Spatial structuring and migratory destination of humpback whales, *Megaptera novaeangliae*, from Nicaragua

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Understanding the migratory behaviour and patterns of humpback whales is of great conservation concern, especially in the frame of the identification of threats. Migratory routes for humpback whales remain largely unknown in the Northeast Pacific, especially for the Central American subpopulation, which is considered endangered under the U.S. Endangered Species Act. Yet, key aspects of the humpback whale's migration ecology, including migratory movements and site fidelity, remain largely unexamined in this region. Here, we combined a 6-year photographic database of humpback whales observed off Nicaragua with web-based citizen science contributions and sightings from dedicated research programs and compared the resulting image collection using an automated image recognition algorithm created by "HappyWhale". Our approach covers ca. 35 years of photo-identification data totalling 2970 recaptures. We determined the sex and relative age of individual whales based on recapture histories, inferred migratory timing, spatio-temporal movements and migratory destinations to feeding areas. Our study provided first-time evidence on fine-scale site affinity of individual humpback whales within Nicaraguan coastal waters and with other breeding and feeding areas, suggesting potential spatial structuring in the Central American distinct population segment. Our research illustrates how citizen science research can help researchers get novel insights in humpback whale migratory ecology.

Keywords
Humpback Whale; Migration; Central America; Nicaragua; Breeding grounds