{rokbox title=| Study area showing the assessed sea turtle nesting beaches in Northwest Costa Rica :: Image: Authors|images/stories/ieo/imagenespublicaciones/centro-oceanografico-baleares-ieo-csic-remote-sensing-reveals-santidrian-2026-thumb-et-al.jpg|}images/stories/ieo/imagenespublicaciones/centro-oceanografico-baleares-ieo-csic-remote-sensing-reveals-santidrian-2026-et-al.jpg{/rokbox}

Keilor E. Cordero-Umaña and **Pilar Santidrián Tomillo**,2026. **Remote sensing reveals nesting habitat vulnerability for sea turtles in Costa Rica over forty years.**
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Abstract:Sandy beaches are dynamic ecosystems where erosion and accretion continually modify shorelines and sea turtle nesting habitat, conditioning their reproductive success. Although quantifying beach dynamics is essential for evaluating erosion risk and habitat vulnerability, long-term assessments remain scarce worldwide. Here, we provide the first consistent four-decade (1984–2024) satellite-based assessment of nesting-habitat change for sea turtles in Northwest Costa Rica, using shoreline change rates as indicators of habitat vulnerability across eight major nesting beaches. Our findings showed that six of the eight studied beaches remained stable over time, suggesting a capacity for shoreline recovery despite the observed long-term negative trends. Playa Grande and Ventanas, at Las Baulas National Park (PNMB), experience moderate erosion, retreating at a rate of −0.79 m yr−1 (95% CI: −0.96 to −0.73 m yr−1) and − 0.50 m yr−1 (95% CI: −0.62 to −0.37 m yr−1), respectively. Although all beaches showed alternating erosion-accretion cycles, four sites, especially PNMB beaches, shifted to sustained erosion after 2008 without recovery to this date, suggesting changes in sediment dynamics that may be linked to watershed and coastal management outside the park. Kernel density analysis revealed high vulnerability at Playa Grande, where erosion hotspots overlapped historically important nesting zones for the critically endangered East Pacific leatherback population. Conversely, Nancite, Naranjo, and Zapotillal were less vulnerable (minimal retreat or stable trends) and may serve as key nesting refugia under accelerating coastal change. Our study provides a transferable shoreline indicator framework applicable to nesting beaches worldwide to assess habitat vulnerability, identify early warning signals of nesting habitat change, and support adaptive conservation and coastal management.

Keywords:Remote sensing,Shoreline indicators,Beach erosion,Nesting beach,Leatherback turtle,East Pacific.