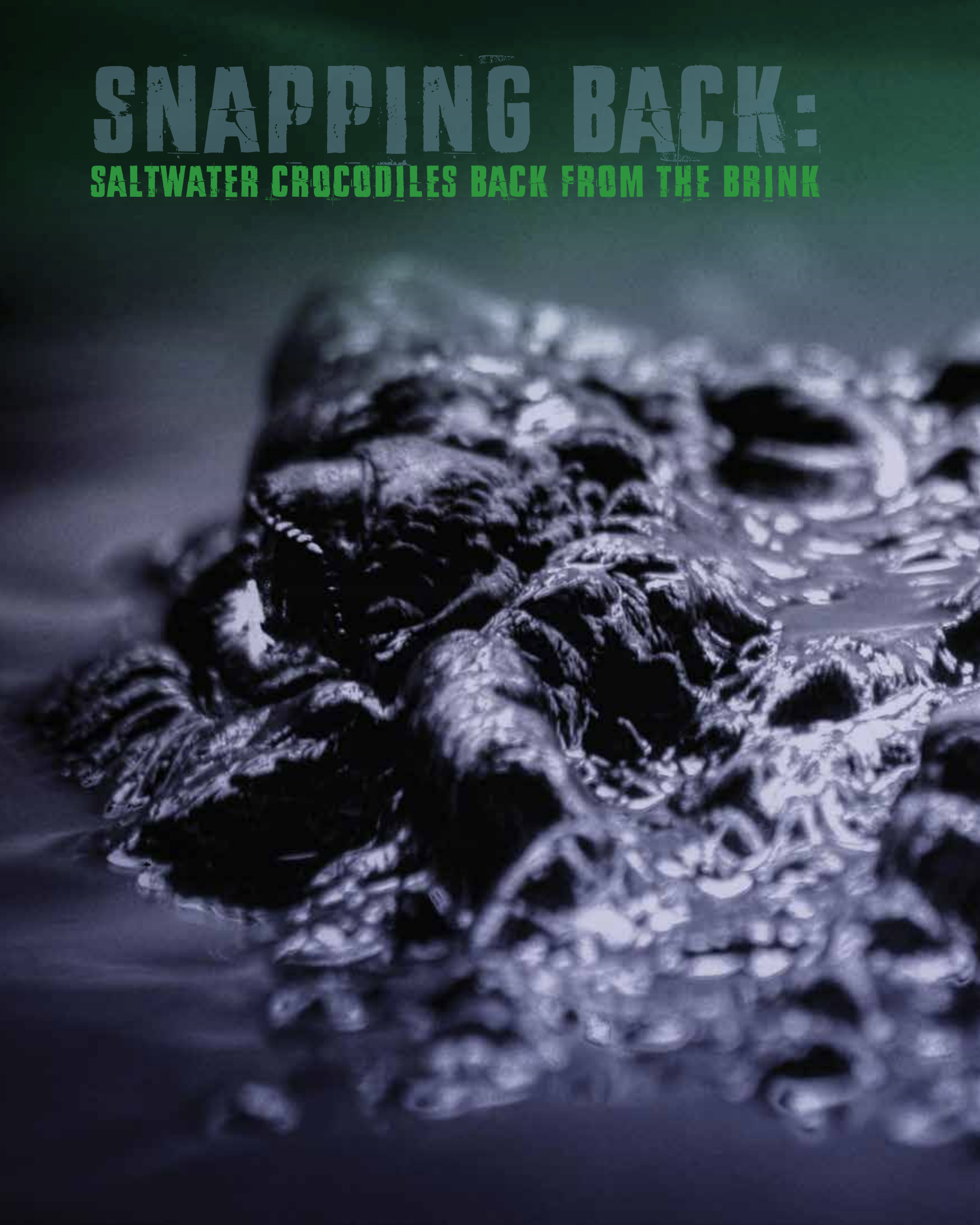
SNAPPING BACK:

SALTWATER CROCODILES BACK FROM THE BRINK



For many people, a primeval fear of large carnivores clouds their ability to see how top-order predators struggle to survive on a planet dominated by an ever-intrusive human population. Lions, tigers, wolves, bears, sharks and crocodiles have all suffered extensive population losses due to the proximity of their habitats to cities and towns. Today, Australia has sophisticated nature management capabilities supported by appropriate legislation and enforcement. However these capabilities were not present when the saltwater crocodile was hunted to the brink of extinction between 1950 and 1970. It was only after a national ban on hunting crocodiles was put in place around 1970 that crocodiles were able to begin a slow process of recovery which continues to this day.

by Andrew Halford and Daniel Barrow

Today's crocodiles and alligators all belong to a single clade, the Crocodylians, which has been around for about 100 million years. Only a few groups from this clade survived the cataclysmic extinction event in the late Cretaceous period (about 65 million years ago), when a massive asteroid impact killed off the non-avian dinosaurs leaving the surviving crocodilians as the world's dominant large reptiles. Having survived such events, it is sobering to think how close saltwater crocodiles might have come to regional extinction in the post-war years when the country was recovering from the financial and emotional toll of war. The ready availability of .303 rifles in the wake of WWII provided a large-calibre weapon for reliably killing crocodiles, and the high international price for crocodile skins motivated those seeking adventure and the opportunity for financial gain. As a result, commercial crocodile hunting became extensive across the top of Australia, between 1950 and 1970 with an estimated 270,000 skins exported between 1945 and 1972. In Western Australia, hunting peaked in the mid-1960s and by 1969 crocodiles were considered rare in the Kimberley and elsewhere, with fewer than 8,000 crocodiles estimated left across their natural range and only 2,500 of these in the west Kimberley. Hunting finally stopped in 1972 when the Federal Government declared a total ban on the import and export of crocodile products.

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Main Saltwater crocodile.
Photo – Marc Russo

Above The powerful jaws of saltwater crocodiles makes them formidable predators.
Photo – Andrew McInnes

STUDY SUBJECT

Research into the remnant saltwater crocodile (*Crocodylus porosus*) population started in the Northern Territory in 1971, led by a team run by the indefatigable Professor Harry Messel from the University of Sydney. This science expert and his team went on to produce a series of 20 monographs detailing the population size and structure of crocodiles across all major rivers in WA, NT and Queensland. This established an unprecedented baseline upon which future work could be based. In the NT, annual surveys of crocodiles have continued across multiple rivers since 1975, enabling a detailed understanding of how crocodile populations have recovered during the more than 30 years since hunting ceased. This has not been the case in WA where there were no follow-up surveys since Messel and colleagues completed two in 1978 and 1986.

To rectify this situation, the then Department of Parks and Wildlife re-surveyed the two biggest river systems in the West Kimberley during the winter of 2015 as part of a research project funded through the Western Australian Marine Science Institution (WAMSI) and the department. Between late July and early August a small team of crocodile experts, including traditional owners, traversed about 300 kilometres of creeks and rivers in the Prince Regent and Roe-Hunter river systems, heading out each night in a five-metre boat to count and size crocodiles. These 'spotlight' surveys took advantage of the crocodiles' tendency to freeze under the glare of a powerful torch beam, enabling the team to approach close enough to estimate the size of each animal. By repeating these surveys at the same time of year, using the same techniques and covering the same ground as Messel and his colleagues, direct comparisons between Messel's studies and the new surveys could be made.

IT'S ALL IN THE NUMBERS

In the eight years between 1978 and 1986 the total number of non-hatchling crocodiles in the Prince Regent and Roe-Hunter river systems increased from 293 to 505. In the 30 years from 1986 to 2015 the numbers increased to 1,171. In 1978 you were likely to encounter only a single crocodile for every kilometre of river you travelled along, and that crocodile would, on average, weigh about 15 kilograms and be 1.5 to 1.8 metres long. In 2015 you could find four crocodiles for every kilometre you travelled with the average crocodile weighing about 26 kilograms and being 1.8 to 2.4 metres long. While the numbers represent an increase in abundance of up to 300 per cent from their 1978 nadir, they only tell part of

the story, and it is the size structure of the population that provides a more informative picture of their recovery.

In 1978 about 13 per cent of the population, or 39 crocodiles out of the 293 non-hatchling crocodiles counted, were longer than 2.1 metres. By 2015 this rate had climbed to 16 per cent of the population, equating to 186 crocodiles out of the total of 1,171. However, only 29 of these 186 crocodiles were three metres or longer. These size categorisations are important because they help researchers understand the rates at which a crocodile population can replenish itself, as male crocodiles do not reach sexual maturity until they are about three metres in length and 16 years old, and females around 2.1 metres and 12 years old.

The other vital measure of the ability of a population to recover is the number of hatchlings or new recruits that enter the population each year. Only 25 per cent of crocodile eggs survive to hatching and 55 per cent of the hatchlings are killed before they are a year old. Young crocodiles are easy prey for other crocodiles, fish, goannas and birds so their earliest years are when they are most vulnerable. However, for the crocodiles that make it to maturity their chances of living a long life are as high as 99 per cent given they have no natural predators, except for man. Nesting success in crocodiles is closely linked to the ebb and flow of the wet seasons as fresh water is required for breeding. Nests are usually built in grasslands that are inundated with freshwater during the rainy season. These areas are at their most prevalent at the furthest upstream reaches of river systems. Ironically, good wet seasons do not always translate to successful nesting seasons because the nests can be washed away by flooding. In the 1978 survey, Messel and colleagues found 119 hatchlings, indicating a successful nesting season. However, in 1986 there was almost complete recruitment failure with only 15 hatchlings observed. The latest surveys counted 213 hatchlings indicating successful nesting in the 2014–15 summer.

MODERN-DAY STUDIES

Before Messel and his colleagues completed their surveys, no broad-scale formal assessments of crocodile populations had been done. This means that there is no 'before' baseline against which to compare the current state of crocodile populations in the west Kimberley. Anecdotal evidence suggests that before hunting there were far more crocodiles in the area. But this is just an educated guess.

Discover more about saltwater crocodiles

Scan this QR code or visit Parks and Wildlife's '*LANDSCOPE*' playlist on YouTube.

Above left Gary Umbagai from the Dambimangari, who are the traditional owners of the Prince Regent area, provided his expertise to the study.

Above DBCA vessel *PV Warndoom* at Kings Cascade in Prince Regent National Park. *Photos – DBCA*

So how do we put the health of the current crocodile populations in WA into perspective? Are the populations fully recovered or is there some way to go? Science tells us that eventually an ecosystem will reach an equilibrium and the population of crocodiles will stabilise and not continue to increase year to year. In the NT where there has been much more intensive monitoring they have found that crocodile populations in many of the river systems have reached equilibrium and are considered fully

Top Crocodiles live in the intricate waterways of the State's top end, such as at Saint George Basin Kimberley.
Photo – David Bettini

Above Crocodile sightings, like those in the south arm of the Prince Regent river systems, were recorded on an app developed by DBCA.

Opposite page
Right Wilinggin rangers and local wildlife officers carry out a reconnaissance of the west Kimberley habitat.
Photo – DBCA

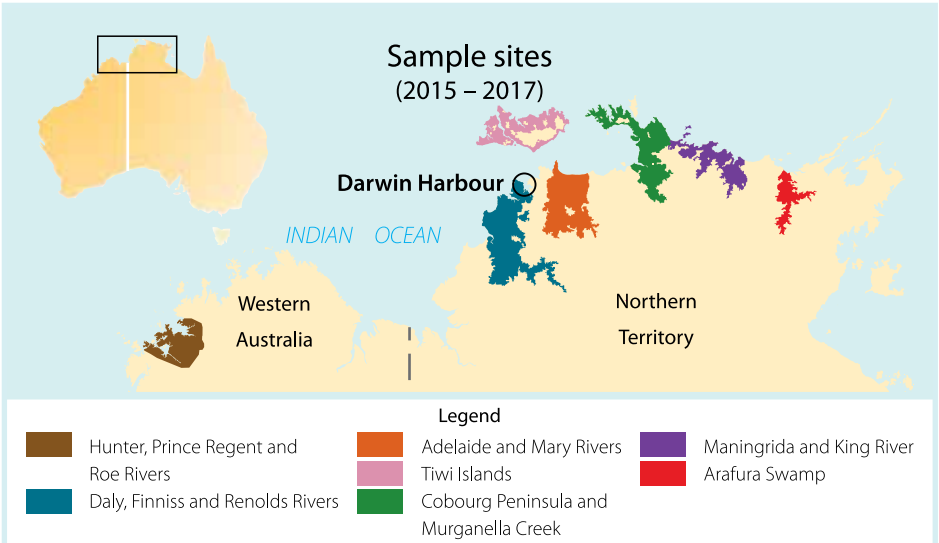
recovered from hunting. We can use these populations to infer where our WA populations are in the recovery process.

We chose the Adelaide and Daley rivers in the NT to inform our study as they are both considered to support fully recovered crocodile populations and are similar in length to the Roe-Hunter and Prince Regent river systems we surveyed. The NT rivers averaged six crocodiles per kilometre of river with the average crocodile weighing about 75 kilograms and measuring between 2.7 and three metres long. These figures indicate that the WA rivers are still holding a considerably smaller and less abundant crocodile population than those found in the NT rivers. This differential is further highlighted by comparing the number of very large crocodiles in each region – NT rivers average 74 crocodiles more than three metres, while WA rivers have only 15. Crocodiles gain weight at an ever-increasing rate once they reach three metres in such a way that a 4.2-metre crocodile can be twice the weight of a three-metre one. Mature crocodile populations stabilise in abundance and then continue to increase in size as larger crocodiles develop in the system.

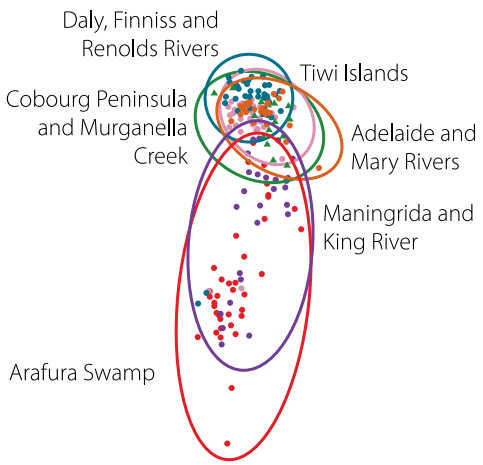
The river systems of the west Kimberley are quite different to those in the NT. Our systems lack the extensive flood plains at their upper reaches which are typical of NT river systems, while west Kimberley rivers have steep-sided walls for much of their length with only marginal nesting areas available. These fundamental differences may act as a bottleneck to the recovery of the west Kimberley crocodile populations which leads us to conclude that crocodile populations are either still recovering in the region and remain significantly different from their NT neighbours, or these systems will never hold a similar population structure to the NT. Only continued surveys will provide the answer to this.

Individual male crocodiles can travel hundreds of kilometres from their natal rivers to find new areas in which to settle, by taking advantage of favourable currents and water temperatures. This is commonly observed in crocodile populations that are stabilising when larger males drive juvenile males out of their home rivers and they must seek new territory to survive and prosper. These mini-migrations introduce new genes into neighbouring populations and must be taken into consideration when determining the spatial scale at which crocodile populations should be managed. If there is regular exchange of genes between river systems then they can often be managed as a single population. However, if there is limited exchange then populations need to be managed as separate units.

As part of the most recent survey, we collected tissue samples from the West Kimberley crocodile populations and compared them to the genetic signatures of samples collected from crocodiles in NT rivers to determine whether they were separate populations (see 'Genetic clustering among crocodiles at sample sites' on page 17). The results were



Genetic clustering among crocodiles at sample sites



Results of genetic testing of crocodile populations from Prince Regent and Roe/Hunter River systems and their regional neighbour populations in the Northern Territory. This work was done by Yusuke Fukuda and colleagues from the Department of Environment and Natural Resources in the Northern Territory as part of a national study into the connectivity of crocodile populations.

very clear and indicated that the West Kimberley crocodile populations have no relationship with the NT populations. This result confirms that we must treat the West Kimberley populations as separate and manage them accordingly.

ENSURING ONGOING SUCCESS

There is no doubt that the successful and ongoing recovery of crocodile populations in Australia is a remarkable success story. These ancient animals are perfectly adapted to the environment in which they live and have shown that when left to control their own destiny, they are capable of maintaining their populations even after the extreme impacts of hunting. The other side of this complex ecological coin is that these recovering populations will bring them into potential conflict with increasing human populations, with potentially disastrous consequences. The ability to coexist is a cornerstone of successful marine and terrestrial park management, and DBCA is committed to developing systems that provide the means for humans and species such as crocodiles to live together as harmoniously as possible. This means maintaining the delicate balance between the rights of all animals to exist within the environments they have evolved in and protecting human populations that wish to be a part of the same ecosystems. In the meantime, we can celebrate the remarkable and ongoing recovery of our saltwater crocodiles and their robust health in our tropical estuarine systems, which remain some of the most intact ecosystems on the planet.

Did you know?

Saltwater crocodiles (*Crocodylus porosus*) have a mottled grey, brown or blackish colour. Their snout is broader than that of the freshwater crocodiles and they can have between 40 and 60 teeth. During the wet season, females lay about 60 eggs in nests on riverbanks and can be particularly aggressive during the breeding season. The temperature of the nest determines the sex of the young.

Crocodiles are known for being effective hunters. They are exceptionally fast on both land and water and often ambush their prey. They submerge themselves near river banks and leap from the water to grab prey in their strong jaws. They only have small stomachs, so often stow their kill underwater for later consumption.

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The crocodile study was made possible through a collaborative broad-scale approach to conservation in the Kimberley in partnership with WAMSI and with support from the traditional owners of the Kimberley.