

# Lessons from extinctions of dugong populations

The dugong (*Dugong dugon*) is one of four living sirenians. Its closest modern relative, Steller's sea cow (*Hydrodamalis gigas*), was hunted to extinction in the 18th century (1). A dugong population near Okinawa, Japan became extinct in 2019 (2), and now dugongs are likely functionally extinct in China (3). The disappearance of these populations follows dugong losses in the Mascarenes, Maldives, Lakshadweep Islands, and Spermonde Islands (4, 5). These extinctions provide crucial lessons for ongoing and future conservation of surviving dugong populations and other marine megafauna.

Extirpated dugong populations were lost through deliberate hunting, accidental by-catch, and destruction of their seagrass habitat (2–6). Hundreds of individuals were harvested between 1893 and 1916 in Japan and the 1960s in China, resulting in substantial declines that possibly pushed populations below sustainable thresholds (2, 3). Incidental captures in fishing gear in both regions caused continued mortality in remnant populations (5, 7), and degradation of seagrass meadows through coastal development and habitat disturbance greatly reduced food availability (6–8). In 1986, a Chinese National Natural Reserve was established for dugongs in Beihai, Guangxi, and dugongs were listed as Grade 1 National Key Protected Animals in 1988 to ban hunting, trade, and consumption (6). However, sightings in China were already rare by the 1980s (3, 6), indicating that these actions were implemented too late to be effective (2).

Dugongs persist in other shallow tropical and subtropical marine environments, but most populations are threatened (4). Understanding the factors responsible for recent dugong losses highlights the steps needed to prevent further extinctions of surviving dugong populations and other vulnerable marine mammals (9, 10). Restrictions against deliberate hunting should be enforced across sirenian and other marine mammal ranges. Evidence-based decision-making is essential for population protection, reserve planning, and seagrass conservation (11, 12). Ongoing dugong extirpations emphasize the crucial need to act early, before efforts to recover populations or locate surviving individuals become too challenging (2, 3).

Mingli Lin<sup>1</sup>, Samuel T. Turvey<sup>2</sup>, Mingming Liu<sup>1</sup>, Heidi Ma<sup>2</sup>, Songhai Li<sup>1,3\*</sup>

<sup>1</sup>Marine Mammal and Marine Bioacoustics Laboratory, Institute of Deep-sea Science and Engineering, Chinese Academy of Sciences, Sanya 572000, China. <sup>2</sup>Institute of Zoology, Zoological Society of London, Regent's Park, London NW1 4RY, UK. <sup>3</sup>Center for Ocean Mega-Science, Chinese Academy of Sciences, Qingdao 266071, China.

\*Corresponding author. Email: lish@idsse.ac.cn

## REFERENCES AND NOTES

- 1.S. T. Turvey, C. L. Risley, *Biol. Lett.* **2**, 94 (2006).
- 2.H. Kayanne *et al.*, *Sci. Rep.* **12**, 6151 (2022).
- 3.M. Lin *et al.*, *Roy. Soc. Open Sci.* **9**, 211994 (2022).
- 4.H. Marsh, S. Sobtzick, *Dugong dugon* (The IUCN Red List of Threatened Species, 2019).
- 5.A. M. Moore, R. Ambo-Rappe, Y. Ali, *Front. Mar. Sci.* **4**, 284 (2017).
- 6.P. Wang, J. Han, Z. Ma, N. Wang, *Acta Theriol. Sinica* **27**, 68 (2007).
- 7.H. Marsh, H. Penrose, C. Eros, J. Hugues, "Dugong status report and action plans for countries and territories," (UNEP Early Warning and Assessment Report, 2002).
- 8.R. Wu, H. Zhang, *Chin. Sci. Technol. Inform.* **22**, 68 (2018).
- 9.J. Panyawai, A. Prathep, *Aquat. Mamm.* **48**, 203 (2022).
- 10.H. Marsh, G. De'ath, N. Gribble, B. Lane, *Ecol. Appl.* **15**, 481 (2005).
- 11.E. D'Souza *et al.*, *PLOS ONE* **10**, 0141224 (2015).
- 12.A. Preen, *Environ. Manag.* **22**, 173 (1998).

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