5 Migrations

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A number of species have the unique lifestyle pattern of migration, either for mating or feeding. Some of these species migrate in and out of KZN coastal waters, resulting in a fascinating spectacle.

5.1 Crustacea Mass Migrations

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5.6 Whale Migrations

5.1 Crustacea Mass Migrations

Spectacular animal mass migrations are by no means limited to the vertebrates of the world. It is a universal phenomenon found in all major animal groups including birds, mammals, fish, reptiles, amphibians, insects and crustaceans (*Section 4.2*)[1].What prompts migration varies from climate triggers to food availability to requirements around breeding with some remarkable feats being reached by animals of all types.[2]

Although often small in body size, the epic journeys that many crustaceans undertake to feed or complete lifecycles are no less impressive. Well known examples are the daily movement of shoals of krill across the Southern Ocean, rising hundreds of metres to surface waters in the evening to feed and descending at daybreak to ocean depths to avoid predators.[3] Not all migrations follow diel (day and night) patterns, breeding mass migrations follow longer term biological cycles such as the long distance movements of juveniles of deep water *Panulirus* – a type of rock or spiny lobster.[4] Most interesting and certainly the most strikingly visible are crustacean mass migrations in the coastal environment. Well documented are the red crabs of Christmas Island in the Indian Ocean, where the synchronised mass movement of millions of crabs commence when tide and season are right. Adults emerge from burrows on the rainforest floor and walk in tight-lined platoons to the sea to breed.[5] Although crab movement to the sea has been recorded on this grand scale, few records exist of the reverse movement upstream. The earliest observation was almost a century ago in Calcutta, India where local drinking water intake pipes were physically blocked by small crustaceans on the return journey from the sea.[6]

At home in KZN, we have our own example of this type of reverse migration with this phenomenon having been observed frequently along our coast for many years. At particular times of year, generally harmonised with the new moon, millions of small, pea-sized scurrying creatures move from the ocean into the nearest estuary and swim upstream on the incoming tide,[7] looking for a home to metamorphose. These are the last swimming stage or megalopa larvae of *Varuna litterata,* otherwise known as the paddle crab. *Varuna* is widely distributed across the Indo-Pacific region, can reach 7 cm carapace width and has a tendency to colonise fresh waters as an adult to live and forage. However, despite long-range movements away from the coast, it is still compelled to return to the sea to breed.

Varuna's travels remain a mystery to the scientific world. Nothing is known of where eggs hatch or where larvae initially develop, only that they migrate back to estuaries to complete their development. Besides moving vast distances for its size, this animal is also a physiological marvel given the difficulties of moving directly between salt and fresh waters in a matter of days.

Varuna litterata megalopae undertaking their migration from the sea into coastal rivers.

Photo: Andrew Kemp

5.2 The Sardine Run

Each winter the KZN South Coast is gripped by sardine fever. Huge shoals comprising millions of the silvery little fish enter KZN waters providing a feeding frenzy for predators and a spectacle not to be missed! Although the sardine *Sardinops sagax* also occurs in Australia, Japan, Chile, Peru and California, the grand scale of this annual sardine migration from the southern Cape waters to KZN appears to be unique.

The earliest documented reports of the sardine run date back to the 1850s, and it continues to attract the attention of the public in the months of June to August each year. What gives rise to the sardine run and what the underlying biological reasons are, have been the subject of several studies which have proposed interesting theories and speculative answers over the years.

The winter run is a reproductive (not feeding) migration to KZN by part of the southern Cape sardine population. Once in KZN waters, the sardines spawn and their eggs and larvae drift down the coast to nursery areas on the Agulhas Bank off the southern Cape. It is not clear what proportion of the population undertakes the migration, but those sardines that do migrate could be genetically distinct from the rest of the population. In other words, they have evolved to undertake the migration, and continue to do so because it increases their chance of reproductive success.[1] Thus, although the migration is instinctive, decisions are made by the sardines as to exactly where to spawn, based on chemical signals in the water "remembered" from when they were in their egg and larval stages.

There are two theories as to why the migration first started. One suggests that, during the last ice age when the sea was much cooler, sardines used to live permanently off KZN, but as the sea warmed the sardines were forced to move further south in order to stay in cool waters, and some of the population still returns to KZN to spawn.

The other theory is that South African sardines originally only occurred in the southern Cape, but for unknown reasons, a shoal of sardines was diverted away from the normal

An expectant crowd gathers around a recently netted catch of sardines on the KZN coast.

Photo: Fiona MacKay

spawning grounds on the Agulhas Bank and ended up in KZN, where extremely high reproductive success led to this migration being ingrained in their behaviour.

In relation to the overall South African stock, the sardine population that occurs from east of Port Alfred up to KZN is very small, with an annual biomass (total weight of sardines) estimated at around 30 000 tons[2] and not all of which actually enters KZN waters.[3] This is extremely small when compared to the annual biomass on the Cape south and west coasts, which is between 500 000 to 4 million tons.[2] Catches off KZN also contribute very little to the annual total allowable catch of South African sardines; on average around 400 tons, compared to the combined south/west coast annual catches of around 130 000 tons.

Nevertheless, although the KZN run is small in terms of biomass, it is believed to inject a substantial amount (~25% of the organic nitrogen) into the KZN marine environment,[3] which is generally poor in nutrients. It also generates a great deal of local interest amongst recreational fishermen, because of the fish predators which accompany the sardines.[4] The public too are enthralled by the spectacle of whales, dolphins and a myriad of gannets chasing the shoals,[5] and because it is an opportunity to collect some free sardines for the table. The run has substantial economic importance for a wide range of communities, which have developed a raft of activities associated with it.[6; 7]

Although some years are perceived to have "good" or "bad" runs by members of the public or the beach-seine netters, this relates to whether or not the sardines came close inshore. In reality, the sardine run happens every year, but the size of the migration and its timing are determined by large-scale oceanographic processes, as discussed in *Section 2.3*. While the main water flow on the KZN South Coast and Transkei coast is from north to south, at times there is a current reversal, caused either by a giant eddy, which travels up the coast every 4-6 weeks, or by a meander down the Agulhas Current (called the Natal Pulse). In the months of June to August each year, the migrating sardines make their way up to an area off Waterfall Bluff in the northern Transkei, coming very close inshore to avoid the worst of the strong, warm, north-south Agulhas Current. Once there they are "trapped"; if they move out of the sheltered bay formed by the Bluff they will experience a strong current preventing their northward movement. However, if one of the southward-moving eddies or a Natal pulse passes by, this will cause an inshore current reversal, producing a south-north flow which can be several kilometres wide. This is the opportunity for the sardines to follow the current further north into KZN waters. This is known as the Waterfall Bluff gateway theory,[8] and is all about oceanographic conditions and timing that allow shoals of sardines to burst through the "gate" and make it up to KZN. Once off KZN, other factors, particularly cool, clear water, calm seas and slow currents have been shown to be critical in influencing whether the sardines come close enough inshore for it be considered a "good" sardine run.[5]

Of course, there is also the seldom-seen return migration back to the Cape; sardines are known to stay in KZN waters until at least November,[9] but on their way back they stay in much deeper, cooler water, using the prevailing north-south current flow to assist their passage home.

Gannet enjoying the sardine run feeding frenzy.

Photo: Jean Tresfon

5.3 The St Lucia Mullet Run

Historically, Lake St Lucia in northern KZN experienced a unique annual phenomenon known as the "mullet run". During the months of April/May each year, large shoals (measuring up to 10 km in length) of adult flathead mullet would migrate southwards from North Lake and False Bay through South Lake and the Narrows to the mouth of the estuary and out to sea to spawn.[1; 2; 3]

These dense spawning aggregations would often be accompanied by an abundance of predators, including Zambezi and blacktip sharks[1], pelicans[4] and Nile crocodiles[5]. While the sharks would normally enter the estuary from the sea, the pelicans and crocodiles would follow the shoals of mullet down through the estuary narrows and congregate at the mouth. The resulting feeding frenzy was spectacular to observe, with mullet leaping in all directions, being hotly pursued by sharks and crocodiles, while flotillas of pelicans would systematically herd the mullet into the shallows where they were easier to catch.

This phenomenon was believed to be very important ecologically, as it enabled the predatory species to fatten up and improve their condition before the onset of winter. The sheer abundance of mullet meant protection for many individuals in the dense shoals and the improved chance of successful spawning. It is believed that the mullet spawned at sea, in close proximity to the estuary mouth.[2] The fertilized eggs would hatch after approximately two days and the larvae remained at sea for at least two to three months before recruiting back into the estuary at 1-4 cm in length.[6]

Unfortunately, with the gradual degradation of the Lake St Lucia system, primarily through the reduced freshwater inflow, periods of hyper salinity and extensive illegal gill-netting,[7; 8] the mullet run has dwindled over the years. During the 1990s, relatively little mullet activity was observed in the estuary Narrows during April/May[9] and in 2002 the estuary mouth closed as a result of an extended drought in northern Zululand. Other than a brief six month opening following a storm surge event in March 2007, the estuary has remained closed to the present day. Although subsequent monitoring of Lake St Lucia's fish populations has revealed the presence of some flathead mullet in the system,[10] numbers are low and no evidence of the famous mullet run has been observed for nearly two decades.

Fortunately, relatively healthy flathead mullet populations still exist in the coastal marine environment and other KZN estuaries and, as a consequence, the species is not believed to be threatened.

St Lucia mullet run in the 1950s.

Photo: Provided by Ricky Taylor (original photographer unknown).

5.4 Game Fish Migrations

The coast of KZN is situated in a unique sub-tropical environment falling between the tropical Delagoa bioregion to the north of Cape Vidal and the warm temperate Agulhas bioregion to the south in the Eastern Cape. In summer, migratory or nomadic game fish species arrive from the tropical waters in the north, and in winter, warm temperate species move up from the cooler Cape waters in the south. Coastal communities eagerly await the arrival of these migrant species and benefit through tourism and the associated sale of fishing related goods and services.

The migratory species arriving in KZN are either pelagic, travelling in the water column or near the surface of the ocean; or demersal, moving along close to the seabed. Species such as shad or elf move up the coast close to shore and are important to shore-fishers, while others such as geelbek remain deeper offshore, often caught by ski-boat anglers. The strength of migrations is not constant and the number of migrating fish that arrive in KZN waters varies from year to year.

In winter, when the sea temperature off KZN is cooler, warm temperate species including shad, garrick, dusky kob, geelbek and seventy-four move up from the Cape to spawn in KZN waters. These are either endemic species, occurring nowhere else in the world (e.g. seventy-four) or are isolated populations of more widely distributed species (e.g. dusky kob, shad, garrick and geelbek).

During the summer, the Agulhas Current brings warm water down from the tropics. Tropical game-fish use this opportunity to migrate or extend their range down the coast towards KZN, sometimes moving as far south as the Eastern Cape. King mackerel, queen mackerel, dorado and yellowfin tuna are some of the main species that undertake this migration. In contrast to the winter migrants, summer migrants are all pelagic species that are widely distributed throughout the South West Indian Ocean.

Summer migrants are also generally not reproductively active while in KZN waters. Their presence is more likely to be a range extension of nomadic species rather than a true migration.[1] As such, seasonality in summer migrants is not as obvious as in the winter migrants. For example, large king mackerel will often remain in KZN waters until early winter, possibly delaying their northward return migration until the arrival of the rich bounty of sardines from the south, discussed in *Section 5.2*.

Shad/elf: a small migratory gamefish species commonly caught along the KZN coast during winter.

Photo: Jade Maggs

5.5 Whale Shark Migrations

The whale shark is the largest fish in the ocean, reportedly attaining lengths of 17 m, although individuals longer than 14 m are now rarely encountered. It occurs in all tropical and most sub-temperate waters and is capable of enormous movements across ocean basins.

The whale shark is generally solitary, although aggregations may occur in response to localized abundance of its food. In KZN, individuals are usually seen swimming at the surface, parallel to the coast, within 1 km of the shoreline.

For the last decade the KZN Sharks Board has been conducting aerial surveys to assess whale shark numbers and attain a better understanding as to their migrations. There are huge inter-annual variations in the density of whale sharks ranging from 0-1.6 sharks per 100 km of coastline in 2001/2002 to a peak of 4.5-21 sharks per 100 km in 2006. Subsequently, numbers have dropped and most commonly the densities are 5-10 sharks per 100 km. Although whale sharks may be present throughout the year, they are more abundant in the warmer months.[1]

Distribution along the coast is by no means uniform. The whale sharks are most common along the far northern KZN coast, from Cape Vidal to the Mozambique border. Few sharks have been recorded along the coast from St Lucia to the Thukela; this is undoubtedly due to the highly turbid water forcing them offshore or into slightly deeper water to avoid the silt. There is a second density peak 50-100 km south of Durban. At this stage there is no obvious explanation for the bi-modal distribution, but it is possibly linked to coastal oceanographic features (*Section 2.3*).

Whale sharks are prone to stranding on the South African coast[2] and the incidence of such events appear to be far higher than anywhere else in the world. In KZN, 61 strandings have been documented between 1984 and 2010, generally north of St Lucia or immediately south of Durban. Usually only a single shark strands, with a maximum of six strandings in a group. On very few occasions the shark has been found alive, and rescue attempts have been met with mixed success.

Whale sharks are highly nomadic and their presence along the KZN coast appears to be a range extension, with animals moving southwards from the tropics. In some parts of the world they aggregate in response to highly seasonal events such as mass coral or fish spawning. Although whale sharks do feed within KZN waters, their presence has not been closely linked to such events. Few of the sharks are large enough to be mature, so their occurrence on the KZN coast is not related to reproduction.

The whale shark is one of the few sharks protected by the *Marine Living Resources Act* because their habit of swimming slowly at the surface, close inshore, makes them vulnerable to damage from ship/boat strikes and harassment by divers. Most dive operators at Sodwana Bay adhere to a voluntary code of conduct for their clients, the aim of which is to reduce harassment of the sharks.

Majestic whale shark.

Photo: Lesley Rochat (www.lesleyrochet.com)

5.6 Whale Migrations

They may appear to be out of sight, but careful scanning of the horizon will often yield spectacles of whales blowing or breaching. In any year several hundred whales migrate along the coast of KZN. Most are one of seven species of filter feeding baleen whales: the blue, sei, fin, Bryde's, southern minke, humpback and southern right whales. Only one species of large toothed whale, the sperm whale, is known to migrate through the coastal waters of KZN.

The majority of the baleen whales migrate from high latitude summer feeding grounds to warmer winter breeding grounds, resulting in two annual peaks of abundance being recorded as they pass along the coast of KZN. Little is known of the low-latitude migratory destinations of blue, fin and sei whales.[1; 2]

Various studies have suggested that the blue whale migration to KZN waters precedes the other baleen whale species (April to June),[3] with fin whales migrating to and from high latitudes after the blue whales, but before sei whales.[4] It has also been suggested that sei whales migrate to the north of Durban each winter.[3; 5]

Migrating humpback whales utilise the KZN near-coastal waters as a migration corridor en route to and from their breeding ground in the shelf waters of Mozambique.[6]

Interestingly, migrating female humpbacks are segregated by reproductive class. Newly pregnant females are the first to leave the breeding ground, and the last to leave the feeding ground, maximising the period of feeding and blubber deposition. Females with new calves are the last to leave the breeding ground and the first to leave the feeding ground, minimising the calf's time in the cold feeding ground water in its first year.[7]

Baleen whale migrations generally appear to be linked to their reproductive cycles, with both mating and calving occurring in the warmer low latitude grounds while feeding occurs in the cooler high latitude grounds, replenishing the blubber reserves on which the whales survive during their migration.

Migration patterns of sperm whales in KZN waters show that males have a largely winter seasonality, while females have a higher abundance in summer.[8] Female sperm whales tend to remain in tropical and temperate waters, while male sperm whales migrate to Antarctic waters in summer.

The migrations of Bryde's whales in KZN waters are not well understood. Three stocks of this species are believed to occur in South African waters: the South East Atlantic stock along the west coast, the South African inshore stock (in waters over the continental shelf, and the South West Indian Ocean stock off the east coast including KZN).

Bryde's whale.

Photo: Jean Tresfon