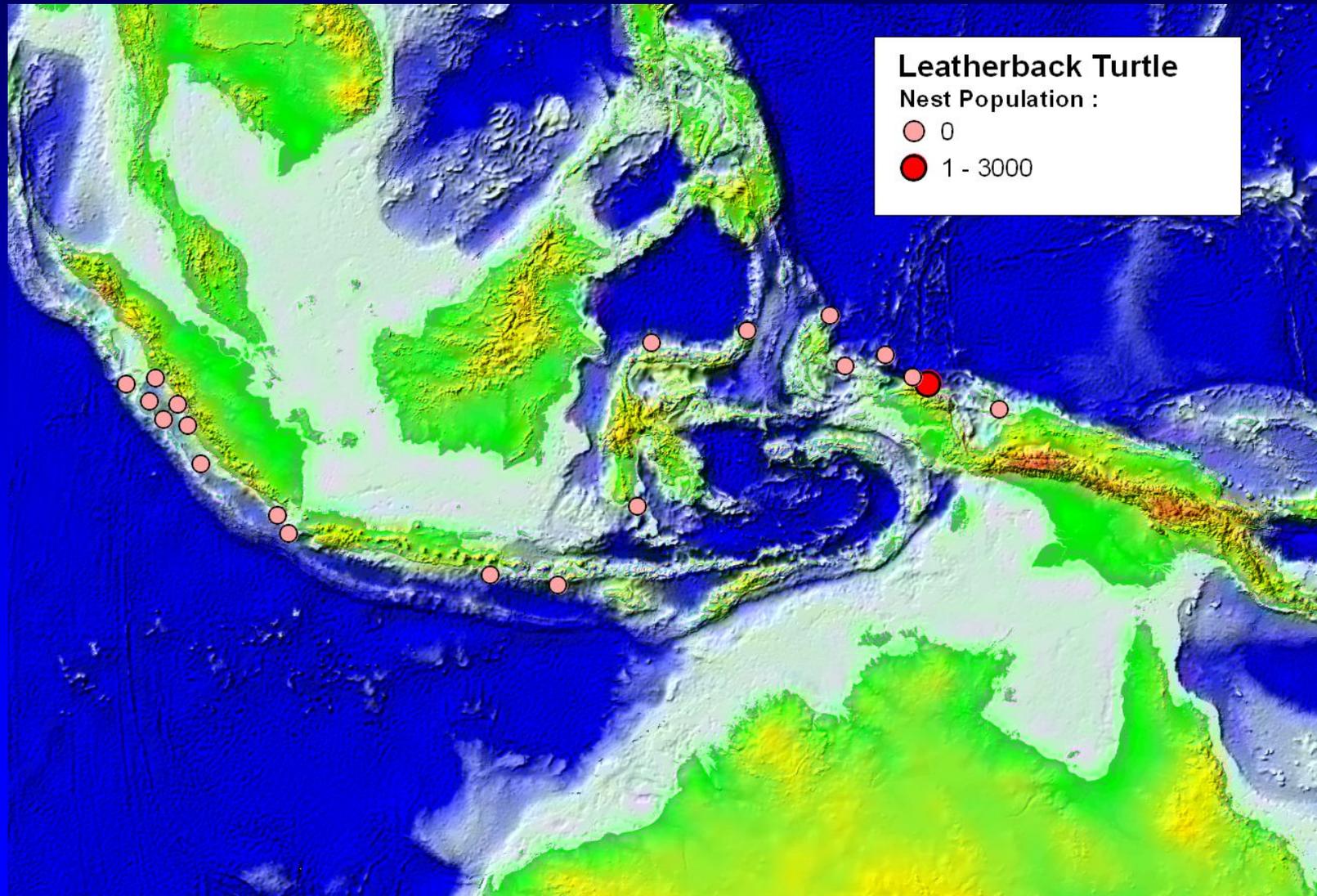
M HALIM, KS PUTRA, C HITIPEUW, GUSWINDIA



SELECT DATA INPUTS

LEATHERBACK ROOKERIES

M HALIM, KS PUTRA, C HITIPEUW, GUSWINDIA



SELECT DATA INPUTS

SEA TURTLE ROOKERY SUMMARY

Major Sea Turtle Rookeries in Indonesia (Draft)



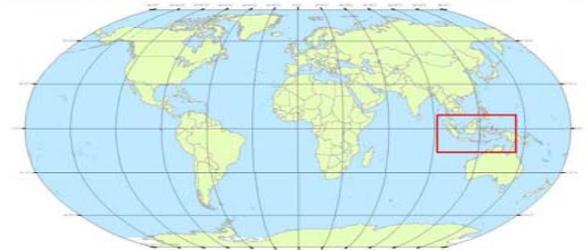
- LEGENDA/LEGEND**
- Ibu kota negara/State capital
 - Kota provinsi/Province city
 - Batas provinsi/Province boundary
 - Garis pantai/Coastline
 - Daerah Alas Sabah/Alor Sook Region
 - Koridor penerj Selat Bali-Bali Strait turtle corridor
 - Kap. Derawan/Derawan Islands
 - Pulau Eku, Anu Tenggara/Eku Island, Southeast Anu
 - Pantai Jambu/Jambu/Jamboni Beach
 - Kabupaten Kolabatu/Kolabatu District
 - Kap. Ratu-Anambas/Ratu-Anambas Islands
 - SML Sabda Talanga/Sabda Talanga Reserve, Papua
 - Kabupaten Sembawa/Sembawa District
 - Kap. Sayang dan Piar/Sayang and Piar Islands, Raja Ampat
 - Pantai Barat Sumatera/West Coast Sumatra
 - Pantai Pangumbahan-Cipatjah/Pangumbahan-Cipatjah Beaches

- Ketinggian/Elevation**
- Tinggi/High
 - Rendah/Low
- Kedalaman laut/Bathymetry**
- Dangkal/Shallow
 - Dalam/Deep

Skala 1 : 4.500.000

proyeksi/projection : geographic
 peta ini dibuat oleh GIS Unit CI Indonesia/this map is produced by the GIS Unit of CI Indonesia
 ©2008, CI Indonesia, Jakarta
 kartografi/cartography: Heni Sumetri

Sumber/Source:
 Atlas Sumber Daya Kelautan, 1:5.000.000, Belokoutan 1997/1998
 GTOPO30/30S50
 Global Forest Watch
 Conservation International



Scale/Scale 1 : 100.000.000
 Proyeksi/Projection : World_Robinson

SELECT DATA INPUTS

CETACEANS

B KAHN

- Large areas of unknown, though at least 9 areas (incorporating 6 ecoregions) stand out. Historical whaling data is of interest of course
- Ecoregion boundaries don't make that much sense to cetaceans
- Two main habitats of primary importance:
 - Deepsea habitats – great whales and oceanic dolphins
 - Coastal areas –coastal cetaceans.
- Indonesia also unique with deepsea yet nearshore habitats (and seamounts, etc). Abundant opportunities to slightly expand current MPAs to capture these important features for large migratory marine life

SELECT DATA INPUTS

CETACEANS

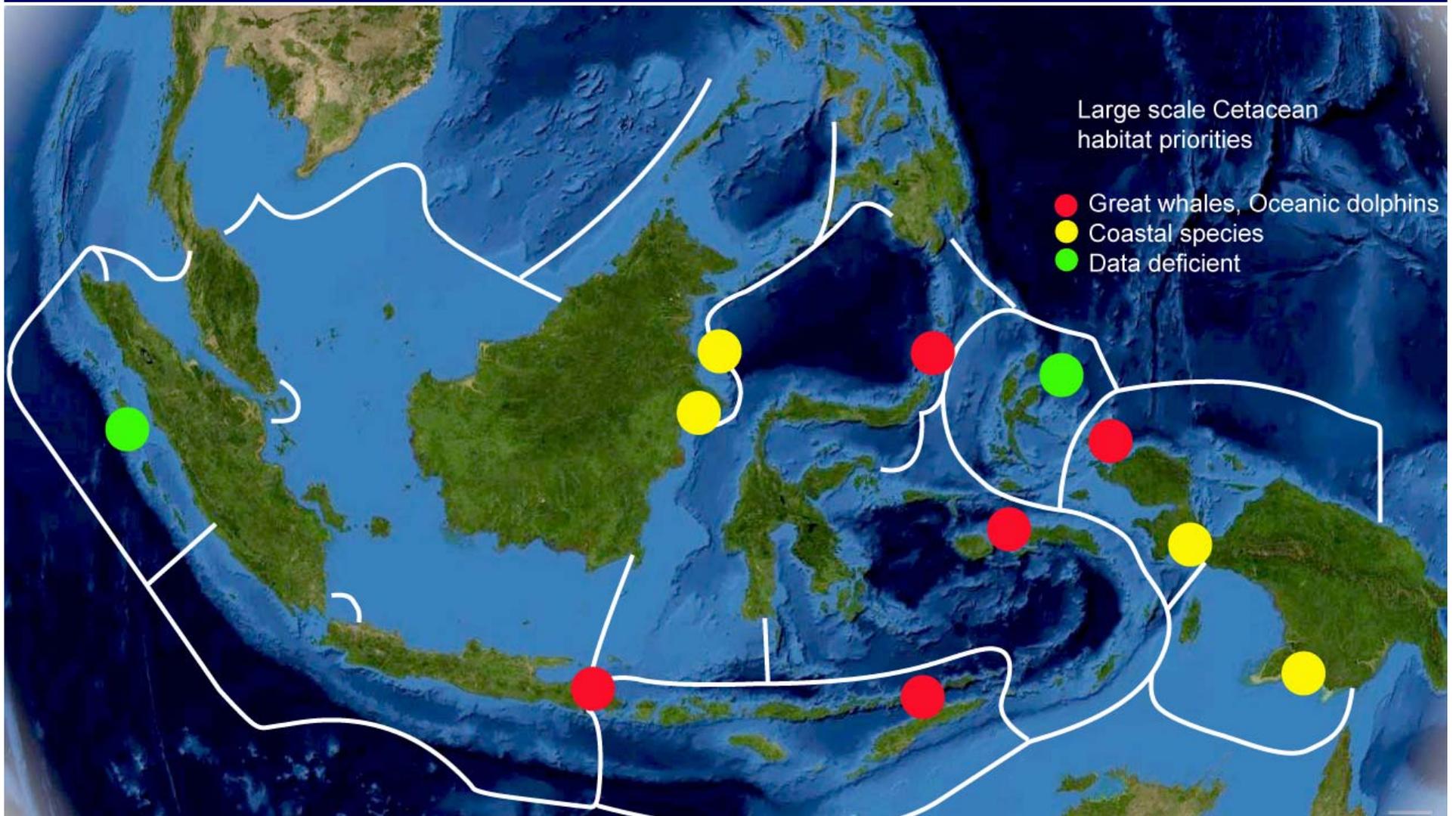
B KAHN

- Lesser Sundas – top cetacean priority - migration corridors, foraging habitat (massive upwelling productivity areas), calving in Savu Sea, possible increasing importance for “top up” for “skinny whales”
- Banda Sea – Blue whales resident up to 3 months/yr
- Bird’s Head – calving for sperm whales, excellent prey densities
- Sangihe-Talaud – calving area for sperm whales
- Triton Bay/SW Papua (Papua/Arafura Sea) – prime coastal whale habitat that is now largely gone from SE Asia
- East Kalimantan (Mahakam, Berau Rivers) – Irrawaddy dolphins, finless porpoises in mangrove river areas

SELECT DATA INPUTS

CETACEANS

B KAHN



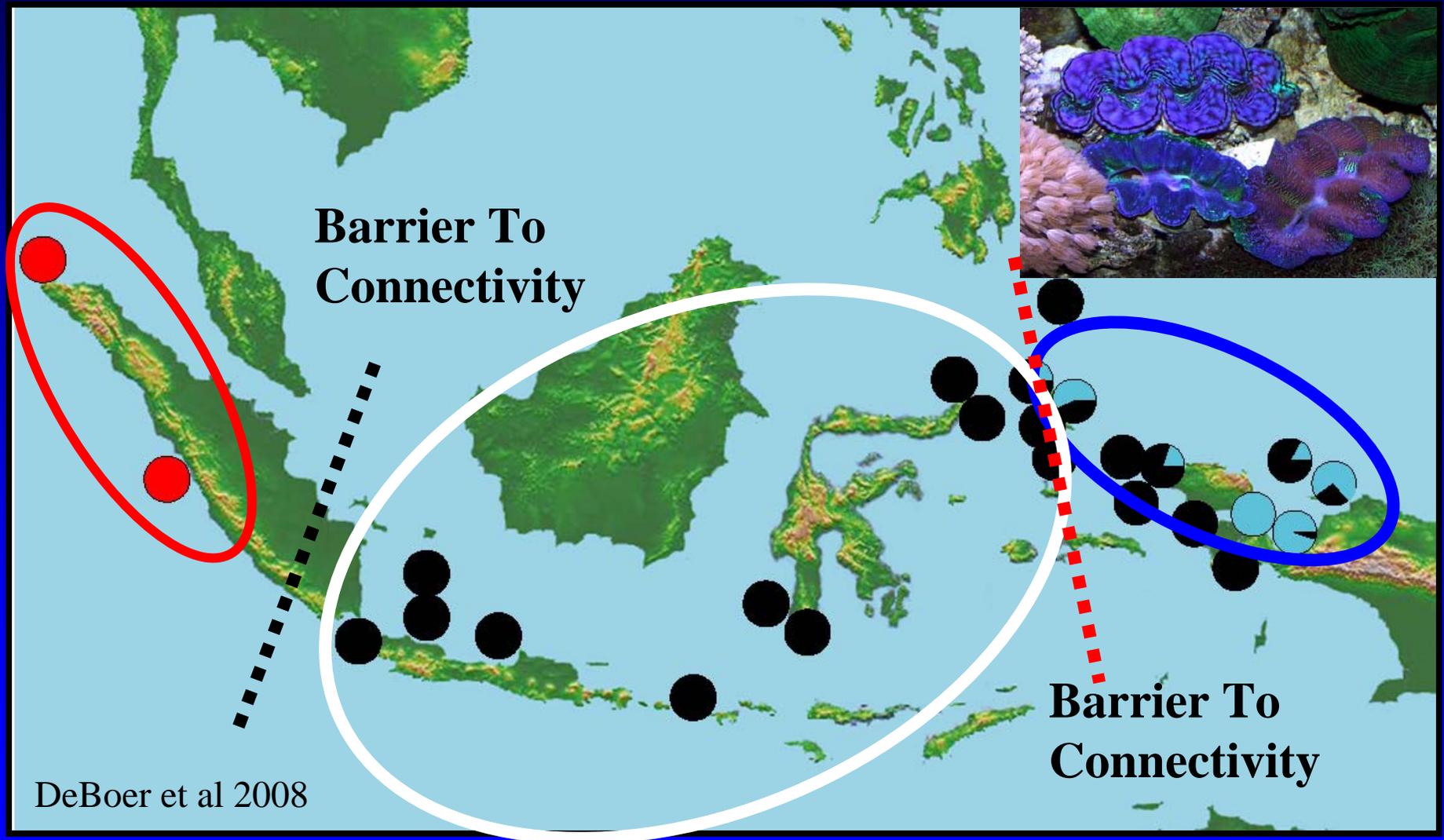
SELECT DATA INPUTS

MARINE POPULATION GENETICS

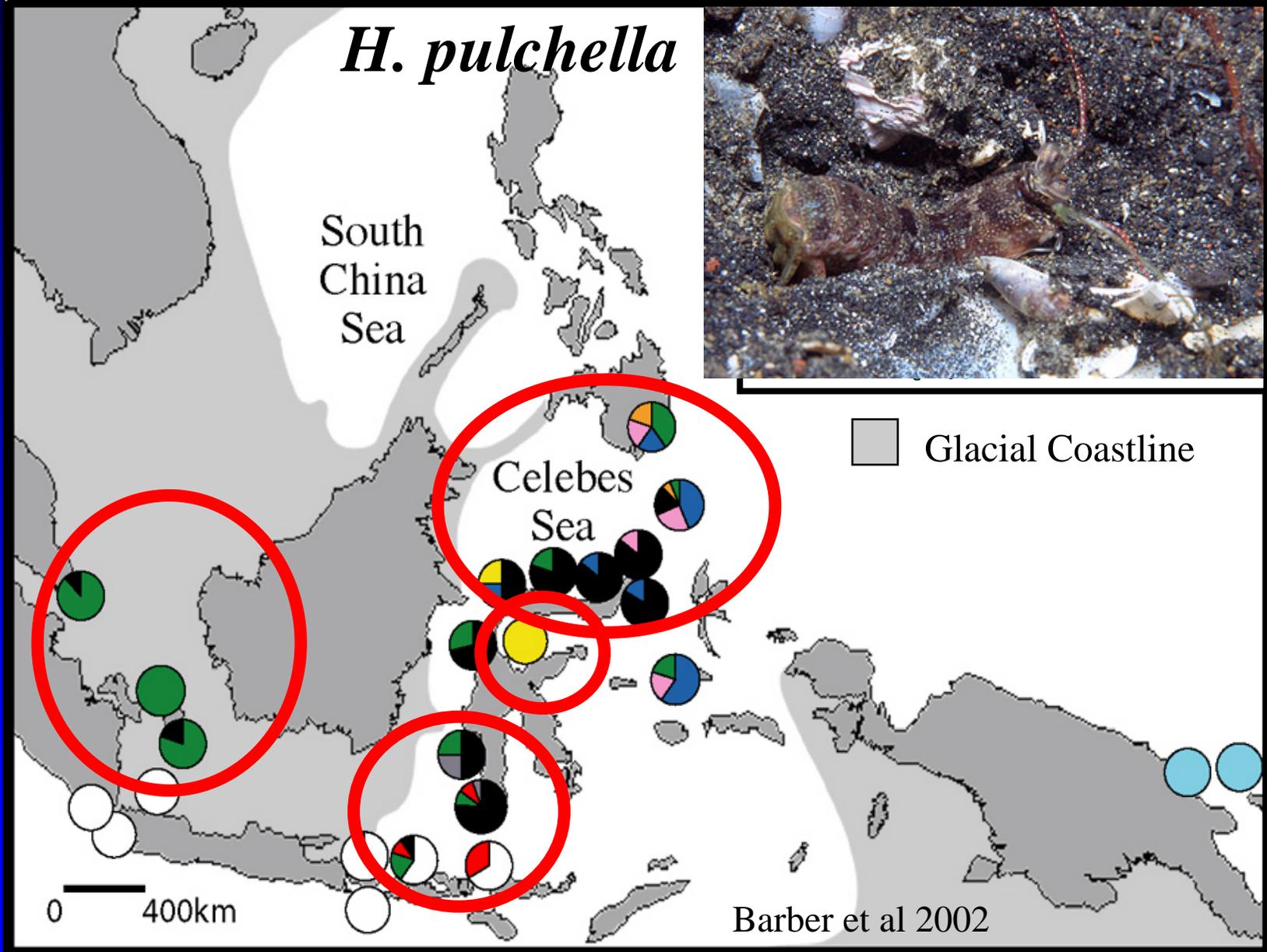
PH BARBER ET AL

- Three basic patterns of genetic structure seen across Indonesia:
 - Western, Central, Eastern Indonesian clades
 - Pacific vs. Indian Ocean clades
 - Complete homogeneity (no structure)
- Important: takes a very long time to evolve patterns, but they are very quickly erased by gene flow. Ie, if we see complex structure/ genetic breaks today, it means these barriers are still operating
- Although not immediately obvious, maintaining genetic diversity is extremely important in the face of global change – this diversity represents the very building blocks of adaptation

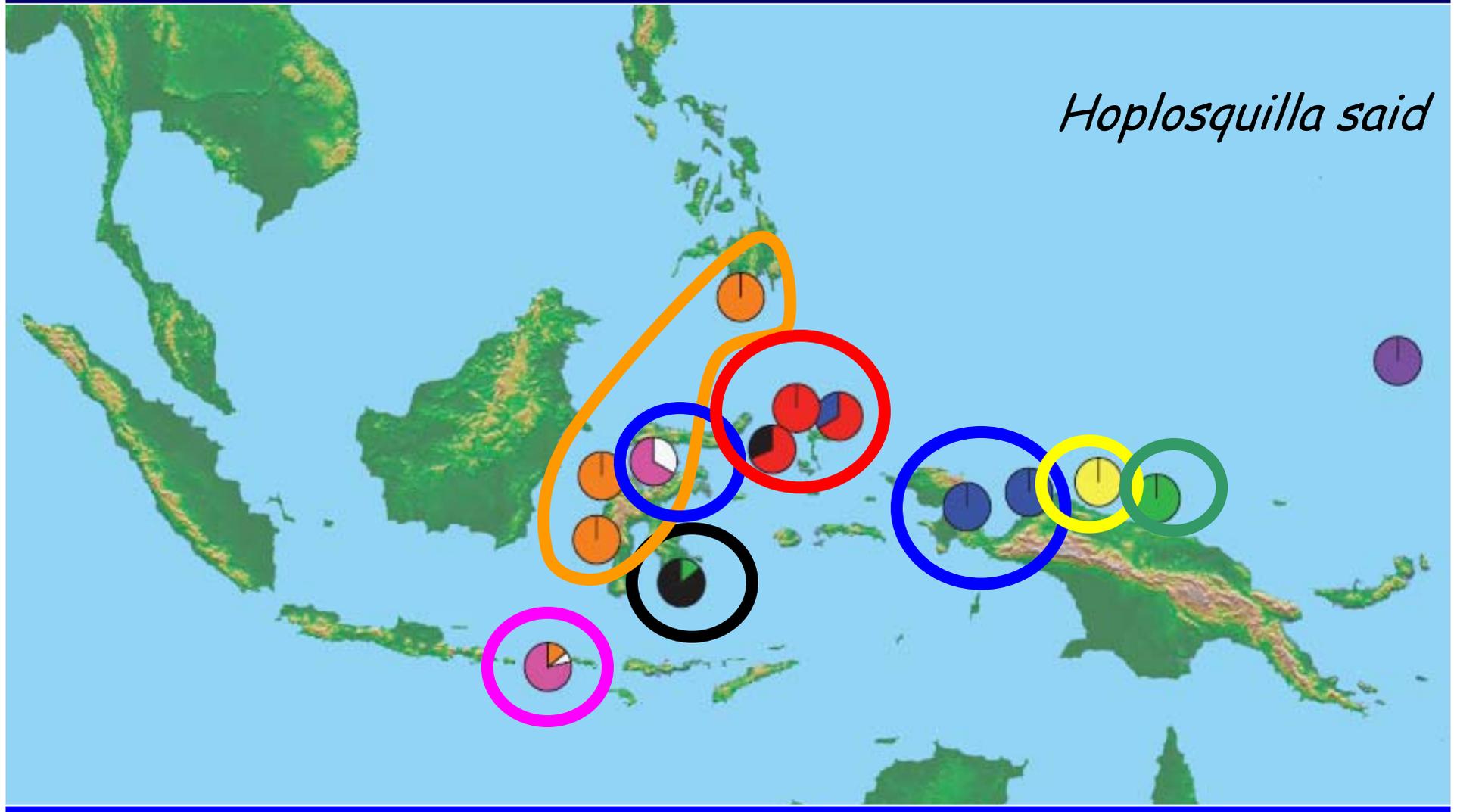
Regional Divergence among Eastern, Western and Central Indonesia



Subtle Fine-Scale Divergence



Strong Patterns of Fine-Scale Divergence



ADDITIONAL DATA INPUTS

WESTERN SUMATRA

- Regionally significant aggregations of threatened/RR spp: Nesting and foraging grounds for 6 species of sea turtle
- Unique Features: Sarabua Bay (Siberut) – deep inland bay with unique coral assemblages, best example of Indian Ocean fauna
- Climate Change Considerations: This region is subject to significant water movement (both from currents and constant oceanic swell) and has deep water in close vicinity to many reefs, and as such may show significant resilience to climate change impacts
- Conservation Opportunities/Threats: Reconstruction/revision of spatial plans after tsunami allow for potential for better marine resource management, possibility for tying marine conservation initiatives to surfing tourism (untapped potential)
- Particular Sites of Conservation Interest: Pulau Banyak, Pulau Bengkaru, Pulau Simeleue, Pulau Siberut, Nias, Weh

ADDITIONAL DATA INPUTS

MALACCA STRAIT

- Regionally significant aggregations of threatened/RR spp: Important post-nesting migration corridor for hawksbills
- Unique Features: Connectivity corridor from Andaman Sea/Indian Ocean to South China Sea
- Climate Change Considerations:
- Conservation Opportunities/Threats: One of busiest shipping lanes in the world, highly impacted anthropogenically
- Particular Sites of Conservation Interest: Selat Dumai, Karang Gading Langkat, Patch Reefs north of Medan

ADDITIONAL DATA INPUTS

SUNDA SHELF/JAVA SEA

- Regionally significant aggregations of threatened/RR spp:
Natuna/Anambas may be one of the most important hawksbill rookeries in SE Asia. Saltwater crocodiles common in mangrove forests of Sumatra and Kalimantan
- Unique Features: Sediment adapted coral reef assemblages; several rare seagrass species are abundant in Riau
- Climate Change Considerations: Reefs “pre-adapted” to stressful conditions (lowered salinities, high sediment load). Recovery after El Nino bleaching relatively quick.
- Conservation Opportunities/Threats:
- Particular Sites of Conservation Interest: Natuna-Anambas-Tambelan, Karimunjawa, Kangean, Riau, Paloh (Sambas), Mangrove areas of Kapuas River/Batu Ampar in Kalimantan), Belitung

ADDITIONAL DATA INPUTS

SOUTHERN JAVA

- Regionally significant aggregations of threatened/RR spp: extensive turtle nesting beaches (at least hawksbill, green, leatherback, olive ridley)
- Unique Features: apparent spawning aggregations of sardine species. Apparent very high levels of deep sea marine biodiversity
- Climate Change Considerations:
- Conservation Opportunities/Threats: because of the relative inaccessibility of area, could relatively easily enact no-take reserves. Mangrove areas in Cilicap/Segara Anakan are last extensive mangroves in Java
- Particular Sites of Conservation Interest: Alas Purwo, Sukamade, Sukabumi (Pangumbahan), Meru Betiri, Ujung Kulon, Segara Anakan, Pulau Seribu, Pangandaran, Krakatau/Sunda Strait

ADDITIONAL DATA INPUTS

LESSER SUNDAS

- Regionally significant aggregations of threatened/RR spp: main passageways of Indonesian throughflow – which also means channels/bottlenecks for large migratory marine life
- Unique Features: narrow deep-water channels that create upwelling areas and high productivity zone along south. Marine lake with stromatolites in Pulau Satonda. Endemic stylerasterid coral in Bali/Komodo; *Acropora suharsonoi* appears endemic
- Climate Change Considerations: Constant water movement (from currents and wave exposure) and strong seasonal upwelling of deep cold water suggest that reefs in this region are likely resilient to climate change.
- Conservation Opportunities/Threats:
- Particular Sites of Conservation Interest: Komodo, Nusa Penida, Southeast Lombok, Kepulauan Sabalana/Tengah, Pantar, Wetar, Roti, Teluk Maumere, Savu Sea

ADDITIONAL DATA INPUTS

PALAWAN/NORTH BORNEO

- Regionally significant aggregations of threatened/RR spp: Southeast Asia's largest green turtle rookery, manta aggregations, Irrawaddy River Dolphins and finless porpoises
- Unique Features: Anchialine marine lakes in Kakaban/Maratua, each with unique (endemic) assemblages, One endemic fungiid coral
- Climate Change Considerations:
- Conservation Opportunities/Threats: Derawan group of Islands are vulnerable to the impact of unsustainable land-based activities, e.g. mangrove cutting at Berau Delta and conversion of this ecosystem into shrimp pond
- Particular Sites of Conservation Interest: Berau (Kakaban, Derawan, Maratua, Semama, Sangalaki, Balikukup, Bilang-bilangan, Panjang, Mataha)

ADDITIONAL DATA INPUTS

SULAWESI SEA/MAKASSAR STRAIT

- Regionally significant aggregations of threatened/RR spp: Calving grounds of sperm whales in Sangihe, whale shark aggregations in Spermonde
- Unique Features: Seamounts, Lembeh Strait.
- Climate Change Considerations: This ecoregion is critical from a climate change perspective, as it is the main region through which the Indonesian throughflow of water from Pacific to Indian Oceans travels. Most reefs are located in areas which are immediately juxtaposed with deep water (and strong currents and tidal upwellings), so overall may be resilient to climate change
- Conservation Opportunities/Threats: This area is well-known for having excellent local human resources in marine sciences and marine resource management (both in Makassar and Manado) and a long history of marine conservation investment and conservation-minded marine tourism operators
- Particular Sites of Conservation Interest: Bunaken-Likupang-Lembeh, Sangihe-Talaud, Postiljons/Sabalana Islands, Spermonde, Toli-toli (Teluk Dondo), Donggala

ADDITIONAL DATA INPUTS

NORTHEAST SULAWESI/TOMINI BAY

- Regionally significant aggregations of threatened/RR spp: Numerous apparent endemic species (corals, fish, stomatopods, anguillid eels),
- Unique Features: The northern coastline of Tomini Bay is also quite unique in that steep high forested ridges plunge into the ocean and immediately drop off into the abyss, with no continental shelf. The semi-enclosed nature of Tomini Bay is also unique, and the endemism and genetic isolation seen there have been hypothesized to be a result of both ongoing speciation due to isolation as well as relictual Tethyan faunal elements enclosed as the arms of Sulawesi collided to form the deep bay while the Tethys seaway disappeared
- Climate Change Considerations:
- Conservation Opportunities/Threats: Togean Islands National Marine Park is an excellent anchor for conservation plans; proactive conservationist Governor in Gorontalo
- Particular Sites of Conservation Interest: Togean Islands, Gorontalo coastline, Ampana/Tanjung Api coastline

ADDITIONAL DATA INPUTS

HALMAHERA

- Regionally significant aggregations of threatened/RR spp: highest concentrations of coconut crab known in Indonesia
- Unique Features: Teluk Kao as a large, nearly-enclosed bay; very high habitat diversity as a result of very active tectonics
- Climate Change Considerations:
- Conservation Opportunities/Threats: Mining is a major threat; Kao Bay suffers harmful algal blooms each year. The provincial government, local communities (especially in Goraici area) and local University Khairun are very interested in conservation initiatives (Ternate Declaration)
- Particular Sites of Conservation Interest: Goraici/Kayoa Islands, Tobelo, Southern and Northern Loloda Islands, Bacan, Widi, Morotai

ADDITIONAL DATA INPUTS

BANDA SEA

- Regionally significant aggregations of threatened/RR spp: seabird nesting colonies (Pulau Manuk and Taka Bone Rate), Blue whales, major turtle nesting beaches on Lucipara, Kei Islands are important foraging grounds for leatherbacks, reef fish SPAGS in Watubelas
- Unique Features: Unique oceanic reef habitats (deep, clear water) not found elsewhere in Indonesia, atolls, abundant seamounts. Up to 32 endemic species of cryptic holothurians. Apparent very high levels of deep sea marine biodiversity
- Climate Change Considerations: Deep water basin can act a refuge; strong upwellings
- Conservation Opportunities/Threats:
- Particular Sites of Conservation Interest: Wakatobi, Banda Islands, Banggai Islands, Lucipara, Inner Banda Arc, Outer Banda Arc, Taka Bone Rate, Watubela Islands

ADDITIONAL DATA INPUTS

PAPUA

- Regionally significant aggregations of threatened/RR spp: world's largest Pacific leatherback rookery, major green turtle rookeries, resident Bryde's whales in Kaimana, healthy dugong populations
- Unique Features: Anchialine marine lakes abundant in Raja Ampat and Kaimana, each with unique assemblages; some coral species don't penetrate further west into Indonesia than Waigeo; mindblowing habitat diversity
- Climate Change Considerations: Studies have shown that reefs in the area are naturally subject to a massive 16°C variability in sea surface temperature, suggesting a high resilience to climate change.
- Conservation Opportunities/Threats: Low human population density and generally receptive governments; on flip side, mining and transmigration and poorly-planned coastal development are major threats
- Particular Sites of Conservation Interest: Raja Ampat, T. Cendrawasih, Jamursba Medi/Abun, Teluk Bintuni, Kokas, FakFak, Kaimana, Mapia

ADDITIONAL DATA INPUTS

ARAFURA SEA

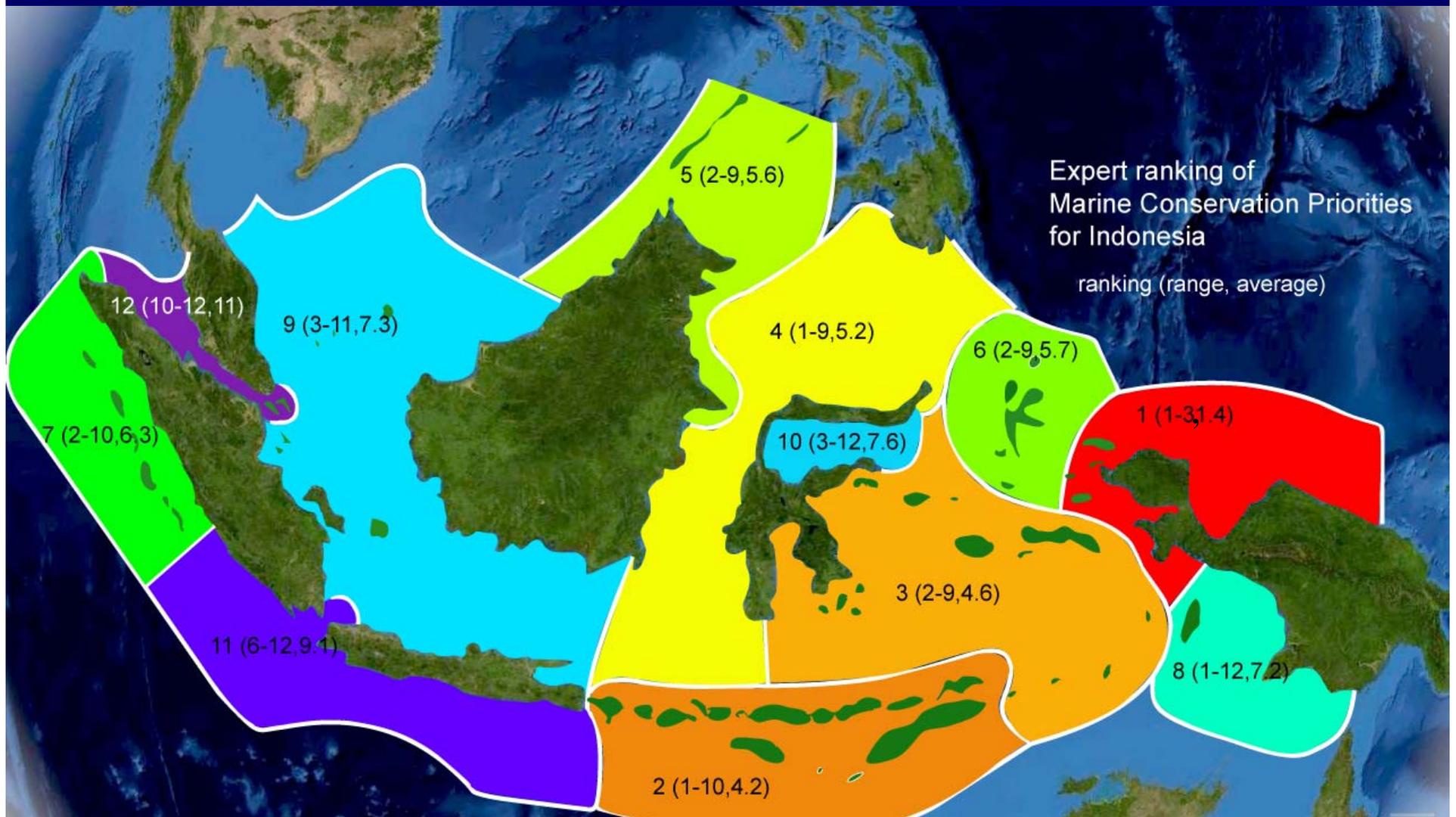
- Regionally significant aggregations of threatened/RR spp: Major green turtle nesting beaches. Major foraging grounds for greens and olive ridleys, and migration corridor for greens, olive ridleys and leatherbacks, possibly whale sharks. Foraging area for dugongs. Estuarine crocodiles
- Unique Features: 21 endemic brachyuran crab species and 26 endemic anomuran crustaceans. Possibly most important mangrove forests in Indonesia. The Aru Islands present a unique habitat in the form of narrow river-like extensions of the sea between the various islands.
- Climate Change Considerations: Major lowland swamp areas (room for migration). Potentially climate-change resilient reefs
- Conservation Opportunities/Threats: Largest shrimp fishery in Indonesia; legal trawling allowed.
- Particular Sites of Conservation Interest: Aru Islands (Enu, Jeh, Karang), submerged patch reefs SE of Aru, Wasur, Lorentz, Rawa Biru, Pulau Kimaam

OVERALL RANKING RESULTS



- **COMPOSITE RANKING COMPILED FROM 15 QUESTIONNAIRE RESPONDENTS**
- **RESPONDENTS EXPRESSED OVERALL CONFIDENCE IN RANKINGS, PARTICULARLY OF TOP RANKINGS – THOUGH NOTING THAT SOME LOWER AREAS (PARTICULARLY WESTERN SUMATRA) MIGHT RISE WITH SURVEY WORK**

OVERALL RANKING RESULTS



RANKING JUSTIFICATIONS

PAPUA (RANKING 1)

- Exceptionally high and unique species diversity, habitat diversity, ecosystem health, and low human population density
- NO BRAINER: highest biological and habitat diversity, highest endemism, largest Pacific leatherback rookery in the world, ecosystems largely intact, low human population, yet at the same time highest vulnerability due to rapid implementation of mining and all sorts of poorly-planned development – island ring roads, transmigration, large-scale conversion of coastal/mangrove forests, etc
- Major nesting sites for 4 species of sea turtle; largest Pacific leatherback turtle rookery in the world
- Critical marine mammal habitats for both coastal species and large whales (Bryde's whales).
- Hypothesized as an evolutionary center of speciation

RANKING JUSTIFICATIONS

LESSER SUNDAS (RANKING 2)

- Important ecoregion under numerous conservation criteria, including corridors, endemism, wide range of habitats, cetacean abundance and diversity
- Marine migratory corridors as well as upwelling zones of regional importance within the Indo-Pacific
- One of the most important habitats for oceanic cetaceans in the Indonesian Seas (and possibly SE Asia)
- Many unique Indian Ocean clades and Indian Ocean taxa
- Likely a larval sink coming from the N from Indonesian Throughflow
- High species diversity, at the periphery of Indian Ocean
- High reef habitat diversity Potential repository for diversity to respond to changing environmental conditions.
- Developmental and foraging habitats of turtle that are nesting around the southern part of Indonesia (Indian Ocean)
- Low density of turtle nesting

RANKING JUSTIFICATIONS

BANDA SEA (RANKING 3)

- High biodiversity, heavily fished, urgently needs conservation attention
- Large amount of deep water habitat which may preserve diversity better through sea level fluctuations
- High diversity of reef habitats with some extensive reef areas next to deep and clear waters
- Slight endemism, but high diversity and excellent habitat variability
- Major feeding grounds and migration routes for turtles
- Need for doing more surveys
- Strategic with regard to connectivity (current patterns) and as a refuge during lowered sealevel stands or perhaps climate change
- One of the least known marine areas for cetaceans in the world, though excellent deepsea habitats and known area of residence of blue whales

RANKING JUSTIFICATIONS

SULAWESI SEA/MAKASSAR STRAIT (RANK 4)

- This region represents a contact zone between Pacific and Indian Ocean populations and Eastern and Western Indonesian populations. As both a mixing zone of divergent faunas and its potential as a larval source for a large amount of downstream population, this region deserves high prioritization.
- Very important for cetaceans – sperm whale calving ground
- Strategic with regard to connectivity (Indonesian TF)
- Bunaken NP provides a sound basis for expansion of the MPA network
- Biodiversity is largely a subset of eastern Indonesia
- High biodiversity, seamounts, rare/unique spp in Lembeh Strait

RANKING JUSTIFICATIONS

PALAWAN/N. BORNEO (RANKING 5)

- Derawan/Berau MPA is the largest green turtle rookery in South East Asia
- Very important migration corridor for Green and Hawksbill turtles
- High biodiversity (species, habitats incl. anchialine lakes)
- Important region due to high endemism and excellent habitat variability (including marine lakes).
- Strong genetic affinities with Sulawesi (with Sulawesi considered a much higher conservation priority)
- Biodiversity is similarly a subset of other ecoregions
- Mangrove/seagrass beds
- Endangered populations of Irrawaddy dolphin and finless porpoises

RANKING JUSTIFICATIONS

HALMAHERA (RANKING 6)

- may be an important stepping-stone linking Papua and Sulawesi
- downgraded in terms of priority due to its relatively degraded nature
- A few turtles nesting sites, and some feeding grounds
- Position with regard to currents and tectonic plates.
- Exceptionally high site species richness
- excellent habitat variability and high diversity
- subregion of the Bird's Head rather than being considered as a separate region
- Nesting sites for four sea-turtle species
- This area really deserves immediate conservation attention in close collaboration with the provincial government and Universitas Khairun, perhaps focused in the SW corner (where mining is not currently a big issue).

RANKING JUSTIFICATIONS

WESTERN SUMATRA (RANKING 7)

- Although this ecoregion does not have the same overall diversity of eastern Indonesia, what little research has been done here indicates significant endemism and Indian Ocean faunal elements not found in other parts of the archipelago. From the perspective of representation of the full range of Indonesian marine biodiversity, this ecoregion deserves more focus than it has been given to date
- Has the best examples of the Indian Ocean (IO) coral fauna found in Indonesia
- Second only to Papua in terms of distinct genetic clades
- Important nesting beaches for green and leatherback turtles; all 6 species of sea turtles either nesting or foraging here
- Significant endemism and Indian Ocean faunal elements not found in other parts of the archipelago – very important from a representativeness perspective

RANKING JUSTIFICATIONS

ARAFURA SEA (RANKING 8)

- Extremely important coastal habitats for mangroves and seagrasses and associated fauna along south Papua coast
- Unquestionably of importance to some large globally threatened species (green turtles, dugongs, crocodiles, whale sharks, and possibly sawfish)
- No or very little reef/coral habitat
- Lacks data
- Prime undisturbed coastal cetacean habitat
- Dispersal corridor btwn Australia and Indonesia
- Aru is very important area for green turtles, dugongs
- Major threats to turtles are direct commercial take of adults (plastron) and fisheries by-catch (trawls)

RANKING JUSTIFICATIONS

SUNDA SHELF/JAVA SEA (RANK 9)

- Marginal reefs that have been only been established since the end of the last glacial maxima
- Highly impacted by freshwater run off and sediment
- Human impacts
- Very important feeding and nesting area for turtle population as well as migration pathway for green turtle across ASEAN countries
- Perhaps the most important hawksbill turtle rookery in SE Asia
- Important flyway for migrating birdlife along eastern coast Sumatra
- Overall low species richness and endemism
- Unique sediment-adapted reef assemblages

RANKING JUSTIFICATIONS

NE SULAWESI/TOMINI (RANKING 10)

- Much like the rest of Sulawesi, this area is a zone of mixing. In addition to containing a large amount of genetic diversity and being a potential larval source, this region also has areas like the Togeans where there are known endemics, suggesting that this is a particularly unique region.
- Distinctive genetic clades, endemism
- In the absence of information on current threats and conservation activities, I might rank it higher due to the endemism and genetic subdivision of populations in this region. However, because the area is now partly included in the Togean Island National Park and the rest of the bay is a focus for integrated management, I put its ranking at 7 at this time.
- Rare habitats
- Some important turtle areas; complete unknown for cetaceans

RANKING JUSTIFICATIONS

SOUTHERN JAVA (RANKING 11)

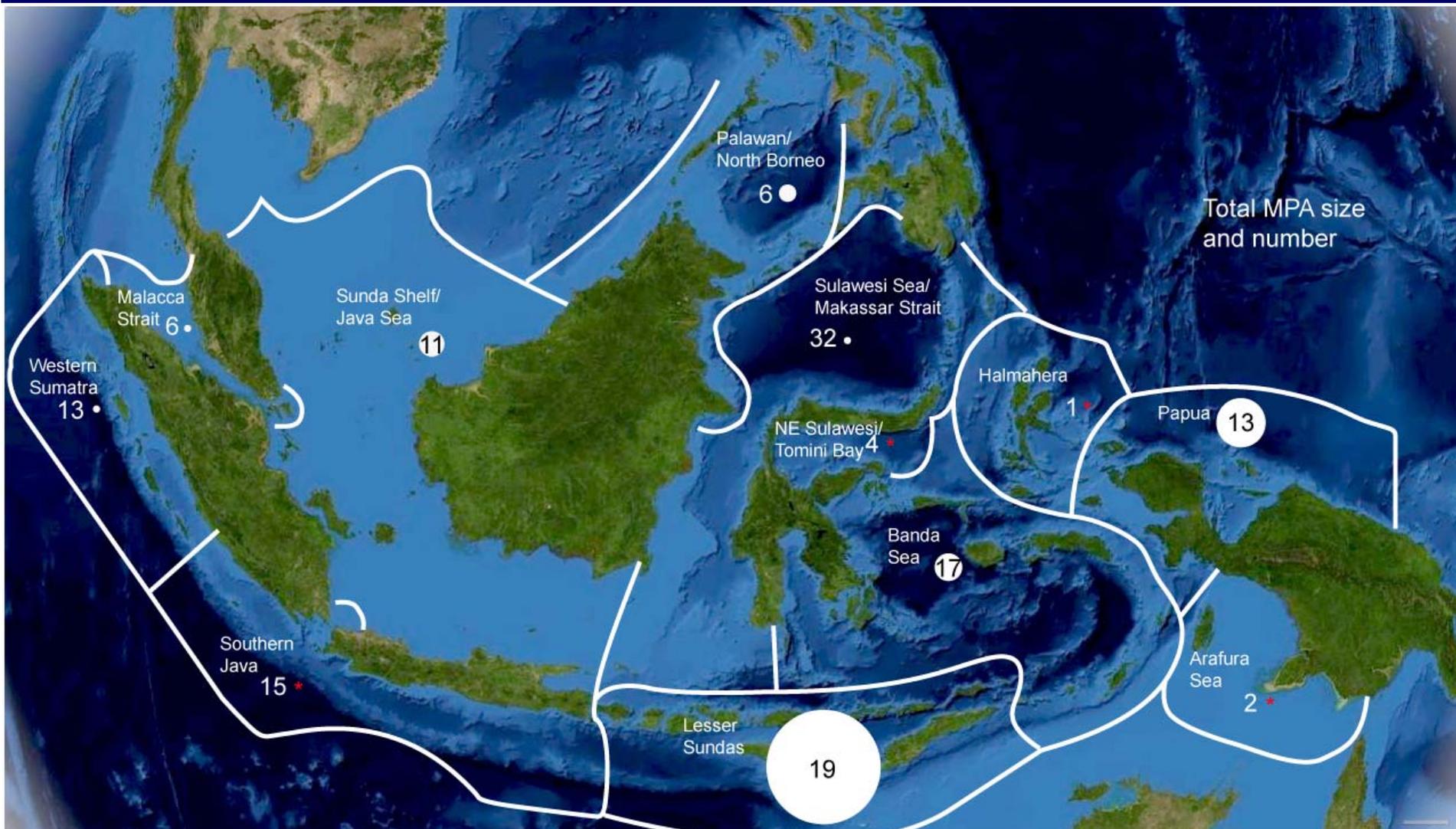
- The islands of Krakatau are a natural lab and absolutely should be a conservation priority for their scientific value
- Low amount of reef area and rough sea conditions
- Low species richness
- Very important nesting habitats for green, hawksbill, olive ridley, and leatherback turtles
- High intensity of coastal fisheries
- Apparent high deepsea biodiversity in Java Trench
- Known biodiversity of this ecoregion is in fact already captured in the Western Sumatra ecoregion and to a lesser extent in the Lesser Sunda ecoregion

RANKING JUSTIFICATIONS

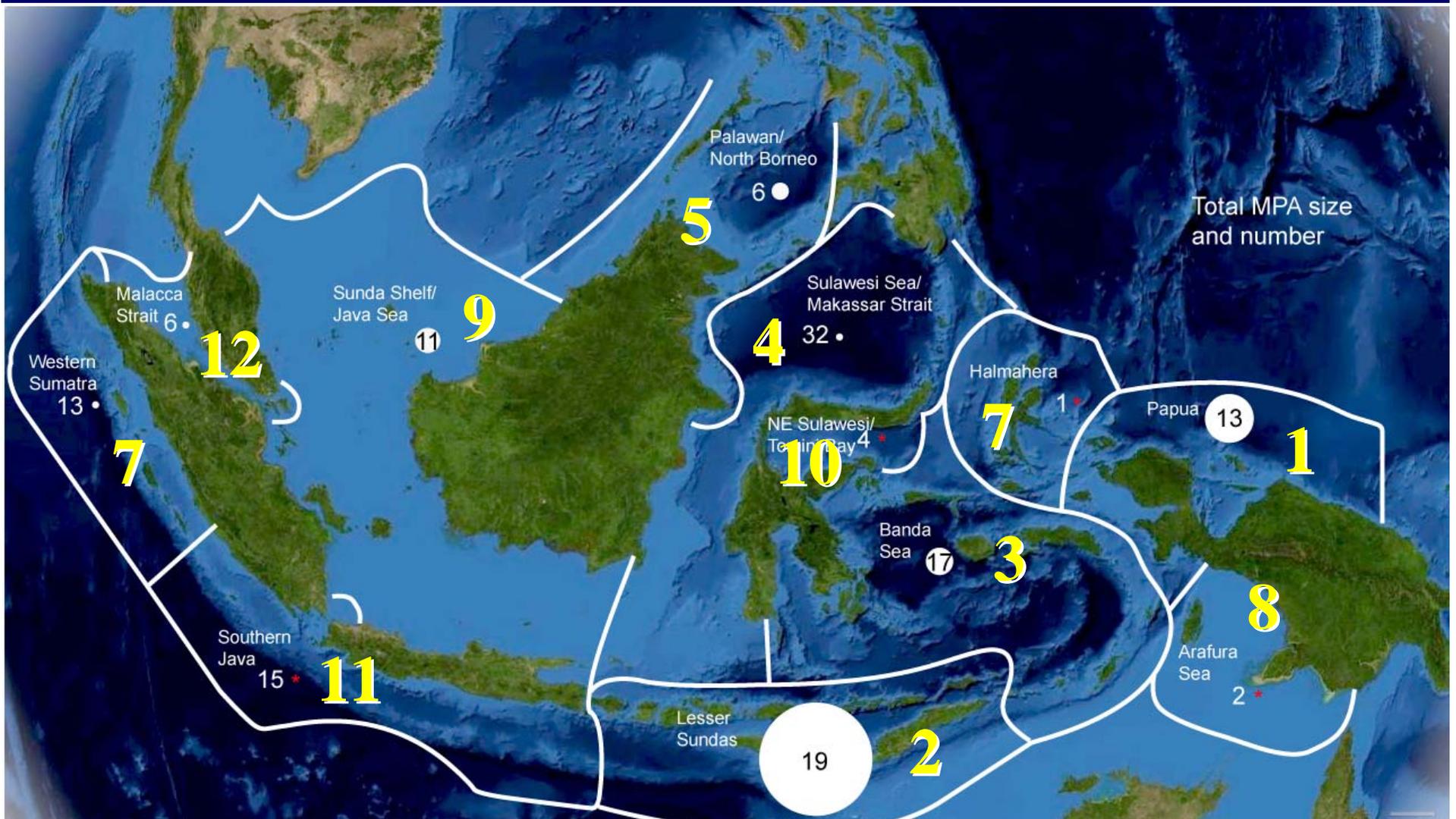
MALACCA STRAIT (RANKING 12)

- Reefs are not expected to be very diverse in this region
- May be an important corridor linking Andaman Sea and South China Sea (important for post-nesting migration of hawksbills)
- Extremely depauperate for reef diversity
- Highly impacted by human activities/sedimentation/ pollution
- This area is so heavily impacted and so difficult to manage (busiest international shipping lane in the world) that it shouldn't be considered an ecoregion at all
- This region represents a unique habitat and is a potential corridor for dispersal between Indonesia and the Eastern Indian Ocean. However, the shallow nature of this strait combined with proximity to terrestrial environments with high run off and sediment load suggests that reef systems in this area are largely marginal and not a high conservation priority.

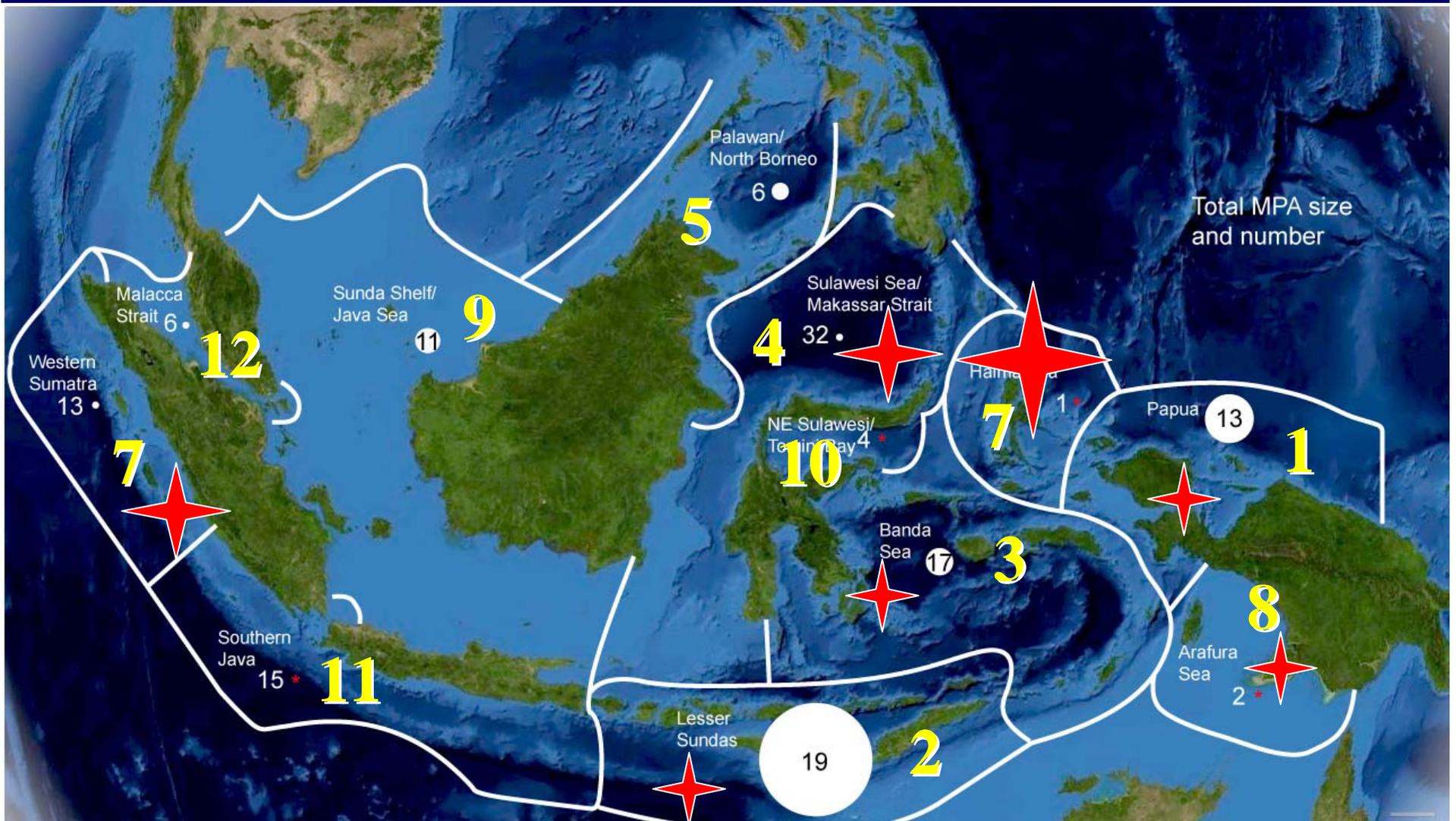
CURRENT MPA COVERAGE



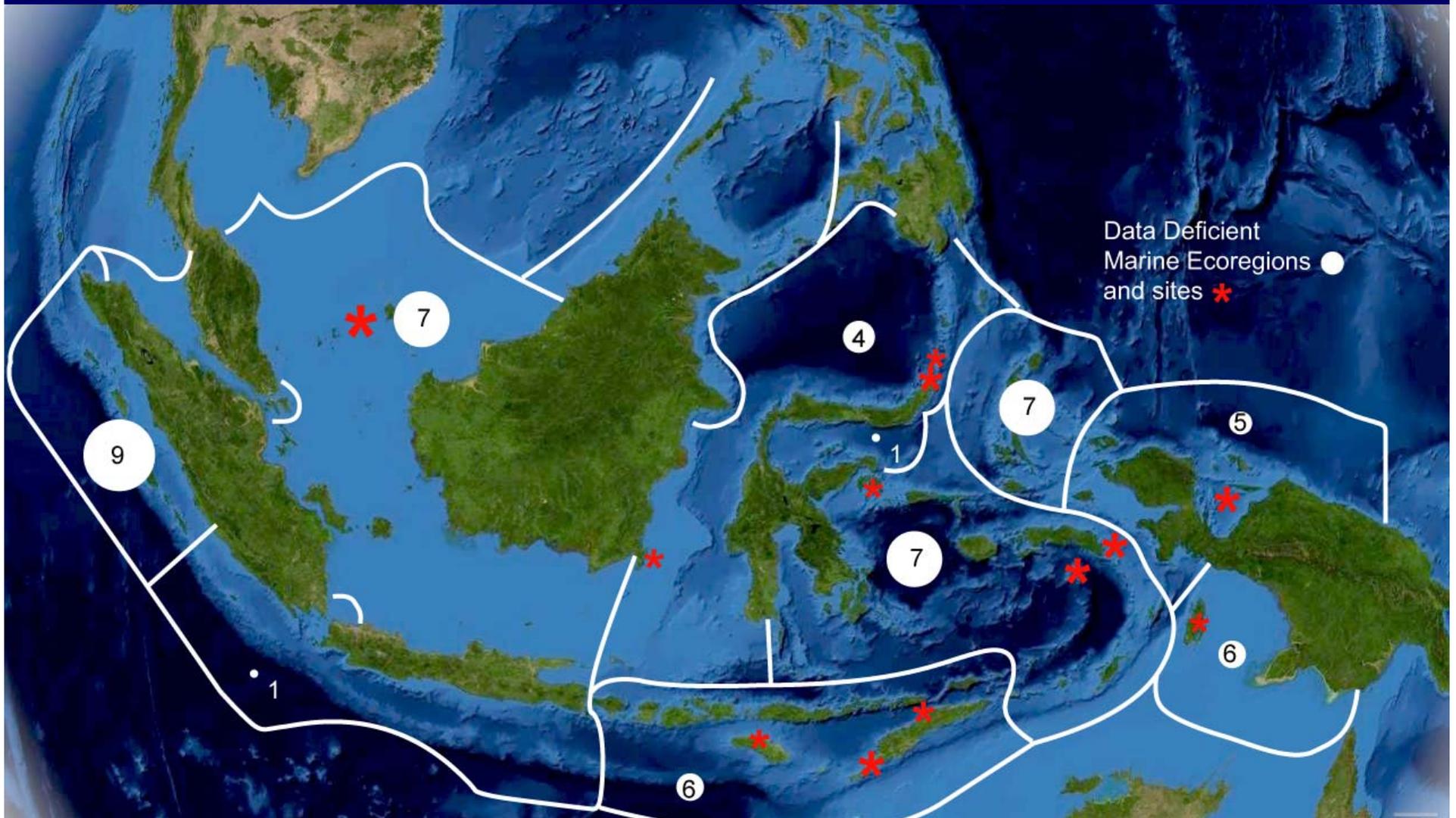
CURRENT MPA COVERAGE COMPARED TO ECOREGION RANKS



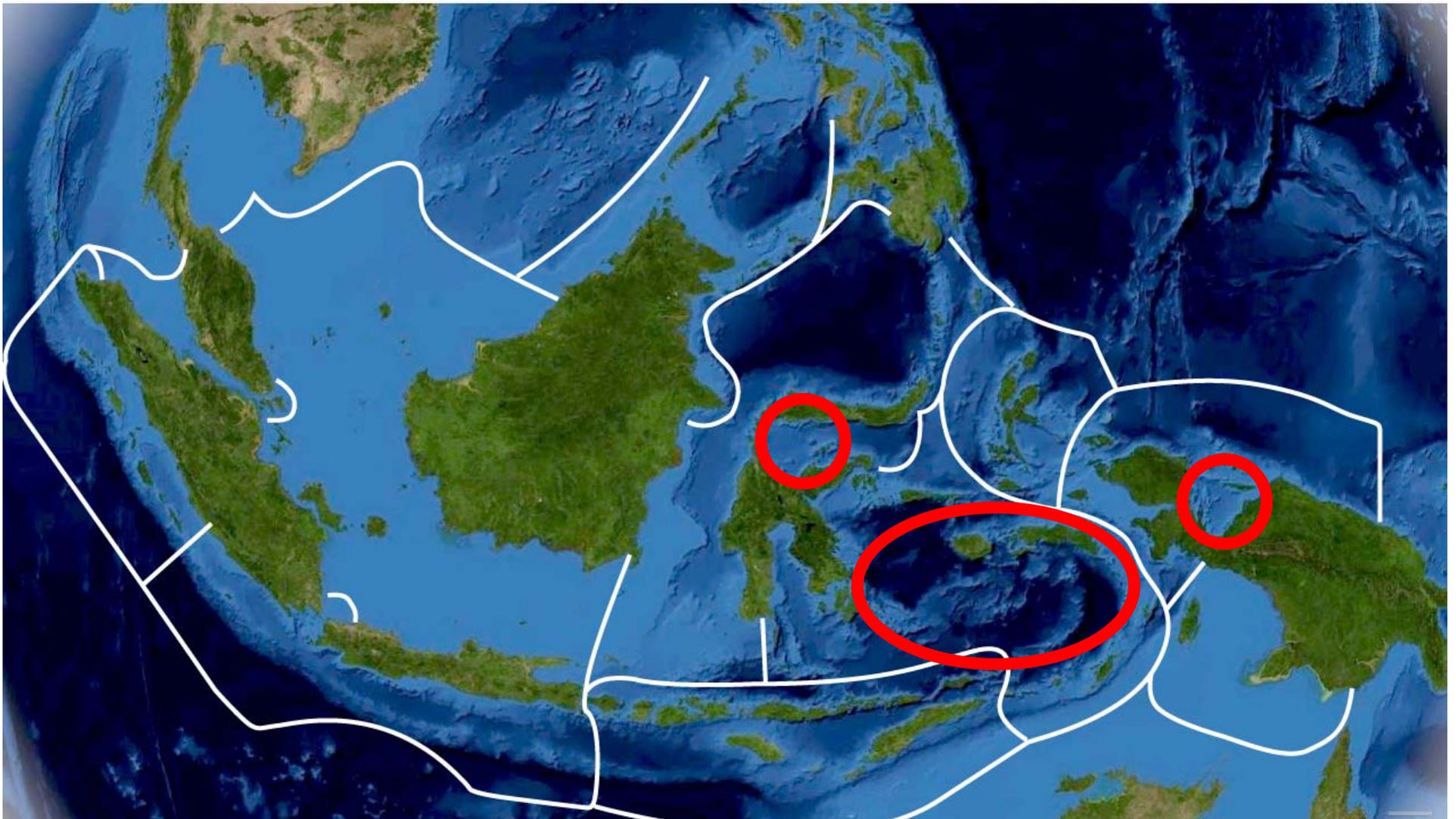
CURRENT MPA COVERAGE COMPARED TO ECOREGION RANKS



GAP ANALYSIS – BIODIVERSITY DATA DEFICIENCIES



IMPORTANCE OF CONSERVING “EVOLUTIONARY SOURCES”



RECOMMENDATION #1

- Irreplaceability and representativeness criteria strongly underscore importance of major focus of marine biodiversity conservation efforts in **Papua, Lesser Sundas, the Banda Sea, and Western Sumatra** – including strengthening and building upon current MPA networks. However, ecoregion ranking alone does not capture all the rich detail and habitat diversity of Indonesia's marine heritage; there are many individual sites within lower-ranked ecoregions that stand out as regionally or even globally important and these also need to be prioritized in a national strategy/system of MPAs (eg, Natuna/Anambas in Sunda Shelf, Alas Purwo and Segara Anakan in Southern Java, Aru in Arafura Sea, Togeans in Teluk Tomini)

RECOMMENDATION #2

- Given the overwhelmingly top prioritization of Papua, DKP and the GoI should focus urgent and significant resources (human, financial, policy) to this ecoregion, particularly given the very high vulnerability of this region due to immediate threats from coastal mining and logging, ill-conceived transmigration projects, and poorly-planned coastal development including island/coastal ring roads. A focus on proper and strictly-enforced spatial planning is imperative

RECOMMENDATION #3

- While this prioritization exercise has highlighted important gaps in MPA coverage in Indonesia (see recommendation #5), it also highlights areas of critical biodiversity importance which are already covered, but not effectively protected, by MPAs (eg, **Savu Sea MPA in Lesser Sundas**). **Strengthening the management of current high priority MPAs** is every bit as important as designating new ones in gap areas.

RECOMMENDATION #4

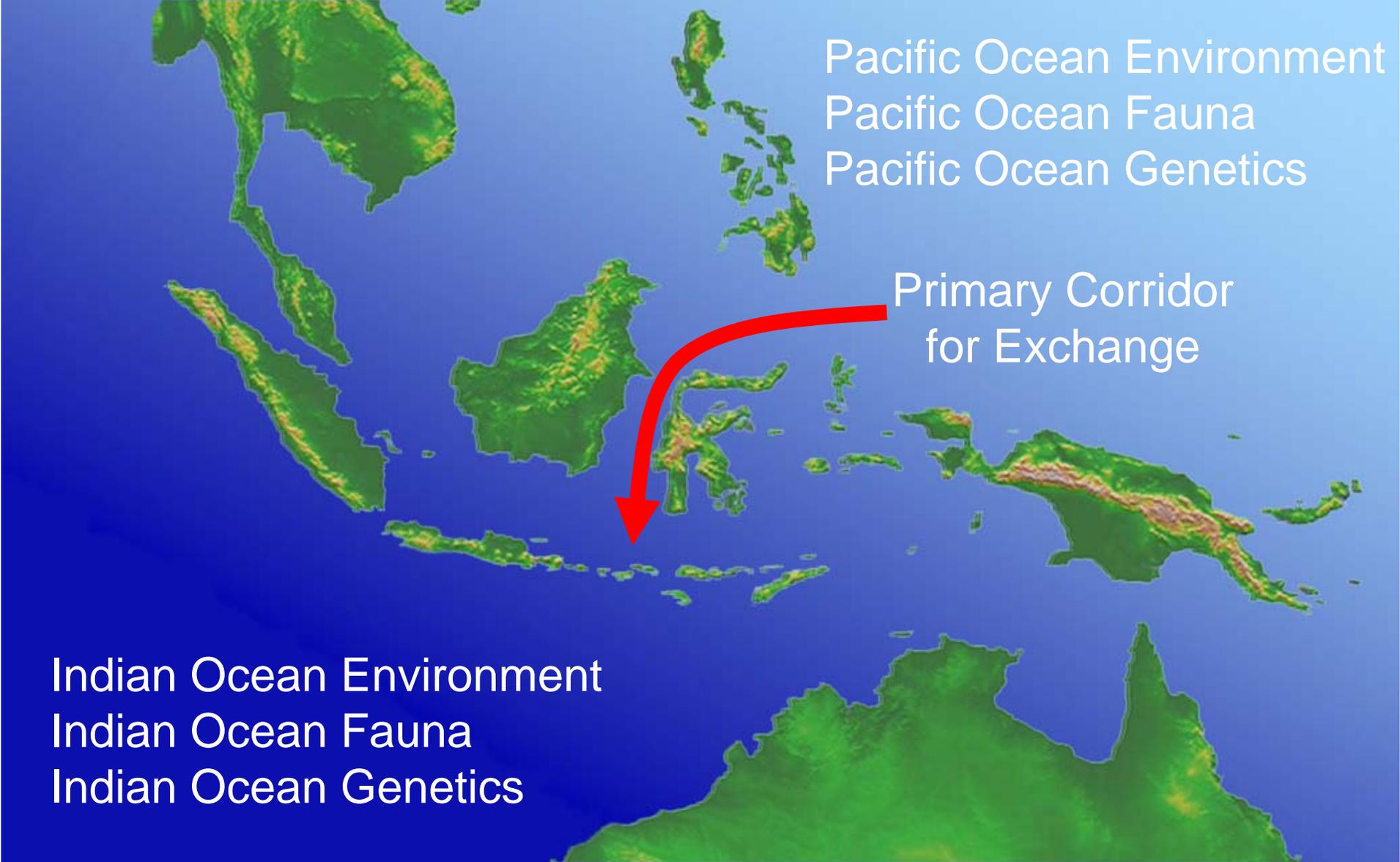
- Maintenance of not only species diversity but also genetic diversity within species is critically important as a bet-hedging strategy for adaptation to global change, climate and otherwise. Indonesia's national marine conservation and MPA strategy must include a focus on maintaining genetic diversity. Besides protecting genetic diversity in eastern and western sectors of the country, a “connectivity corridor” focused along the western coastline of Sulawesi (a major mixing zone with longest contiguous reef-fringed coastline in Indonesia) should be a top priority for establishment

Sulawesi is an important corridor between Pacific and Indian Oceans

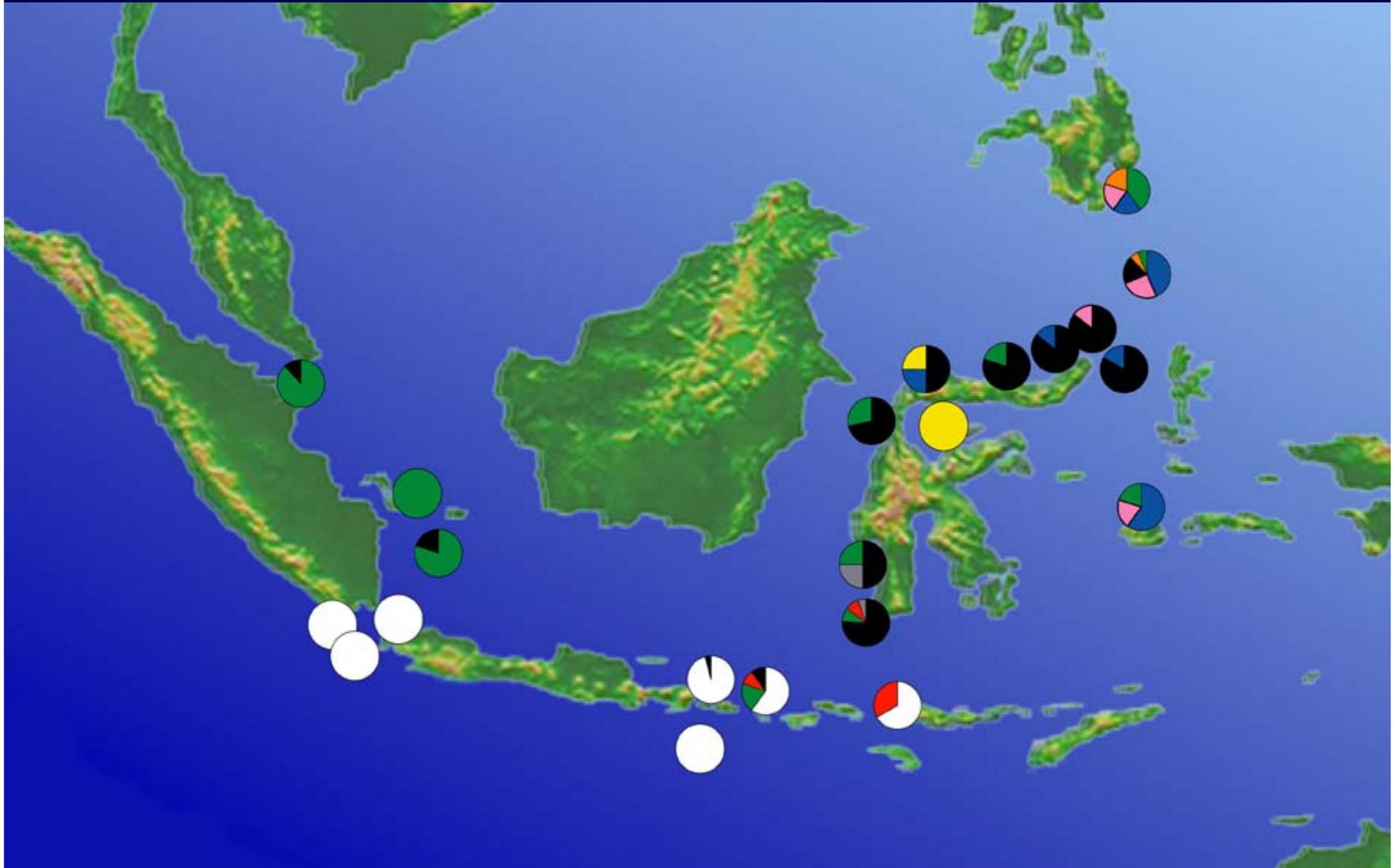
Pacific Ocean Environment
Pacific Ocean Fauna
Pacific Ocean Genetics

Primary Corridor
for Exchange

Indian Ocean Environment
Indian Ocean Fauna
Indian Ocean Genetics

A topographic map of Southeast Asia and the Indonesian archipelago. The landmasses are shown in shades of green and brown, indicating elevation. The surrounding oceans are blue. A red arrow points from the Pacific Ocean region towards the Indonesian archipelago, specifically highlighting Sulawesi. Text labels are placed in the Pacific and Indian Ocean regions to describe environmental, faunal, and genetic characteristics. A red arrow also points to Sulawesi, labeling it as a primary corridor for exchange.

Sulawesi is an important zone of mixing that may provide resiliency to climate change



RECOMMENDATION #5

- Based upon the above considerations, areas which show **important gaps in MPA coverage** and which should be considered top priority for new MPA coverage include:
 - **Halmahera**
 - **Western Sumatra**
 - Sulawesi Sea/Makassar Strait (particularly western coast of Sulawesi “connectivity corridor”, Sangihe-Talaud, Postiljons/Sabalana)
 - Banda Sea (particularly outer island arcs, Lucipara, Watubela, Seram, Banggai, Tanimbar)
 - Papua (particularly FakFak, Kokas, outer Cendrawasih Bay)
 - Arafura Sea
 - Lesser Sundas (Alor/Solor, Nusa Penida)

RECOMMENDATION #6

- Several ecoregions/sites stand out for lack of biodiversity survey data, and are considered a top priority to better understand Indonesia's biodiversity distribution and how to manage it. These include:
 - **Western Sumatra**
 - **Natuna/Anambas Islands**
 - **Halmahera (particularly southern sector)**
 - **Banda Sea (especially inner and outer Banda Arcs)**
- Also important and not well-surveyed are **Alor-Wetar-Savu, Teluk Cendrawasih, and Arafura Sea**

TERIMA KASIH

