

# Marine Turtle Faeces on Hawaiian Beaches

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Faeces of the green turtle, *Chelonia mydas*, washed ashore in large numbers at a beach park in Hawaii over a 40-day period in 1989. The formed pellets were originally misidentified as being from pigs or humans, and therefore were perceived as a pollutant of potential health hazard to humans. However, bacteriological analysis of the nearshore waters indicated low and legally acceptable levels of faecal coliforms and enterococci. Similar diminished levels were also found in direct cultures of the fresh pellets. Green turtle faeces have been known to drift ashore in Hawaii, but never in the quantities recorded during this short-term event. The reason for the occurrence could not be determined, but several possible explanations are given.

During July of 1989, numerous floating faecal pellets began to wash ashore on the island of Oahu at Kualoa Beach Park located at the northwestern end of Kaneohe Bay, the largest bay in the Hawaiian Islands (Fig. 1). As a precautionary measure, the State of Hawaii's Department of Health closed this 1 km stretch of beach to public use. At the same time an effort was made to determine the source of the pellets and their possible health hazards. Sewage spills into Hawaii's nearshore waters from treatment plants have been reported but have never resulted in the appearance of formed faeces in the water. No spills of this nature occurred at the time. Faecal wastes from domestic pigs being transported by barge were initially suspected. The possibility of a human origin from tourist-related recreational activities was also suggested by the news media, but this was unlikely. Coliform counts in surrounding waters, however, were not elevated (Fig. 2) as might be expected in such cases.

A more careful investigation of the droppings revealed them to be faeces originating from the herbivorous green turtle, *Chelonia mydas*. The pellets ranged from 0.5 to 2 cm in diameter and up to 5 cm long (Fig. 3). They were found to consist almost entirely of partially digested benthic algae, mainly *Codium edule* and *Amansia glomerata*, which are commonly eaten by green turtles in Hawaii. Algal particles were clearly discernible with the naked eye after the pellets were broken open. In addition, ova in the faeces were determined to be from non-mammalian parasites, and

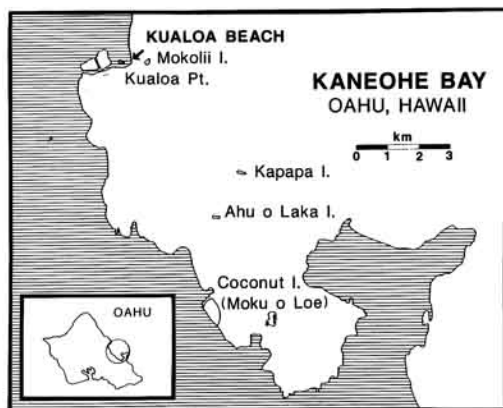


Fig. 1 Location of Kualoa Beach (21°31'N, 158°51'W) where faeces of the green turtle washed ashore in record numbers during 1989. Kaneohe Bay, the largest bay in the Hawaiian Islands, is 13 km long and 4 km wide.

most likely from flukes that parasitize green turtles in Hawaii (Dailey *et al.*, 1991). The pellets were green to brownish in colour and 'dog-like' in appearance. They had a distinctly different and somewhat less objectionable odour than mammalian faeces, and appeared to be less attractive to flies and other insects.

Kualoa Beach was reopened after a 40-day closure (11 August–22 September 1989) when the daily number of pellets declined and any health risks to humans were judged to be minimal (Fig. 4). During the

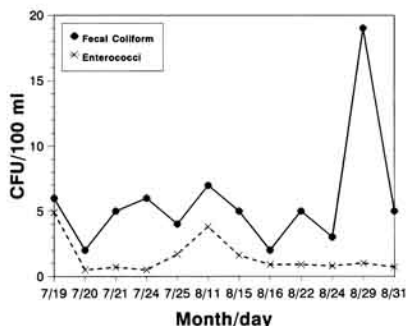


Fig. 2 Faecal coliform and enterococci counts (Colony Forming Units (CFU) per 100 ml) in the nearshore waters at Kualoa Beach, 19 July to 31 August, 1989, sampled while green turtle pellets were washing ashore.



Fig. 3 Faecal pellet of a green turtle washed ashore at Kualoa Beach.

periods of greatest abundance, over 300 pellets per day (maximum 470 pellets) were counted and picked up for disposal by park maintenance personnel. A total of nearly 5500 pellets were removed during the 40 days. Even after the beach was reopened, pellets continued to float ashore, but in much reduced numbers.

### Bacteriological Analyses

Despite the high abundance of faecal pellets seen during the 40 days, nearshore water samples analysed by the Department of Health did not exceed indicator bacterial limits set by the US Environmental Protection Agency for ocean recreational waters (i.e. <33 Colony Forming Units of faecal enterococci per 100 ml of sea water, Fig. 2). Spills from sewage treatment plants have on occasion produced counts in Kaneohe Bay of up to 2300 CFU of faecal coliform and 570 CFU of enterococci (State of Hawaii, Department of Health, pers. comm.).

To measure bacteriological aspects of the turtle faeces, a preliminary follow-up study was conducted. Faecal coliforms and faecal enterococci from turtle pellets freshly collected at Kualoa were found to be low (most probable number (MPN) 3–43  $g^{-1}$  of faeces), compared with mammalian and avian faeces (MPN  $10^6$ – $10^8$   $g^{-1}$  of faeces). Furthermore, turtle pellets held at laboratory room temperature (21.5–25.5°C) showed no multiplication of faecal coliforms or enterococci. Pellets placed in beakers of seawater for 15 days continued to remain intact, and mostly buoyant, with no bacterial growth. Breaking the faeces into small pieces after 15 days failed to result in the isolation of faecal coliforms or enterococci (Fujioka, 1990). Cultures from fresh pellets performed by a private hospital laboratory, as well as the State of Hawaii's Department of Agriculture, were found to be negative for Salmonella.

### Results and Discussion

Faecal pellets of the green turtle have been known since 1976 to occasionally wash ashore in small numbers on certain beaches throughout the Hawaiian Islands. The opportunity to easily collect this material has provided a simple method of identifying food sources exploited by the turtles in their nearshore foraging pastures (Balazs, 1980). However, Kualoa is

### Faecal Pellet Counts Kualoa Beach, Oahu 1989

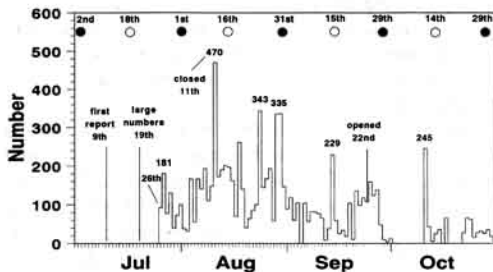


Fig. 4 Green turtle faecal pellet counts at Kualoa Beach, July–October 1989. The State of Hawaii's Department of Health closed the beach to public use from 11 August–22 September, 1989.

not a site where this phenomenon had been previously reported. Park maintenance personnel, lifeguards, and other people long familiar with Kualoa Beach unanimously agreed that large numbers of faeces have never washed ashore there.

No unusual seasonal weather conditions, nor notable activity by turtles immediately off Kualoa, occurred that might explain the observed faecal event. A general review of data for tidal cycles, moon phases, wind speed and direction, and surf conditions failed to identify any consistent correlation with the erratic fluctuations in daily faecal counts recorded (Fig. 4). Southeasterly winds prevailed on 28–29 August 1989, which partly coincided with counts of 335 pellets per day ashore for 2 days in a row. However, no such relationship was apparent for any of the other days studied. It should be noted that green turtles are only occasionally sighted directly off Kualoa, where they sometimes become entangled in fishing lines or wash ashore dead from various causes.

The most plausible area for the faecal pellets to have originated appears to be Kaneohe Bay, which extends for some 13 km immediately to the southeast of Kualoa Beach (Fig. 1). A comparatively large aggregation of green turtles, estimated at 500 or more individuals mainly composed of immature size classes resides in this bay for foraging and resting purposes. There is no evidence that a sudden increase in turtles occurred during 1989 (or in any other year). However, for the past 4 years, special attention has been focused on the turtles in Kaneohe Bay because of the documented increased incidence of fibropapillomas, a debilitating and life threatening tumour disease of unknown aetiology. About 50% of all green turtles found washed ashore in a dead or disabled condition in the Hawaiian Islands have these tumours (Balazs & Pooley, 1991). In addition, about half of the turtles sighted during diving surveys in Kaneohe Bay now have these tumours to varying degrees of severity.

The possibility exists that the large quantity of faeces that washed up on Kualoa Beach during the summer of 1989 may have been related in some way to the tumour epidemic in Kaneohe Bay. However, the manner in which this might have been mediated remains unknown,

and open to speculation. Perhaps a sudden surge of the disease reduced the turtles' ability to adequately digest algae, possibly by changes in intestinal microbes, thereby causing the faecal pellets to be more buoyant and resistant to breakdown. It is known that many, and possibly most, faecal pellets from Hawaiian green turtles are not buoyant but rather sink to the bottom, and hence never wash ashore.

Another hypothesis is that certain turtles feeding exclusively on *Halophila hawaiiiana*, a sea grass that grows in Kaneohe Bay, moved to algal foraging habitats during the summer of 1989. Bjorndal (1980) has pointed out that a change of diet by the green turtle, from sea grass to one of algae, would likely require radical changes in intestinal microflora resulting in a lowered digestive efficiency, at least for a period of time. Such a move could have been related to the tumours and/or the considerable increase in commercial tourist-related activities and associated disturbances to foraging turtles in the bay. Since 1989, certain sections of Kaneohe Bay where turtles forage heavily on *Halophila* have been legally set aside as zones that exclude anchoring by commercial tour operators.

Kualoa Beach has been periodically monitored for a reoccurrence of the mass arrival of faecal pellets since late 1989. Such an event has not been seen again, although small numbers continue to wash ashore both at Kualoa and elsewhere in Hawaii. Even at low levels, the drifting ashore of these faeces appears to be unique. No other published or even anecdotal reports are known of faecal pellets of the green turtle, or any other species of marine turtle, washing up at any location outside of the Hawaiian Islands.

- Balazs, G. H. (1980). Field methods for sampling the dietary components of green turtles, *Chelonia mydas*. *Herpetolog. Rev.* **11**(1), 5-6.
- Balazs, G. H. & S. G. Pooley (eds) (1991). Research plan for marine turtle fibropapilloma. US Dept. Commer., NOAA Tech. memo. NMFS, NOAA-TM-NMFS-SWFSC-156.
- Bjorndal, K. A. (1980). Nutrition and grazing behavior of the green turtle, *Chelonia mydas*. *Mar. Biol.* **56**, 147-154.
- Dailey, M. D., M. L. Fast & G. H. Balazs (1991). *Carettacola hawaiiensis* n. sp. (Trematoda: Spirachidae) from the green turtle, *Chelonia mydas* in Hawaii. *J. Parasitol.* **77**(6), 906-909.
- Fujioka, C. (1990). Assessment of the impact of sea turtle faeces on the bacteriological quality of water at Kualoa Beach Park, Oahu, Hawaii. Water Resources Research Center, University of Hawaii at Manoa, Honolulu. Unpublished report.

## THIS WEEK

## NEW SCIENTIST

# The night of a thousand turds

FOR forty days and forty nights they just kept on coming. And four years later, marine biologists in Hawaii are still puzzling over the extraordinary summer when a tide of turtle turds washed up on a beach on the western side of Oahu. "There has always been the odd pellet here and there, but all of a sudden, we were talking in terms of hundreds and hundreds a day," says George Balazs of the Southwest Fisheries Science Centre in Honolulu.

Balazs and his colleagues report in the current issue of the *Marine Pollution Bulletin* how 300 pellets a day were washing up on Kualoa Beach: "A general review of data for tidal cycles, moon phases, wind speed and direction, and surf conditions failed to identify any consistent correlation with the erratic fluctuations in daily faecal counts."

Balazs and his colleagues did establish

that the pellets came from green turtles (*Chelonia mydas*) which graze in nearby Kaneohe Bay. One clue to the invasion, says Balazs, is that the pellets were buoyant, whereas they normally sink. He points out that at the time, the turtles in the nearby colony were suffering from an unexplained disease which left many animals covered in tumours. The researchers suggest that the disease may have disrupted the animals' digestion, making the faeces buoyant.

But Balazs said last week that the colony still suffers from the disease, yet there has never been any sign of surplus pellets since. The beach was closed throughout the event, though analysis of the pellets showed that they were not a hazard to human health. "It would not feel very nice to walk down the beach and step on one of them, but they do not present a health hazard," says Balazs. □