Seasonal prevalence of cookiecutter shark bites on short-finned pilot whales in Hawai'i

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Why is this interesting?

- Cookiecutter sharks (*Isistius brasiliensis*) are small pelagic squaloid sharks common throughout tropical and sub-tropical waters
- Little is known about their ecology due to their cryptic nature, difficulty to capture, and typical depth range (85 - 3,500m)[3,4]
- A resident population of short-finned pilot whales (*Globicephala macrorhynchus*) off Hawai'i Island is often observed with cookiecutter shark bites, which we used to infer shark behaviour
- This is the first study to examine seasonality in cookiecutter shark foraging in Hawai'i over a multi-year period and the first study to use whales as a proxy to examine seasonality in these sharks

What we did

- We used a long term photo-ID catalogue of 405 resident whales representing 5,871 identifications from 365 encounters (2003 – 2012) to examine seasonality in bite prevalence
- For each bite we noted status (fresh, healed, scarred), location (Fig. 1 and 2), whale ID and mean Sea Surface Temperature (SST)*

Fig. 1: Cookiecutter shark (left), with examples of fresh (middle) and healing (right) bites. Fresh bites were open wounds with exposed tissue, generally considered < 1 week old; healing bites had inflamed tissue filling the wounds and were often colonized by cyamids. Healed bites scarred white at first, re-pigmenting over a period of months. The animal on the right has several healing and healed bites, including some that have re-pigmented

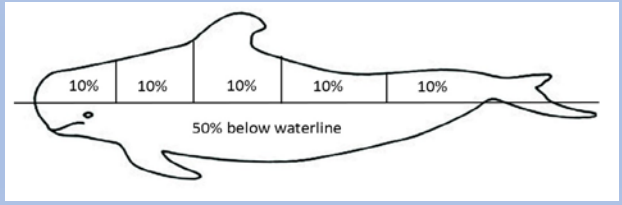

Fig. 2: Each whale was divided into 5 equal segments visible above the waterline. % of body visible in each photo was used to calculate bite frequency by location

What we found

- Almost all animals (97.8%) displayed evidence of bites, and bites were most frequently documented on the head:

Table 1. Status and number of bites recorded

Status of Bite	Total # of bites	# of individuals	# of identifications
Fresh	169	115	161
Healing	575	211	490
Scar	8,549	389	2,779

Table 2. Location on body of fresh bites

Fresh bite location on body (%)	
Head	33.1
Lateral	29.0
Peduncle	27.2
Dorsal Fin	10.7

- The prevalence of fresh bites varied seasonally; annual peaks in fresh bite probability occurred in late April, mid-July and mid-October
- Fresh bites were negatively correlated with SST in the spring and summer but not fall (Fig. 3)
- No fresh bites were recorded in September which had the highest average SST (27.0°C, SE± 0.02)
- Changes in bite prevalence may be due to a combination of SST as well as pilot whales and cookiecutter sharks targeting specific species at certain times of the year[2]

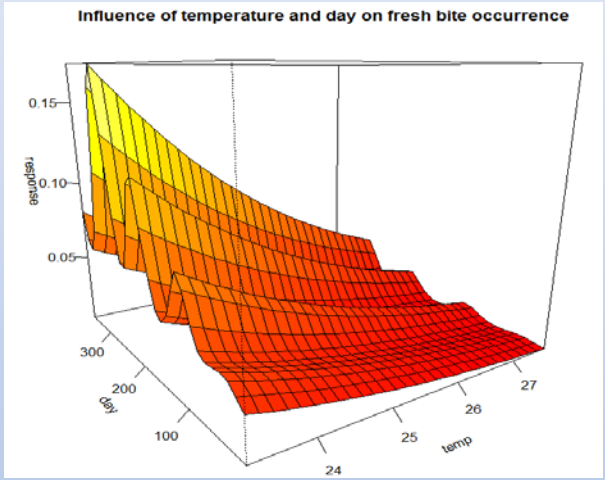

Fig. 3: SST ranged from 23.2° - 27.6°C (mean =25.6°C) and had a negative influence on bite probability. Previous studies indicate cookiecutter sharks prefer waters between 18° – 26°C[1]

Why is this important?

- Research on the ecology of deep sea sharks has been limited by accessibility. This method provides data on behaviour that was previously unobtainable
- Seasonal peaks in bite probability may indicate fluctuations in other shark prey species or whale movements into areas where they are more likely to be bitten
- Negative correlations with sea surface temperature may highlight potential future impact of climate change influencing foraging ecology

References [1]Nakano, H., Tabuchi, M. (1990) Occurrence of the cookiecutter shark *Isistius brasiliensis* in surface waters of the North Pacific Ocean. Japanese Journal of Ichthyology 37:60-63. [2]Papastamatiou, Y.P., Wetherbee, B.M., O'Sullivan, J., Goodmanlowe, G.D., Lowe, C.G. (2010). Foraging ecology of cookiecutter sharks (*Isistius brasiliensis*) on pelagic fishes in Hawai'i, inferred from prey bite wounds. Environmental Biology of Fishes 88:361-368. [3]Jahn, A.E., Haedrich, R.L. (1987) Notes on the pelagic squaloid shark *Isistius brasiliensis*. Biological Oceanography 5:297-309. [4]LeBoeuf, B.J., McCosker, J.E., Hewitt, J. (1987) Crater wounds on northern elephant seals: the cookiecutter shark strikes again. Fishery Bulletin 85:387-392. *Data obtained from the National Oceanic and Atmospheric Administration using the Thredds catalogue AVHRR Pathfinder Sea-Surface Temperature v5, v5.1

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