No place for humans!

*Corey Bradshaw hunts for crocodile eggs in an Australian swamp and considers the important role that commercial crocodile farms have played in conserving saltwater crocodiles (*Crocodylus porosus*) in the wild.*

"So does each team get a hand gun?"

"No, you get an oar."

"What good is an oar?"

"Listen, mate. When a 3-meter croc jumps out of the swamp at you, there is nothing more natural in the world than to thump him with a big stick. It's an autonomous response. With a gun, IF you manage to keep it dry, and IF you manage to get it out in time before the croc bites off your head, chances are you'll just shoot the bloke in front of you anyway. So you get an oar."

"Fair enough."

Figure 1. *Saltwater crocodile in Australia's Kakadu National Park.*

That is an approximate, paraphrased reproduction of the initial conversation I had with renowned Australian crocodile biologist, Grahame Webb, just prior to my first (and as it turns out, only) trip to collect crocodile eggs for his Darwin wildlife park and crocodile farm. I volunteered to take part in the collection because I had recently begun working with Grahame and his team in tracking the world's largest crocodile species – the saltwater or estuarine crocodile *Crocodylus porosus* (Figure 1) – and modeling aspects of its populations (Bradshaw *et al.* 2006). I had already been out on several occasions to satellite-tag animals (some measuring > 4 m) on the Mary River and to cage-trap others in Kakadu National Park (both in Australia's Northern Territory), so I thought a little egg collection would be a proverbial walk in the park. Little did I know that it would end up being one of my more memorable experiences.

Let me walk you through the process. First, you wait until the height of the wet season and drive out as far as you can toward the breeding swamp of interest – in this case, Melacca Swamp in the Adelaide River floodplain, about one hour's drive from the city of Darwin. Then you and two other loonies pile into a small helicopter, equipped with pontoons for water landings, which ferries you to one of many previously identified crocodile nests. Because there is usually too much vegetation around the nest itself, the helicopter must land about 100–300 m away. Clothed only in long pants, a long-sleeved shirt, and cotton gloves to protect your skin from the slicing blade grass, you jump off the helicopter's pontoons into impenetrably murky, chest-deep water. One member of the team drags an esky (a cooler into which eggs will be placed) and another carries an oar. As the noise of the departing helicopter fades away, you suddenly realize that you are in the middle of a crocodile-filled swamp – and all you are holding is an oar.

It gets better. After the initial wave of paralyzing terror has passed, you must proceed toward your goal. And it is here one appreciates the second vital role of the oar – checking every prospective footfall for submerged surprises in the form of large, biting reptiles (remember, you cannot see the bottom). As I am sure the reader appreciates, this and the wading ensure slow progress toward the nest. The cutting blade grass quickly fades to irrelevance as finger-long leeches visibly slither just below the surface of the water toward the line of perambulating human flesh. The procession is only occasionally interrupted by the voice of the person behind you saying "hang on, mate", and then the gentle brush of a hand across your back as a palm-sized spider is swept off you and into the adjacent vegetation. You continue to hone that once-vague feeling that humans were not meant to be in this place.

As you approach your prize – a circle of mounded vegetation 3 m in diameter and surrounded by a carefully prepared moat – your progression slows and your vigilance rises. On more than one occasion, the prodding oar head disturbs something large just ahead of you, and something unseen but decidedly crocodilian races ahead under the water's surface, leaving a trembling wake in its stead. Parting that final veil of blade grass reveals the nest, which, I am told, often supports an angry, 3-m-long green mum, just waiting for a bit of a dust-up. Thankfully during my outing, all visited nests had been recently vacated.

As one team member carefully uncovers the nest vegetation to locate the 70 or so glassy, white eggs, you assist by

standing guard with oar in hand, ready for an attack launched from the surrounding moat (which you had just checked thoroughly before). Each egg is marked with a pencil to indicate its orientation (Figure 2) and then carefully placed on a mat of nest vegetation in the esky. It is a delicate process because wrongly placed eggs can rotate and cause the embryo to detach from the shell and die. After the eggs are retrieved, you make the long progression back to the helicopter drop-off site, from where you are whisked off to the next nest. And then the next – all day long. On one particular occasion, the wade back to the pick-up site revealed the track of a large crocodile (most likely a male, since the tracks were much bigger than those of most females) that had followed us into the nest. We never did see him, and I think I am happier for it.


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Figure 2. *The author marking eggs at a crocodile nest site.*

Having vicariously shared this experience with you, I turn now to explaining why my brief moment of "fun" has some fairly serious implications. Any seasoned biologist will likely have analogous tales of danger and excitement associated with the pursuit of precious and elusive data. This particular story differs only in that it was not specifically related to data collection per se; rather, it is a normal part of the commercial venture that is modern crocodile farming in Australia. Some might balk at the concept, but such farming is most likely the reason that *C porosus* persists today.

Like many large animals, Australian saltwater crocodiles were hunted to near extinction in the latter half of the 20th century. Valued for their skins, intensive commercial hunting began in 1945 and quickly depleted populations throughout northern Australia, until an export ban was imposed and full legal protection established in 1972 (Messel and Vorlicek 1986). Fortunately, *C porosus* was recognized under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and listed in its Appendix II (Webb and Manolis 1993b). By 1979, the species was transferred to Appendix I (comprising the most endangered among CITES-listed species). Some subsequent recovery of northern Australian populations was used successfully to argue for moving the species back to Appendix II (Webb *et al.* 1984, 1987). It is this listing, and the data collected to support it (see Webb and Manolis 1993a), that effectively removed the economic incentive to hunt wild crocodiles. A market saturated with skins of known and legal origin made any other form of harvest irrelevant (Webb 2001).

As a conservation ecologist, I find it intriguing that ways to slow biodiversity loss are sometimes, at least superficially, counterintuitive. The *C porosus* example also reminds us that our response to the biodiversity crisis must span more than the purely biological fields – economics, political science, energy technology, sociology, anthropology, psychology, geography, and philosophy also play important roles (Sodhi and Ehrlich 2010). While I doubt that I will ever have the opportunity or the desire to stress myself quite to that extent again, I consider myself fortunate to have had the chance to get up close and personal with the world's largest reptile.

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