Synthesising Nile crocodile attack data and historical context to inform mitigation efforts in South Africa and eSwatini (Swaziland)

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Abstract

While damage-causing animals are a major challenge for conservation across Africa, and Nile crocodiles are allegedly responsible for more attacks on humans than any other species, data is lacking. This paper analyses 67 years of reported Nile crocodile attacks on humans in South Africa and eSwatini (1949-2016), identifying patterns in attack incidence in space and time, as well as victim demographics. Our literature review and archival searches identified records of 214 attacks. Most attacks occurred in natural water bodies, with attacks in dams increasing since 2000. Hotspots for attacks are identified. Most victims were attacked while swimming or bathing, followed by fishing, domestic chores, and crossing waterways. There was a significant relationship between gender and activity when attacked. Children (<16) account for 51% of all attacks, with a higher fatality rate compared to adults. Most victims were male (65%), with teenage boys the largest individual category. We conclude with recommendations for conservation policy and management to mitigate attacks by Nile crocodiles.

Key Words

Crocodile attacks; Nile crocodile; South Africa; eSwatini (Swaziland); conservation management

Introduction

Of the wild animals that attack humans and their livestock across Africa, Nile crocodiles (*Crocodylus niloticus* and *C. suchus*) are very widely distributed, and it has been claimed that they are responsible for most attacks on humans (e.g. Lamarque et al. 2009; Dunham et al. 2010). Male Nile crocodiles (in particular *C. niloticus*) may exceed 4 m and grow up to 5m in exceptional cases, taking large prey such as wildebeest and buffalo. They are highly adaptable to local environmental conditions and are found in a wide range of natural and manmade aquatic habitats, such as canals and dams, where they increasingly come into contact with humans and their livestock.

Increasing human populations and utilisation of rivers, lakes, wetlands and dams (from small farm dams to large irrigation dams), as well as gillnetting (for fish), are resulting in increasing human-crocodile interactions and a perception that adverse human-crocodile encounters are increasing (Lamarque et al., 2009; Aust et al., 2009, Fergusson, 2010; Wallace et al., 2011, Zakayo, 2014). The online attack database CrocBITE records attacks in 29 African countries, with attacks known for one additional country (Kpéra et al., 2014).

Research papers on crocodile attacks around the globe are revealing informative spatial and temporal patterns in attacks, and useful information about the demographics of attack victims (recent examples include Brien et al., 2017; Das & Jana, 2017; Shaney et al., 2018; Vyas & Stevenson, 2018), but data is inadequate for Nile crocodiles. Published data of varying quality and quantity (most of it not peer reviewed) exists for 12 of the 30 African countries where attacks are known to occur (Pooley, 2018). More data, as well as reviews of mitigation efforts are urgently required (Fergusson, 2010; Pooley, 2015a).

This paper offers an analysis of 67 years of crocodile attack data on humans in South Africa and the Kingdom of Swaziland (renamed eSwatini) from 1949-2016. It uses the resulting generalisations to investigate some of the patterns and issues identified in specific locations, in the context of the history and management of crocodile attacks in the study region. Drawing on attack data and historical evidence, we suggest ways forward for conservation policy and management of human-crocodile relations in the study region.

Study Area

This study focuses on the northeastern region of South Africa, including the warmer, low-lying ('lowveld') region of the interior confined mainly to Limpopo and Mpumalanga Provinces, and northern KwaZulu-Natal Province (KZN), and also the lower-lying warmer areas of eSwatini (see Figure 1). Nile crocodile distribution in the region is limited to the warmer, summer rainfall regions of these countries, with the hot and wet season (minimum temperatures above 15°C) from October to March (November to March in the interior of South Africa). Most of the rivers flow eastwards, from the central plateau and eastern escarpment, to the Indian Ocean.

From c.1949-1992 during the study period, South Africa's ('black') African majority was persecuted under the system of Apartheid, with the resettlement of Africans in remote rural 'homelands' with poor land and few jobs, and men working in cities as migrant labourers. This system kept two-thirds of the population rural (some of them more likely to encounter crocodiles) until the early 1980s, when Apartheid began to fail. Apartheid influx laws were defied, and urbanisation accelerated, especially after an ANC-led government came to power in 1994 (Turok 2012). Employment in the Agricultural sector is now small (c.5% in 2010) and declining, with unemployment much higher in rural areas (UN 2017; Turok 2012). Unfortunately census data (decadal, from 1951) is of limited use for investigating relationships between human population densities and crocodile attacks in particular locales. The Apartheid era data is considered highly questionable (Christopher 2011), the borders of magisterial districts varied across the study period (Giraut & Vacchiani-Marcuzoo, 2009), and estimates of human population density exist only at a very coarse scale (magisterial districts).

[table 1 here]

eSwatini is a small, stable absolute monarchy with a largely rural population. The population has grown sixfold during the study period. Classified as a lower middle income country, the majority of Swazis are very poor, with an estimated 70% of the population employed in subsistence farming (UN 2017; CIA 2017). They depend on rivers for water for drinking, cooking and washing.

Crocodile Populations and Threats

Today, naturally occurring wild Nile crocodiles (*C. niloticus*) are found as far south as the Zinkwazi River in South Africa, but the major viable populations are restricted to three disjunct protected areas: the eight large seasonal and perennial rivers traversing Kruger National Park (KNP) in Limpopo and Mpumalanga provinces; and in KwaZulu-Natal Province, in Ndumo Game Reserve and the Lake St Lucia estuarine system (Ferreira and Pienaar 2011; Combrink, Warner and Downs 2013; Calverley and Downs 2014a).

Crocodile abundance in the KNP peaked in the early 1990s, subsequently declining over the period 1993–2000, but has since increased to an estimated population of 4,300 individuals > 1 m in length. This is despite die-offs from the nutritional disease Pansteatitis since 2008 (Ferreira & Pienaar, 2011). In Limpopo and Mpumalanga provinces outside of KNP, just over 600 individuals were counted in the 1980s, mostly < 3 m in length, with breeding populations in the Olifants, Limpopo, Levhuvhu, Komati and Blyde rivers (Jacobsen, 1984). At the time of writing, only the 12.8 km^2 Flag Boshielo Dam on the Olifants River retains a viable crocodile population outside of the KNP in Mpumalanga Province (Botha, 2005). This population declined by 27% following the raising of the dam wall by 5m in 2006 (Ashton, 2010).

In northern KZN Province, populations declined after World War Two as a result of hunting and snaring, as well as habitat destruction and water shortages due to expanding agriculture and forestry. Tony (A.C.) Pooley started a crocodile restocking programme in 1966, which in combination with legal protection (effective from 1969), resulted in a dramatic recovery by the 1990s (Pooley, 1982, Calverley & Downs, 2014a, Harvey & Marais, 2014).

However, the observed Ndumo Game Reserve population decreased by 38% from 1993 to 516 crocodiles in 2009, possibly due to increased illegal killings facilitated by the removal of the eastern boundary fence in May 2008 (Calverley & Downs, 2014b).

The first aerial survey of Lake St Lucia (1972) yielded 356 crocodiles >1 m (Pooley, 1982). The lake was restocked with juvenile crocodiles from 1967–1976 (Pooley, 1980), and 975 individuals were counted in 1993. The population remained stable until 2008, but since then has declined, possibly linked to the recent prolonged drought (Combrink, 2014).

With the exception of the 132km^2 Pongolapoort Dam in KZN (Champion & Downs, 2017), declines have been reported for all other major crocodile populations in South Africa. As a result, Nile crocodiles are classified as Vulnerable in the country (Harvey & Marais, 2014).

In eSwatini, extensive habitat has been converted for agriculture, and illegal hunting remained rife into the 1980s. In 1992, King Mswati III ordered a new draft of the Game Act (1953, as amended), passed in 1993, which introduced the first legal protection for crocodiles outside of protected areas. There is no available crocodile population data for eSwatini, but they are considered 'Vulnerable' (Pooley, 2014; Big Game Parks, 2017).

Conservation management

Ezemvelo KZN Wildlife is the responsible authority in KwaZulu-Natal, South Africa. They remove rather than kill crocodiles wherever possible, will not erect or maintain protective structures, or pay compensation for attacks outside of protected areas. The Mpumalanga Tourism and Parks Agency, and Limpopo Province's Department of Economic Development, Environment and Tourism handle attacks in the interior. Crocodiles are protected under provincial conservation legislation.

In Mpumalanga, problem animals are trapped and released in either the $24km^2$ Loskop Dam or Flag Boshielo Dam (pers. comm. Hannes Botha, 2017), or are sold to commercial farms. The Limpopo authorities have issued tenders licensing trophy hunters to control damage-causing crocodiles, but few have been destroyed in this way. Fences have been built at some dams (Anthony et al., 2010).

In eSwatini, Big Game Parks (BGP) is mandated to manage wildlife in the royal parks and outside protected areas by the office of the king. Their policy is to capture and remove confirmed problem crocodiles. No protective structures are built, and compensation is not paid (pers. comm. Mick Reilly, Big Game Parks, 2014).

Methods

Information on Nile crocodile attacks was obtained from the personal archives of Tony (A.C.) Pooley and Dr Ian Player, and the St Lucia Crocodile Centre, and the *Times of Swaziland* archive in Mbabane, eSwatini. Searches were made for newspaper reports (print and online), journals and popular magazines. Literature search terms were ‘crocodile’ paired with ‘attack,’ ‘bite’ or ‘victim,’ in English and Afrikaans.

Only details of attacks by wild crocodiles which resulted in injuries or death were included. Alleged attacks which were not witnessed or where forensic proof was lacking were excluded. Fatal attacks include attacks where victims died later as a result of injuries sustained. Demographic categories for age included: child (<16) and adult (>15) to include all victims (sometimes exact age data were missing, but victims were described as children or adults); and 5-year age categories for cases where exact age data was known.

We excluded crocodile attacks prior to 1949 as a result of a paucity of reliable data. It is likely that during the study period, some attacks involving minor injuries went unreported. In remote regions, particularly where people were removed to by Apartheid authorities, some serious attacks may have gone unreported.

Historical rainfall and temperature data was obtained from the National Oceanic and Atmospheric Administration’s online National Climate Data Center search tool (NOAA 2017) and NOAA Central Library’s archive of annual climatological reports for South Africa (NOAA Central Library 2013). All rainfall and temperature averages are for 30-year periods.

We tested for time trends by constructing poisson Generalised Linear Models of attack frequency as a function of year. Quasipoisson GLMs were constructed when the data was overdispersed. We tested for differences between victim demographic categories using chi-square tests.

Results

Literature searches returned 132 print newspaper stories and six magazine features for South Africa, and 15 Swazi print newspaper stories of attacks in eSwatini. Sixteen online stories were retrieved through Google searches and searches of digital archives of five South African newspapers (English and Afrikaans), and nine stories from the digital archives of two Swazi newspapers. Tony Pooley's archive included personal records of 73 attacks in the study region, and Ian Player's archive included 15 newspaper reports of attacks.

The dataset comprises 214 attacks for the period 1949–2016: 185 crocodile attacks in South Africa, and 29 in eSwatini. In South Africa, attacks have been recorded in 13 district municipalities; however, only five districts have more than five attacks recorded. Figure 1 shows the spatial distribution of attacks, highlighting the provinces and water bodies that have the most recorded attacks.

Attack locations

The majority of crocodile attacks have occurred in natural water bodies, with 69% of attacks recorded for rivers or streams (N = 148), 15% for lakes or pans (N = 33), 3% for the St. Lucia estuary (N = 7), and 1% in wetlands (N = 2). Attacks have also been recorded in manmade water bodies, with 8% in dams of varying sizes (N = 18) and 2% in canals or drains (N = 5), and for one attack the exact location is unknown (<1%).

[Table 2 major locations of crocodile attacks in SA and eSwatini]

Annual Trends

A Poisson GLM indicates no significant trend in annual attack frequency across South Africa (eSwatini attack data before 2000 is patchy) between 1949 and 2016 (estimate = 0.001844, $z = 0.529$, $p = 0.597$). However, the records do suggest some temporal trends in particular districts and locality types. For example, there has been a significant decrease in the number of attacks reported in the Umkhanyakude District since 1949 (estimate = -0.025765, se = 0.006448, $t = -3.996$, $p < 0.001$), with only one attack recorded since 2010. In comparison, there has been a significant increase in the number of attacks reported in Limpopo Province's Mopani district (estimate = 0.07183, se = 0.02397, $z = 2.997$, $p = 0.00273$) and Vhembe district (estimate = 0.04680, se = 0.01698, $z = 2.756$, $p = 0.00585$). From 2006 to 2016, Mopani district and Vhembe district have recorded 8 and 6 attacks respectively, totalling 32% of all attacks during this period (N=44). Figure 2 shows the number of attacks recorded by five-year period, for the five Municipal Districts in South Africa with most attacks.

There have also been some temporal trends in attack frequency for different water body types. For example, there has been a fourfold increase in the proportion (28%) of attacks reported in dams since 2000, when compared with 1949-1999 (estimate = 0.06534, se = 0.01764, $z = 3.703$, $p < 0.001$), and a significant decrease in the number of attacks reported in lakes or pans from 1949-2016 (estimate = -0.04160, se = 0.01061, $z = -3.921$, $p < 0.001$). In South Africa, 64% of all reported attacks in dams have occurred since 2000, with a record high of six attacks in 2014.

Seasonality of Attacks

There seems to be a strong relationship between crocodile attacks and season (figures 3a and 3b), which follow seasonal fluctuations in average monthly rainfall and average monthly minimum temperature.

Victim Demographics

190 records include the activity the victim was engaged in when the attack occurred. Of these, most victims (31%) were attacked while swimming or bathing (N=59), followed by fishing (N=41, 22%), doing domestic chores at the water's edge (N=35, 18%), crossing (N=30, 16%), or other (N=25, 13%). There was a significant relationship between gender and activity when attacked (chi-squared (4, N=190) = 59.363, $p < 0.001$). The data indicates a relationship between age (adult ≥16> child) and activity, but this was not significant (chi-squared (4, N=124) = 8.6251, $p = 0.07118$). Table 3 summarises the number and percentage of attacks for each activity by age and gender.

[Table 3 here]

Of the reports including exact age information (N=139), 68 (49%) attacks were on adults (age > 15), and 71 (51%) attacks were on children (age < 16). A greater proportion of the attacks on children were fatal (54%), compared with adults (35%), and this difference is significant (chi-squared (1, N=139) = 3.9616, $p = 0.0466$). Figure 4 shows the distribution of victim ages, subset by fatal and non-fatal attacks.

Discussion

The analysis and interpretation of long term crocodile attack data provides valuable information on the seasonality of attacks, locations of attacks, and demographics of attack victims. Outcomes from this research could help focus mitigation efforts, providing that local contexts are taken into account, as outlined in this section.

Seasonality of attacks

Three possible explanations for the seasonality of crocodile attacks have been offered: increased dispersal and encounter rates resulting from high rainfall and water levels (wet season); temperature (crocodiles are ectothermic thus more active when it is warmer); and increased aggression during the breeding season (Pooley et al., 1992; Pooley, 2015a). High average water levels (where data exists) and high monthly average rainfall averages (particularly in the interior of South Africa) track high seasonal attack incidence. However, preliminary studies suggest there is no significant relationship between individual attacks in the study region when compared with high rainfall and water level conditions recorded for dates of attacks only (Potter, 2014; Powell et al. in prep.). In neighbouring Mozambique, Le Bel et al.'s (2011) short term data (1997-2003) indicate that most attacks occur in the dry season.

Instead, monthly-mean daily temperature is the strongest environmental predictor, with most attacks occurring at temperatures of ≥16°C (Potter, 2014; Powell et al. in prep.; and see Lance (2003) on American alligators). This effect of temperature would be explained by decreased physiological maintenance costs of crocodiles under cooler conditions, and conversely, increased activity levels and food requirements under warmer conditions, as suggested for saltwater crocodiles (*Crocodylus porosus*) in Australia by Manolis and Webb (2013: 100).

A limitation of trying to explain the seasonality of crocodile attacks based on biophysical variables and crocodile behaviour alone, is the overlap between human and crocodile activity, for example the seasonality of both crocodile and human aquatic activities. Nearly half of attacks in the study region occurred on weekends and holidays, suggesting human activity patterns are influential. Although the climate varies slightly between the interior and the coastal regions where crocodiles occur, the peak attack season is the same: December-March (see fig.3). More data on local behaviour patterns of crocodiles as well as humans in hotspots for crocodile attacks would contribute to more effective mitigation measures. For instance, it is known that crocodiles congregate in lakes in Ndumo Game Reserve, and on the eastern shores of Lake St Lucia, in winter. Larger animals disperse outside of the protected areas or around the lake system in the summer. Thus recreational areas around the Lake St Lucia system, notably the Estuary, see seasonal overlaps between the distributions of larger crocodiles and humans (Pooley 1982; Combrink 2014).

Spatial distribution of attacks

Our data shows that historically, most attacks occurred in waterways linked with major crocodile populations, namely the St Lucia Lake system, Ndumo Game Reserve and Kruger National Park (KNP). This situation was exacerbated in South Africa by the Apartheid 'Homeland' or 'Bantustan' system under which Africans were relocated to remote rural regions with little infrastructure (Beinart, 2001). Wildlife conservation areas similarly persisted where land was undesirable for farming and settlement (McCracken, 2008). Most crocodile attacks occurred where so-called native reserves bordered or were crossed by rivers linked with protected areas. In KZN Province this includes former Native Reserves on the Hluhluwe, Nyalazi and Umfolozi rivers. In Mpumalanga, attack hotspots persist where the former homeland of Gazankulu was located on the western border of the Kruger National Park (KNP). In Limpopo Province, attacks persist where the former homeland of Venda straddled rivers flowing into KNP.

Fluctuations in crocodile numbers (decline followed by a small recovery during the peak attack incidence from 1957-72), and rapid recovery and stabilisation during the period of reduced attacks (late 1980s–1990s), does not track attack incidence. Shifts in the distributions of crocodiles as a result of environmental events (droughts, floods etc.) and anthropogenic interventions (dam building, pollution, habitat transformation, direct persecution), as well as rapid urbanisation of South Africa's human population from the 1980s seem to be of more consequence (Pooley, 2013).

An upward trend in attacks in the interior since 2000 may be the result of encounters with crocodiles in unexpected locations, notably dams, where they have moved in response to the drying up of perennial rivers, disturbances along the riverbanks, or pollution in rivers (Botha et al. 2011). Some have been displaced through habitat loss caused by the widespread raising of (larger) dam walls in South Africa notably Flag Boshielo Dam, and the 150km^2 Massingir Dam in Mozambique, both on the Olifants River (Harvey & Marais, 2014; 88).

Commercial and subsistence fishing on a number of dams inhabited by crocodiles are an ongoing safety concern (Tapela et al., 2015). The key dams include Flag Boshielo Dam and the 0.75km^2 Makuleke Dam, and possibly Middle Letaba Dam (18.79km^2, in Limpopo Province) and Driekoppies Dam (18.7km^2, in Mpumalanga).

Some of South Africa's most historically problematic rivers for crocodile attacks (including the Usutu, the Pongola and its pans, and the Mkuzi River), have had few attacks since 2000, possibly offering proxy data that few crocodiles survive outside protected areas in these river systems in South Africa. Since 2000, there have continued to be attacks in the rivers listed in

Table 4, and St Lucia Lake and Estuary. Attacks since 2000 are listed separately as of more relevance for managers as they reflect more recent trends in attack incidence. Dams in or near waterways listed in Table 4, and in addition the Limpopo River (where crocodile populations may be recovering), should be regarded as higher-risk areas as they have more recent records of attacks. Of the 17 attacks recorded in eSwatini from 2000-2016, 65% occurred in the Usutu (or Lusutfu) River, and 29% on the Mbuluzi River.

Table 4 here

Victim demographics

The finding that it is mostly men (65%) that have been attacked in this region contradicts the assumption that 'in Africa' women and girls are disproportionately at risk because their domestic tasks at the water's edge (e.g. Lamarque et al. 2009: 19). The numerous attacks on females, most performing domestic chores, along the Pongola floodplain system in the 1960s and 1970s are atypical. Census data reveals a high proportion of women relative to men resident in this region in this period, with men away working as migrant labourers (Smedley & Ribeiro-Tôrres 1979). Our data shows that domestic chores have been a less important category since c.2000 in the wider region, reflecting both contracting crocodile range and improved water provision in some rural areas.

A key finding is that 51% of victims were children aged 0-15. That 62% of victims were aged 0-20 and the largest adult category was 21-30 (19%) may simply reflect the demography of the country (average age 25). Nevertheless, the high proportion of children, especially aged

11-15 years, 72.5% of whom were boys, suggests this should be a focus for concern and education.

The overall fatality rate from attacks was 49% (1949-2017), comparable to Thomas's (2006) findings for the Okavango Swamps (55%) and Maheritafika et al. (2016) for Madagascar (56%), but notably lower than the 63% estimated by Fergusson for Africa in general (2004). However, 57% of attacks on children 0-15 were fatal (N=65) and 54% of victims 0-20 were killed (N=79), in comparison with 40% of attacks on those aged 21+ (N=45). Fatality rates were influenced by whether the victim was accompanied or alone, and the size (length) of crocodile involved, as well as the victim. Smaller victims (children) are more vulnerable to fatal attacks as found in an analysis of factors affecting the survival of victims of saltwater crocodile attacks (Fukuda et al., 2015). We found that, of those adults who escaped death, 57% (29) escaped without help and 43% (22) were rescued, whereas only 35% (11) of children escaped unaided and 65% (20) were rescued.

Only 15 crocodiles involved in attacks were accurately measured, so size data could not be used as an accurate variable. Further, most crocodile counts have been made from fixed wing aircraft (pers. comm. Combrink 2018), so there is no general data on the size of crocodiles to enable comparison of fatal attacks with proportion of large crocodiles in wild populations. Comparing the length of crocodiles with fatality/non-fatality outcomes is complicated by age and size of victim, and whether there were rescuers present. More data is required to assess the relationship between size and deliberate attacks on humans by crocodiles in this region, though data from alligators and saltwater crocodiles suggest that animals measuring >1.8m can inflict serious injuries, and animals measuring 2.4m+ carry out fatal attacks (Caldicott et al. 2005; Fukuda et al. 2015).

Overall, most victims were swimming, bathing or fishing, but disaggregating data on activity of victim when attacked by age and gender reveals distinct profiles (Figure 5). Thomas (2006) and Wallace et al. (2011) found similar results in the Okavango Swamps (Botswana) and lower Zambezi (Zambia) respectively. Our data shows that until the 1980s, most victims were performing domestic chores or crossing water, but since then these activities have been superseded by swimming and fishing.

Management recommendations

For high risk areas, there are a number of mostly low-cost actions that can be taken. Local authorities can facilitate safe water crossings, and safe access to water for swimming (particularly near rural schools) or domestic needs, including alternatives like water tanks, piped water and protective enclosures.

Provincial conservation authorities and district municipalities could create, equip and train teams to capture and remove problem crocodiles. Where these already exist, it would be helpful to make such teams known to the public. If departmental resources are an issue, the U.S. system of licensing private individuals could be trialled (Dutton et al., 2014; King & Elsey, 2014). Some commercial crocodile farmers already provide this service on an ad hoc basis. Removing crocodiles requires the creation of clear protocols for disposing of captured crocodiles.

Educating children should be a priority, particularly in identified high risk areas. Outreach activities can be supported with existing materials (Pooley, 2015b, Pooley, 2017) which provide information on crocodile biology and behaviour, their ecological and conservation importance, as well as advice on avoiding and responding to attacks.

Provincial conservation authorities should appoint knowledgeable spokespersons to brief the public in the event of a crocodile attack (or alleged attack). Accurate reporting will be improved through keeping detailed records of attacks, and building better communication between the police and coroners and conservation authorities to ensure accurate information on causes of death are reported. In a region where crocodiles are farmed but not ranched, and taboos against the eating of crocodiles have recently been overturned (Viljoen, 2014; Zulu, 2015), tolerance of wild crocodiles should not be taken for granted.

Author contributions

SP drafted the paper, collected and collated attack data and historical information; XC and HB contributed insights on crocodile populations and management; GP performed statistical analyses and generated figures.

Acknowledgements

SP thanks Vince Egan, Tal Fineberg, Mick Reilly and Freek Venter for information on management policies. Figure 1 created by Andrea Ballatore & Michele Bush. SP is funded by the Lambert Bequest at Birkbeck.

Conflicts of interests: none

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Tables

Table 1: Country statistics for South Africa and eSwatini

	UNDP HDI and country rank (/188)	Population	Median age (years)	Unemployment (%)	% urban
South Africa	0.666 (119)	54.5m	25.7	25	64.8
eSwatini	0.541 (148)	1.3m	20.5	25.6	21.3

Note: all figures for 2015 (UNDP 2016)

Table 2: Major locations for crocodile attacks in South Africa and eSwatini (1949-2016)

River or other water body	**Provinces (S. Africa) or country (eSwatini)**	**Years in which attacks were recorded 1949-1999**	**Attacks 2000-present**
Pongola River and floodplain pans (including Ndumo Game Reserve)	KwaZulu-Natal	1952, 1954, 1960, 1963, 1964-67, 1969-72, 1986, 1988, 1990	2000
Lake St Lucia estuarine system	KwaZulu-Natal	1952, 1956, 1957, 1960, 1961, 1969,	2000, 2002, 2005, 2012

		1972, 1990, 1995	
Umfolozi River (and canals)	KwaZulu-Natal	1956, 1960, 1962, 1969, 1970, 1984, 1991, 1996, 1999	2005, 2010
Usutu River and linked pans (including Ndumo Game Reserve)	eSwatini / KwaZulu-Natal	1958, 1959, 1961, 1965, 1967, 1968, 1987	2000, 2001, 2003, 2007, 2008, 2009, 2011, 2013, 2015 (all eSwatini)
Komati River	eSwatini/ Mpumalanga	1957, 1984, 1986, 1987, 1989, 1992	2007, 2016
Mbuluzi River	eSwatini	1951, 1958	2002, 2004, 2007, 2011, 2014
Luvuvhu River	Limpopo	1958, 1972, 1980	2002, 2006, 2016
Hluhluwe River	KwaZulu-Natal	1949, 1951, 1957, 1983, 1987	2003
Mkuzi River	KwaZulu-Natal	1969, 1973, 1977, 1984, 1988	
Sabie River	Mpumalanga	1970, 1976, 1980	2001, 2003

Olifants River	Limpopo	1973	2010, 2014, 2015
Enseleni River	KwaZulu-Natal	1993, 1994	2000, 2004

Table 3: Victim activity when attacked, by age category and gender, where all details are known (N=187).

Activity Category	**Women (16+)**	**Men (16+)**	**Girls (0-15)**	**Boys (0-15)**	**Total**
Crossing waterways	11 (24% of women) (38% of crossing victims)	10 (15% of men) (34% of crossing victims)	6 (23% of Girls) (21% of crossing victims)	2 (4% of Boys) (7% of crossing victims)	29
Domestic Chores at water's edge	19 (42% of women) (56% of domestic chores victims)	1 (2%) (2% of men) (3% of domestic chores victims)	11 (42%) (42% of Girls) (32% of domestic chores victims)	3 (6%) (6% of Boys) (9% of domestic chores victims)	34
Fishing	6 (13% of women)	25 (38% of men)	2 (8% of Girls)	8 (16% of Boys)	41

	(15% of fishing victims)	(61% of fishing victims)	(5% of fishing victims)	(20% of fishing victims)	
Swimming or bathing	2 (4% of women) (4% of swimming victims)	18 (27% of men) (33% of swimming victims)	5 (19% of Girls) (9% of swimming victims)	29 (58% of Boys) (54% of swimming victims)	54
Other	7 (16% of women) (24% of ‘other’ victims)	12 (18% of men) (41% of ‘other’ victims)	2 (8% of Girls) (7% of ‘other’ victims)	8 (16% of Boys) (28% of ‘other’ victims)	29
Total	45	66	26	50	187

Table 4: Key areas and water bodies for attacks (2000-2016) N=49.

For each province, only the district municipality with most attacks are shown. For each district municipality, only rivers or river or lake systems ('key water bodies') with numerous attacks are shown. The Nseleni is linked to the Goedertrouw Dam.

South SouthAfrica	**Province**	**District Municipality**				
	<u>KwaZulu-Natal</u>	**Umkhanyakude**		**King Cetshwayo**		
key water bodies			St Lucia Lake System		Mhlatuze/Nseleni rivers system	
natural waterways	18	11	8	7	7	
dams and canals	1			1	1	
all attacks	19	11	8	8	8	
	<u>Limpopo</u>	**Vhembe**			**Mopani**	
key water bodies			Mutshindudi River	Luvuvhu River		Olifants River

natural waterways	16	9	4	3	6	3
dams and canals	5	1			2	
all attacks	21	10	4			3
	Mpumalanga	**Ehlanzeni**				
key water bodies			Sabie River			
natural waterways	5		2			
dams and canals	3		2			
all attacks	8		4			