Long-term study links box jellyfish abundance, environmental variability at Waikiki Beach

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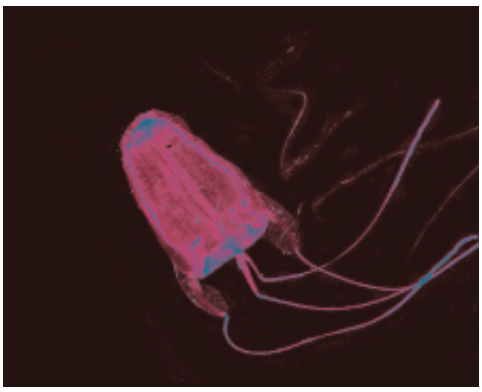

Drawing on 14 years of monthly collection data, researchers at the University of Hawai'i at Mānoa have found that the total number of box jellyfish that come ashore at Waikiki displayed no net increase or decrease, but instead followed an oscillating four-year pattern influenced by climate and environmental conditions. Credit: University of Hawaii at Manoa

You can almost set your watch to it. A familiar sight to local beachgoers, the box jellyfish *Alatina moseri* is known for showing up in big numbers on Waikīkī Beach 8 to 12 days after each full moon.

Continuing a pioneering jellyfish beach count effort initiated in the 1980s by Honolulu lifeguard Landy Blair, researchers at the University of Hawai'i at Mānoa have published an analysis of 14 years of monthly

jellyfish collection data.

173 full moons and 66,000 jellyfish since they began, the resulting paper titled "Long-term fluctuations in circalunar beach aggregations of the box jellyfish Alatina moseri in Hawaii, with links to environmental variability," is scheduled for release in the October 23, 2013, issue of *PLOS ONE.*

"Although there have been long-term studies of jellyfish abundance and climate in recent years, none have looked at box jellyfish species," said Luciano Chiaverano, Research Scholar in the Pacific Biosciences Research Center (PBRC) at UH Mānoa and lead author of the paper. "This is quite surprising, as box jellyfish are among the most venomous animals in the world. Often their habitat overlaps with human recreation, resulting in painful, sometimes even lethal, stings and causing beach closures at various locations around the world."

"Our box jellyfish collection data is the longest continual time-series census of a cubozoan species in the world, and provides a rich data set to analyze and assess physical and biological oceanographic correlations" said Angel Yanagihara, Assistant Research Professor and senior author of the new report.

Overall the researchers' analysis confirms Blair's early observations that box jellyfish arrive in Waikīkī with consistent, predictable timing based on the moon cycle: year after year, month after month, box jellyfish come to shore 8 to 12 days after each full moon presumably to reproduce. However, aggregation sizes varied substantially with no predictable seasonality. In a 400-meter section of the beach, an average of 396 jellyfish arrived each lunar month, with actual numbers ranging from 5 to 2,365 individuals per arrival event.

The total number of box jellyfish arriving to Waikiki displayed no net

increase or decrease during the past 14 years, but instead followed an oscillating pattern with periods of increase and decrease, each one lasting approximately four years. Such patterns, the UH scientists propose, are likely influenced by climate fluctuations that play a role in large scale primary production in the ocean, regulating food availability, and ultimately affecting the numbers of local jellyfish.

To try to explain the 14-year trend of box jellyfish arrivals, Chiaverano, PBRC Associate Research Professor Brenden Holland, and Waikīkī Aquarium Marine Biologist Jerry Crow analyzed three major climatic indexes, 13 oceanographic variables (available from Station ALOHA by the UH Hawai'i Ocean Time-series (HOT) program), and seven local weather parameters. Although researchers found no significant relationship between beach counts and any of the weather parameters, jellyfish beach counts exhibited a strong, positive relationship with the North Pacific Gyre Oscillation index (a decadal-scale climatic measurement specific to the sub-tropical Pacific), primary production, and abundance of small zooplankton.

The authors concluded that the number of box jellyfish arriving at Waikīkī is likely controlled by bottom-up processes: the NPGO is an index of water mass movement, wherein the higher the value, the higher the advection or transport of nutrient-richer waters from the northern Pacific into the oceanic waters around the Hawaiian Islands. This boost may drive regional primary production, and in turn increase zooplankton biomass (food for box jellyfish).

"Jellyfish are known to have increased growth rates and reach larger adult sizes in response to increased food availability, and because body size positively correlates with fecundity in jellyfish, more eggs and more larvae are produced when food is readily available" said Chiaverano.

Predicting changes in jellyfish aggregations over time is challenging due

to the difficulties associated with sampling, the scarcity of historical records, and the unusual characteristics of the jellyfish life cycle. Around the world, there is increasing evidence that jellyfish populations are affected by large-scale climate variations and regional environmental conditions associated with climate fluctuations.

More information: dx.plos.org/10.1371/journal.pone.0077039/

Provided by University of Hawaii at Manoa

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