



ECOSPHERE NATURALIST

Grandmothers and deadly snakes: an unusual project in “citizen science”

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Abstract. We describe initial results of an innovative citizen science project that is unusual in its taxonomic focus (deadly sea snakes), its location (the Indo-Pacific), and its primary contributors (grandmothers from the city of Noumea, New Caledonia).

Key words: Elapidae; Hydrophiinae; population structure; seasonality.

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The growing involvement of amateur enthusiasts in wildlife-research projects has changed the way that researchers gather data. Driven by limited resources for field studies, a passion among the general community for hands-on involvement with nature, and the growth of social media, many projects now rely upon the general public to collect datasets that otherwise would have been prohibitively expensive or logistically impossible (McKinley et al. 2017). Nonetheless, most of those citizen science projects involve small, harmless forms of wildlife, and many projects rely on children and working-age adults as volunteer helpers. We describe a different situation: a project on highly venomous sea snakes in the Pacific island of New Caledonia, conducted by a team of grandmothers. Citizen science may prove particularly valuable for populations of large mobile carnivores, because such species are difficult to survey using conventional techniques (Farhadinia et al. 2018).

The capital of New Caledonia, Noumea, is fringed by shallow-water bays that support biodiverse coral communities including sea

snakes (Ineich and Laboute 2002, Borsa 2008). The largest sea snake species in the region is the greater sea snake (*Hydrophis major*), a robust fast-swimming species that can attain more than 1.5 m in length (Ineich and Laboute 2002; Fig. 1). We have conducted a 15-yr research program on the population ecology of the smaller, harmless turtle-headed sea snake (*Emydocephalus annulatus*) in the Baie des citrons, a small (<35-ha) reef site beside the city’s main swimming beach (Goiran et al. 2013). The sites we survey are popular snorkeling areas for local residents and tourists. Over that period, we occasionally saw greater sea snakes also (Goiran and Shine 2014): a total of six sightings over the period 2004–2012 (Fig. 2) during an average of 45 person-hours snorkeling in January each year, plus (from 2013 onwards) an average of >100 person-hours snorkeling per year at other times.

Markings on the hind bodies of each of these giant snakes are unique, enabling us to recognize individuals, so we began photographing tails of free-swimming snakes in a standardized fashion



Fig. 1. A greater sea snake *Hydrophis major* in the Baie des citrons, New Caledonia. Photograph by Claire Goiran.

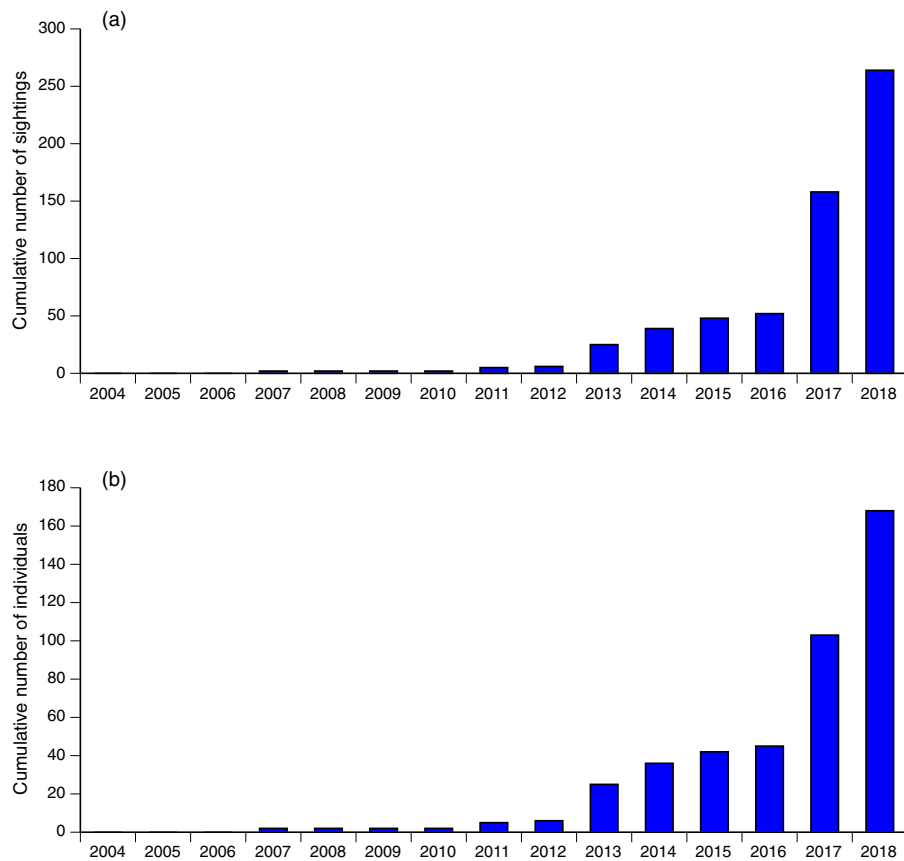


Fig. 2. Cumulative numbers of greater sea snakes *Hydrophis major* recorded in the Baie des citrons, New Caledonia, during the period 2004–present. The steep increase in number of sightings (a) and number of different individuals (b) in 2017 corresponds to the time that the grandmothers joined our research project.



Fig. 3. Two of the grandmother dive team around a greater sea snake *Hydrophis major*, photographing the snake’s tail for identification. Photograph by Claire Goiran.

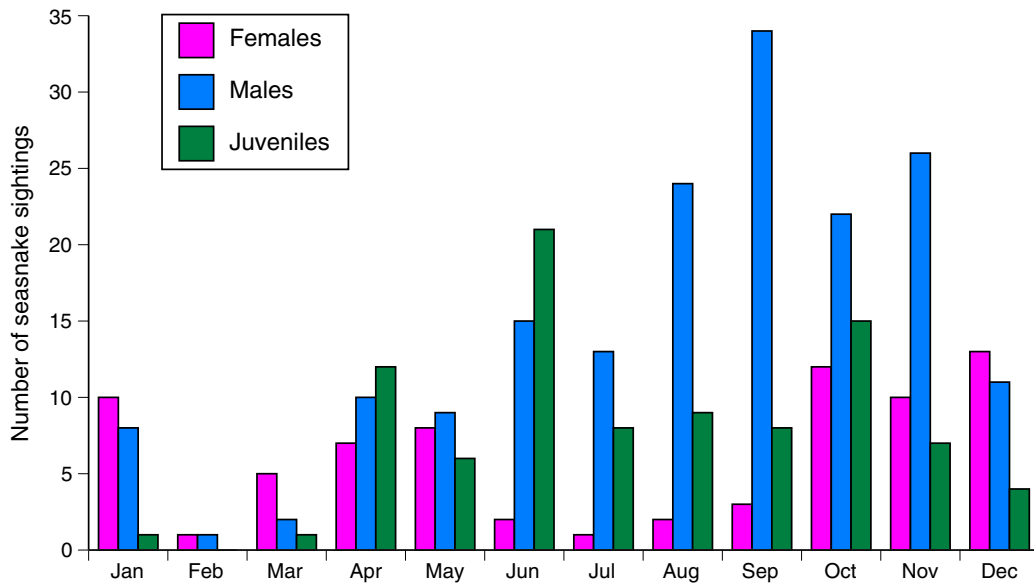


Fig. 4. Monthly variation in the numbers of juvenile, adult male and adult female *Hydrophis major* recorded in the Baie des citrons over the period September 2011–October 2018.

in 2013. With the extra year-round sampling, our annual snake sightings increased from an average of <1 per year to around 10 per year over 2013–2016. By the end of 2016, we had recorded

greater sea snakes on 52 occasions within the Baie des citrons (with at least 45 different individuals), far more than we had expected for such a small urban bay.

The Noumea residents who use the Baie des citrons for recreation include a group of seven women in their 60s and 70s who refer to themselves as “the fantastic grandmothers” (Fig. 3). In June 2017, these expert swimmers and snorkelers offered to begin photographing the posterior bodies of any greater sea snakes that they encountered during their recreational activities. The snakes tolerate close approach by divers without any defensive responses, rendering the procedure safe. None of the volunteers attempt to touch or capture snakes; they simply take photographs.

The results were astonishing. As soon as the grandmothers set to work, we realized that we had massively underestimated the abundance of greater sea snakes in the bay. Photographs taken by the grandmothers and one of us (CG) identified more than 140 greater sea snakes (277 total records) in the bay over a 25-month period (October 2016–November 2018; Fig. 2). Those records, plus accompanying observations, provide more detailed information on the ecology of greater sea snakes than is available for any other wide-ranging hydrophiine snake species worldwide (Heatwole 1999). For example, the data show strong seasonality in reproduction (courting in winter, pregnancy in summer, birth in autumn) with a concurrent shift in sex ratios and age structure of the snake populations within the Baie des citrons across the seasons (Fig. 4). Recruitment rates also varied across the two years for which we have substantial data, with young-of-the-year comprising 35% of all snakes (65 of 187) in 2018 but only 6% (6 of 105) in 2017 ($\chi^2 = 36.36$, 1 df, $P < 0.0001$). The probability of resighting a snake was higher for adult males (mean of 3.13 sightings) than for adult females (mean of 1.76 sightings) or juveniles (mean of 1.18 sightings; $F_{2, 173} = 9.32$, $P < 0.0001$).

Remarkably, then, within a period of 25 months at least 140 lethally toxic sea snakes traversed a small bay that is occupied every day by hordes of local residents and cruise-ship passengers. No bites to humans by *H. major* have been recorded at Baie des citrons (Sebat et al. 2005), testifying to the benevolent disposition of these snakes. It is equally striking that the numbers of these large animals had been massively

underestimated by experienced snake researchers working at the same sites (Fig. 2). In summary, the voluntary participation of a specific group of community members—older women with the time and expertise to survey a local site repeatedly and in detail—is providing a unique window into the ecology of a hitherto poorly known species of large marine predator.

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