Examining intra- and interspecific variability in the diet and carbon and nitrogen stable isotope ratios of kingklip and monkfish caught off the West and South coasts of South Africa

By

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Abstract

Kingklip (*Genypterus capensis)* and monkfish (*Lophius vomerinus*) and are ecologically and economically important demersal fish species that are found along both the eastern and western parts of southern Africa's coastline. Despite their commercial value, limited information exists focusing on the trophic ecology of these two species. This is the first study to make use of both stomach content analysis and stable isotope analysis to directly compare and examine the trophic ecology of *G. capensis* and *L. vomerinus* off the West and South coast of South Africa.

Stomach content data collected during routine annual demersal research surveys by the Department of Environment, Forestry and Fisheries (DEFF) off the West and South coasts from 1984 to 2017 were examined and the diet was quantified using an index of relative importance (*%IRI*) that was derived from three measures: frequency occurrence (*%FO*), numerical percentage (*%N*), and weight percentage (*%W*). Intra- and inter-specific differences in diet were assessed using *%IRI.* Stable isotope measurements (δ^{15}N and δ^{13}C) were also determined from the white muscle tissues of both species collected during DEFF research surveys from 2015 to 2019. General linear models (GLMs) were used to examine intra- and inter-specific differences in the isotopic composition (δ^{15}N and δ^{13}C) of both species off the West and South coast of South Africa.

The results of the stomach content analyses indicated that Callionymiform fishes were the most dominant prey items in the diet of *Genypterus capensis* on both coasts. Teleosts dominated the diet of *Lophius vomerinus* with Gadiformes the dominant prey order on the West coast and Perciformes dominating the diet along the South coast. Both species displayed a difference in diet between coast with a greater variety of species seen in the diet on the South coast. Due to their dietary differences the two species displayed restricted trophic interactions, with *Paracallionymus costatus* identified as one of the important shared prey species. Spatial differences in the δ^{15}N isotope values were noted between coasts with both species displaying higher δ^{15}N values on the West coast than on the South coast. Fish size was also significant in explaining the variability in δ^{15}N with values increasing with fish size, however this was restricted to *G. capensis* only. Fish size and coast explained most of the variability observed in the δ^{13}C model for *G. capensis* with coast and year accounting for the most variability in the δ^{13}C for *L. vomerinus.*

Overall, the stable isotope results were in agreement with those of the stomach content analyses. The increased dominance of larger teleost species in the diet of both species on the West coast along with higher mean $\delta^{15}N$ isotope values suggest a strong relationship between diet and habitat. This is the first study to directly compare the diets of these two species and has identified important prey species and provided insight into their trophic ecology. The importance of these two species to the demersal fishing industry means that this research can assist with the ecosystem approach to sustainable fisheries management.

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Chapter 1: Introduction

African waters are well known for their abundance of fishery resources, with South Africa being no exception (Belhabib et al. 2019). Three of the six African Large Marine Ecosystems (LMEs) fall within the most productive LMEs in the world, and the Benguela Current upwelling ecosystem off Namibia and South Africa is ranked third globally (Belhabib et al. 2019). A large portion of the commercial fishery industry is concentrated on the West coast, largely due to the influence of coastal upwelling in this region (Durholtz et al. 2015). South Africa's marine fishery sector generates significant social and economic benefits, in a country plagued by high levels of poverty and unemployment (Cochrane et al. 2020). In 2015, approximately 27 000 people were directly employed and another 80 000 – 100 000 indirectly employed in 22 sectors of the commercial fishery industry alone (DAFF 2016). A major contributing factor to those numbers came in 1994 when the fishing industry underwent transformation, with historically disadvantaged groups increasingly being employed in the industry. This transformation also led to the expansion of the demersal fishing industry through the allocation of rights to use longline vessels to harvest Cape hakes *Merluccius* spp. (Fairweather et al. 2006).

The importance of South Africa's fish stocks was first recognised as early as 1657 by Jan van Riebeeck (Thompson 1913). Jan van Riebeeck implemented the first recorded fishing regulation (in South Africa) allowing people to fish but "not for the sake of selling" in order to ensure that "agriculture may not suffer" (Thompson 1913). Fast track to 2020 and the fisheries management system in South Africa is widely regarded as being successful and effective (Cochrane et al. 2020). Pitcher et al.'s (2009) comparative study on the application of the ecosystem based management of fisheries ranked South Africa sixth out of thirty-three countries, with a similar study giving South Africa a Fisheries Management Index score of approximately 0,8 out of a possible 1,0 (Melnychuk et al. 2017).

The South African marine fishery sector ranges from the subsistence scale to the large-scale commercial demersal trawling industry (Cochrane et al. 2020). The biggest sector in terms of landings is that of the small pelagic fishes, which targets redeye round herring *Etrumeus whiteheadi*, sardine *Sardinops sagax* and anchovy *Engraulis encrasicolus*. The demersal trawling industry, which is one of South Africa's oldest fishery sectors (Durholtz et al. 2015), is the most valuable (Fairweather et al. 2006) and is concentrated on the West and South coasts of South Africa. With over 25 000 direct and indirect jobs and the value of annual landings exceeding ZAR5.2 billion this makes the hake fishing industry the most valuable South African fishery sector (Branch & Clark 2006, DAFF 2016). The importance of these various sectors can be gauged by the salaries paid and by the number of people employed (Branch & Clark 2006). The trawl industry is the biggest payer in terms of total salary followed by squid, linefish and pelagic fisheries (Cochrane et al. 2020).

The hake resources in South Africa are made up of two species, deep-water Cape hake *Merluccius paradoxus* and shallow-water Cape hake *Merluccius capensis* (DAFF 2016). Both species are targeted by four main fishery sectors, the deep sea sector and inshore demersal trawling sector, and the hake longline and hake handline sectors with up to 80% of all hake quota caught by the deep-sea trawling sector (DAFF 2016). Cape hake directed fishing only began around the end of the First World War with catches averaging 1 000 t per annum. Following World War II, catches escalated to reach 170 000 t in the early 1960s (DAFF 2016).

Two commonly caught by-catch species of this hake directed fishery are kingklip and monkfish, both of which have become economically important species in their own right. *Genypterus capensis* Smith, 1849 or kingklip (king of the rocks) is an endemic slow growing demersal species belonging to the Ophidiidae family. *Genypterus* is a strictly Southern Hemisphere genus with three representatives (Nyegaard et al. 2004): *Genypterus chilensis* occupying the East Pacific, *Genypterus blacodes* found in New Zealand waters and *Genypterus capensis* in southern African waters - specifically the South East Atlantic waters (Payne 1977, Punt & Japp 1994, Henriques et al. 2017). Considered a slow growing fish (Japp 1990), *G. capensis* can grow in excess of 150 cm in length and can attain an age of 24 years (Macpherson 1983, Punt & Japp 1994). Its body shape is similar to that of an eel, and is characterised by an orange to pink colouration and with dark spots located on the dorsal area (Nielsen & Prokofiev 2010).

The distribution of kingklip stretches from Walvis Bay in Namibia to Kwa-Zulu Natal on the East coast of South Africa (Payne 1977) (Figure 1). *Genypterus capensis* occur at depths ranging between 50 m and 800 m, normally in rocky areas on the continental shelf and slope (Japp 1990). It has been suggested that during the day they occupy burrows on the sea floor or caves in the rocky substrata (Macpherson 1983, Gibbons et al. 2000). As seen with *Lophius vomerinus* and other demersal species, *G. capensis* move further offshore as they get older (Badenhorst 1988, Japp 1990, Walmsley et al. 2005).

Literature focusing on the biology of *Genypterus capensis* is limited to certain aspects of feeding (Macpherson 1983), growth (Payne 1977, Morales-Nin 1980, Isarev 1982) and distribution (Macpherson 1984). The species is considered to be a nocturnal carnivore, frequently using ambush or stalking tactics when feeding (Macpherson 1983). Sexes are separate and are difficult to distinguish externally. From roughly 20 cm total length, gonads can be identified in fish of both sexes (Hecht 1976). Males tend to have a substantial dark red inner drumming muscle attached to their swim bladder, whilst females possess drumming muscles that are paler than those seen in the males (Japp & Hecht 1990).

The stock structure of *Genypterus capensis* around southern Africa is a source of major debate, with many arguing that it should be separated into a West coast stock and an East coast stock (Hecht 1976, Punt & Japp 1994, Henriques et al. 2017). The West coast stock extends from Cape Agulhas northwards to Namibia, whilst the East coast stock extends from Cape Agulhas eastwards to Port Elizabeth (Punt & Japp 1994; see figure 1). Earlier studies used the shape of otoliths and morphometrics to recommend that two stocks existed (Punt & Japp 1994). Payne (1977) proposed that three unique stocks occur around southern Africa: the “south-east stock” located on the eastern side of the Agulhas Bank, the “Walvis stock” located north of Walvis Bay and the “Cape stock” stretching from Lüderitz to south of Cape Town. Despite the differences that arise in age of maturity of kingklip between the West and South coasts, Japp & Hecht (1990) suggested that these changes are minor and are unlikely to be characteristics of separate stocks. A study using allozyme markers indicated that a single unique genetic stock existed (Grant & Leslie 2005). However, Grant & Leslie’s (2005) results have been superseded by a recent study by Henriques et al. (2017), who used mitochondrial and microsatellite genetic analyses. The latter authors suggest population sub-structuring, with a minimum of two genetic units noticed; one West coast and one South coast. Low levels of genetic differentiation between the two indicated significant gene flow between them, and Henriques et al (2017) suggested that management should consider the population as two independent stocks. This two stocks approach displays a depleted but fairly healthy stock on the West coast with the South coast stock fully exploited (Brandão & Butterworth 2008).

It has been suggested that the spawning season for the southern kingklip stock begins in Spring (August to October) whilst the western stock begins spawning in April through to July (Winter) (Olivar & Sabatés 1989). The spawning period for the southern stock coincides with decreasing water temperatures over the Agulhas Bank (Olivar & Sabatés 1989). The powerful easterly winds associated with spring often leads to inshore advection, which increases the survival chances of larvae and eggs as they are advected towards the shallower waters associated with the Agulhas Bank (Japp & Hecht n.d.). In the Western stock however, larvae first appear in May and increases in numbers to June (Olivar & Sabatés 1989). The maximum concentration of larvae was recorded in July when there were reduced signs of upwelling (Olivar & Sabatés 1989).

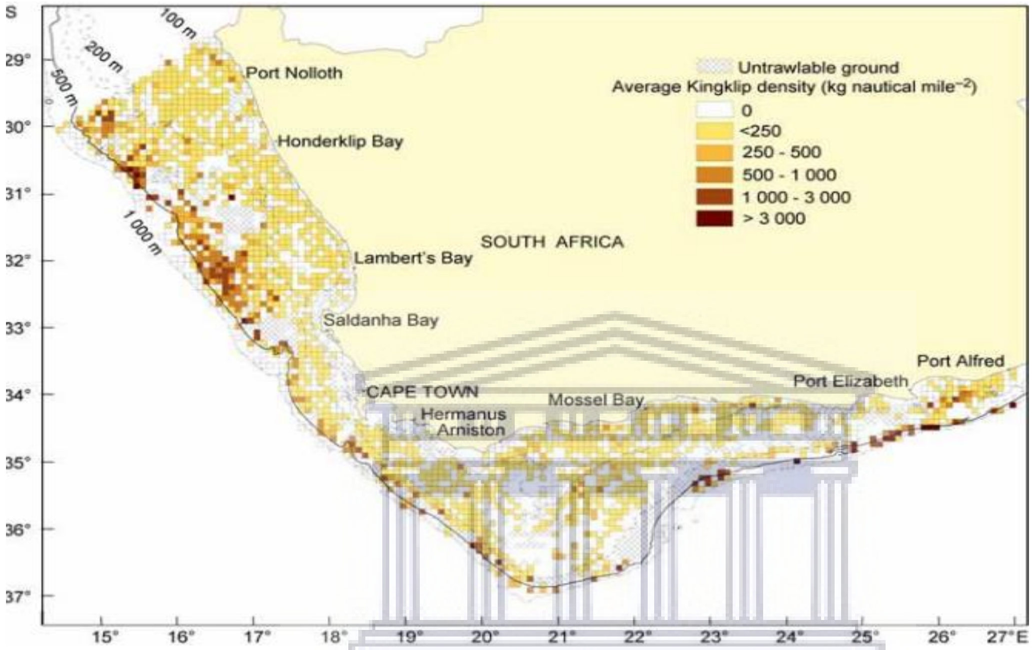

Figure 1: Distribution of *Genypterus capensis* off western and southern South Africa, compiled from demersal trawl research surveys. Average densities were calculated from survey catches over the period 1984–2015 and are illustrated per sampling grid block (DAFF 2016).

Genypterus capensis preys primarily on fish, with hakes (*Merluccius* spp.) making up a substantial proportion of their diet (Kattner et al. 1994). Invertebrates such as crabs and squid are also commonly eaten. Macpherson's (1983) study examined the diet of *G. capensis* off Namibia, and suggested that *G. capensis* are nocturnal feeders that capture their prey through stalking, or by ambush. The frequency of larger prey items increases with fish length (Macpherson 1983). The diet of Namibian *G. capensis* was considered by Macpherson (1983) to be broadly similar with regards to the major taxa consumed, with the southern individuals mainly feeding on *M. capensis* and the northern individuals on macrourids. These differences in diet can be regarded as a reflection of the abundance and distribution of *Merluccius* spp. (Macpherson 1983).

Lophius vomerinus is found in waters off southern Africa. It belongs to the order Lophiiformes, and was first described by Ahille Valenciennes in 1837 (Smith et al. 2012). Lophiiform fishes are commonly known as anglerfishes, and the group is made up of a diverse array of strictly marine fish found throughout the world’s oceans (Fariña et al. 2008). This order contains 65 genera within 18 families that are spread among five suborders: Ceratioidei, Antennarioidei, Ogcocephaloidei, Chaunacoidei and Lophioidei (Fariña et al. 2008). This southern African species is one of seven recognised extant species within the genus *Lophius* with *L. vomerinus* occurring from northern Namibia on the West coast of southern Africa to Durban off the East coast of South Africa (Maartens et al. 1999) (Figure 2). Of these seven species, six occupy both coasts of the Atlantic with *Lophius litulon* the only species found elsewhere in the Northwest Pacific (Yoneda et al. 2001). The genus *Lophius* is phylogenetically the most derived, with dispersal having played an important function as the key force driving speciation (Fariña et al. 2008).

Morphologically, species of the genus *Lophius* are characterised by their dorsoventrally flattened body, large head, wide mouth with numerous teeth, a relatively small body, and the absence of scales and a swim bladder. Individuals possess a unique first dorsal fin ray that acts as a lure (illicium), giving rise to their name of anglerfishes (Fariña et al. 2008). Almost all species of the order possess an illicium that is made up of a cutaneous excrescence from tip to base and is exceptionally flexible and can rotate in any direction (Maartens et al. 1999, Fariña et al. 2008). When moving, the illicium is thought to mimic the movement of a benthic worm through the water.

The most common environment of the genus *Lophius* is bathydemersal, a region which extends from the continental shelf down to depths in excess of 1 000 m: it is often found on muddy substrata (Maartens et al. 1999, Walmsley et al. 2005, Fariña et al. 2008). In their early stages of development (eggs and larvae) they remain within the water column, but once they develop into juveniles they move deeper and take up a more benthic habitat (Fariña et al. 2008). As seen in other demersal fish species, larger individuals are frequently found deeper offshore than smaller individuals (Badenhorst & Smale 1991). Distribution data from Walmsley et al. (2005) suggest that the distribution of both juvenile and adult *Lophius vomerinus* frequently overlap, resulting in fish of varying ages being susceptible to fishing activities. On average, the lifespan of *L. vomerinus* is approximately 17 years, and individuals are capable of reaching lengths in excess of 1 m (DAFF 2016).

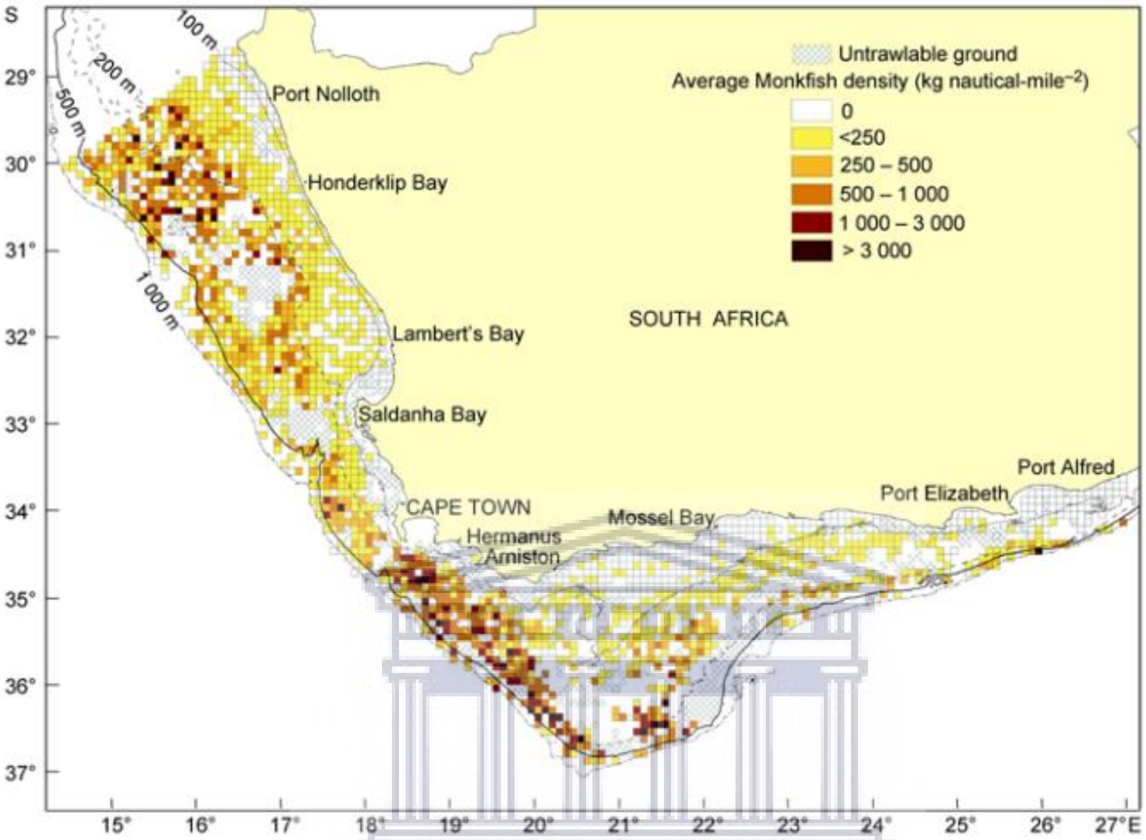

Figure 2: Distribution map of *Lophius vomerinus* off western and southern South Africa, compiled from demersal research surveys. Average densities were calculated from survey catches over the period 1984–2015 and are illustrated per sampling grid block (DAFF 2016).

Lophius vomerinus reproductive organs are similar to that of other species within the genus, but are very different from other teleosts (Afonso-Dias & Hislop 1996, Fariña et al. 2008). It is difficult to determine the sex of juveniles as both the ovaries and testes are small (Walmsley et al. 2005). In many other *Lophius* species, females mature at a substantially larger size than males, although this may not be the case for *L. vomerinus* (Walmsley et al. 2005). The lengths at 50% maturity of *L. vomerinus* off South Africa are the same for the two sexes, at 37 cm TL. In contrast, Maartens & Booth (2005) observed a different pattern in the same species in Namibian waters, with females maturing at 58,2 cm and males at 39,9 cm. Female *L. vomerinus* begin spawning in spring (September) when they release their eggs in single veils that contain in excess of a million eggs allowing for extensive dispersion and to increase survival chances against predators (Armstrong et al. 1992, Fariña et al. 2008). Various studies have suggested that the gonad mass of a fully grown spawning female can be between 35 to 50% of the total body mass of the fish (Armstrong et al. 1992, Yoneda et al. 2001, Walmsley et al. 2005). Spawning during spring allows the larvae to take full advantage of the spring phytoplankton and zooplankton blooms (Walmsley et al. 2005).

Meyer & Smale (1991) have shown that many South African demersal fish display a strong positive correlation between the sizes of the predator and their prey; as evidenced too by *Lophius vomerinus* feeding on *Merluccius* spp. (Walmsley et al. 2005). The diet spectrum of species in the genus is known to be strongly size dependent (Fariña et al. 2008). Simply put, bigger fish eat bigger prey, however prey size choice can be ascribed to visual or sensory factors as well (Fariña et al. 2008). Demersal species such as the ladder dragonet (*Paracallionymus costatus)* and pelagic teleosts such as redeye round herring are common prey items of *L. vomerinus* (Walmsley et al. 2005). Monkfish are considered opportunistic feeders and all share a common feeding strategy (Fariña et al. 2008). These "sit and wait predators" attract the attention of their prey through the movement of their illicium (Pietsch & Grobecker 1978, Maartens et al. 1999). During a single lure sequence the illicium is brought close to the mouth and is rapidly vibrated for one or two seconds and then is held stationary (Pietsch & Grobecker 1978). Prey species moving close to the illicium are then engulfed by the monkfish's large mouth.

In their study focusing on the feeding ecology of *Lophius vomerinus* off the West and South coast of South Africa, Walmsley et al. (2005) noticed a high proportion of empty stomachs, suggesting to them that *L. vomerinus* only attempts to capture prey when certain of a positive result. This is a strategy also shared with other *Lophius* species (Crozier 1985, Armstrong et al. 1996, Thangstad et al. 2002, Laurenson & Priede 2005, Fariña et al. 2008). European species of *Lophius* are known to feed within the water column, having been caught as bycatch by the Icelandic pelagic longline fishing industry (Hislop et al. 2000). The presence of flatfish (such as *Cynoglossus zanzibarensis*) within the *Lophius* diet also suggests that *L. vomerinus* might have alternative ways of securing prey (Walmsley et al. 2005). Isolated reports suggest that whilst not regularly occurring, cannibalism does occur, with most cases seen in *L. americanus,* in which predation by adult conspecifics is known to be quite common (Armstrong et al. 1996).

Both *Genypterus capensis* and *Lophius vomerinus* are important commercial species along the West coast of southern Africa (Punt & Japp 1994, Walmsley et al. 2005) where they are caught as part of both directed fisheries and as by-catch of the hake fishing industry (Badenhorst & Smale 1991, Punt & Japp 1994). Both *Genypterus capensis* and *Lophius vomerinus* are popular delicacies in South African resturants due to their firm texture, white flavourful meat and low-in-fat flesh. Records of *G. capensis* caught bytrawling exist from the early 1930s (Figure 3) (DAFF 2016, Henriques et al. 2017), and between the 1930s and 1940s annual trawl bycatches of *G. capensis* varied between 400 t and 700 t with the bycatch peaking in 1973 with a total annual bycatch of 5 800 t caught primarily along the south coast (DAFF 2016). The use of longlines for a *G. capensis* directed fishery only began on an experimental basis in 1983, but as this was implemented at the same time as the species was caught as a bycatch of the trawl fishery, there were concerns regarding potential overexploitation (Japp 1990). Ten South African vessels initially received longline permits, but only three of these were activated (Badenhorst & Smale 1991). In 1986, close to 11 000 t of kingklip were harvested and in 1990 that amount dropped substantially to roughly 2 500 t (Figure 3) (Brandão & Butterworth 2008). Following the closure of the *G. capensis* directed longline fishery in 1990, a rapid increase in trawl bycatch was noted (DAFF 2016). After the hake-directed longline fishery opened in 1994, bycatch of *G. capensis* reached a peak in 2002, when close to 6 000 t were harvested (DAFF 2016, Henriques et al. 2017). Following a decline in bycatch in both the hake trawl and longline fisheries, an annual 3 000 t Precautionary Upper Catch Limit (PUCL) was implemented in 2006 (de Moor et al. 2015) and presently the PUCL is set at 5 000 t.

Lophius vomerinus is one of the most sought after demersal fish species (Walmsley et al. 2005) often marketed as “mock crayfish”, *L. vomerinus* is a high value product due to being targeted by small operators with reduced hake quotas (Walmsley et al. 2005). The first available data on *L. vomerinus* catches came from the Cape hake trawl fishery in 1974, and until 1994 the total catches fluctuated around 4 700 t per annum (Figure 4) (DAFF 2016). Overall, the annual catch is small compared to that of hake with roughly 5 000 to 6 000 t caught each year (Leslie & Grant 1990). At its peak, 10 000 t were harvested in 2001, an amount that rasied concerns about sustainability (DAFF 2016). A PUCL of 7 300 t was formally introduced in 2006 with the years following seeing the limit slightly exceeded due to lack of sufficient monitoring and management (DAFF 2016).

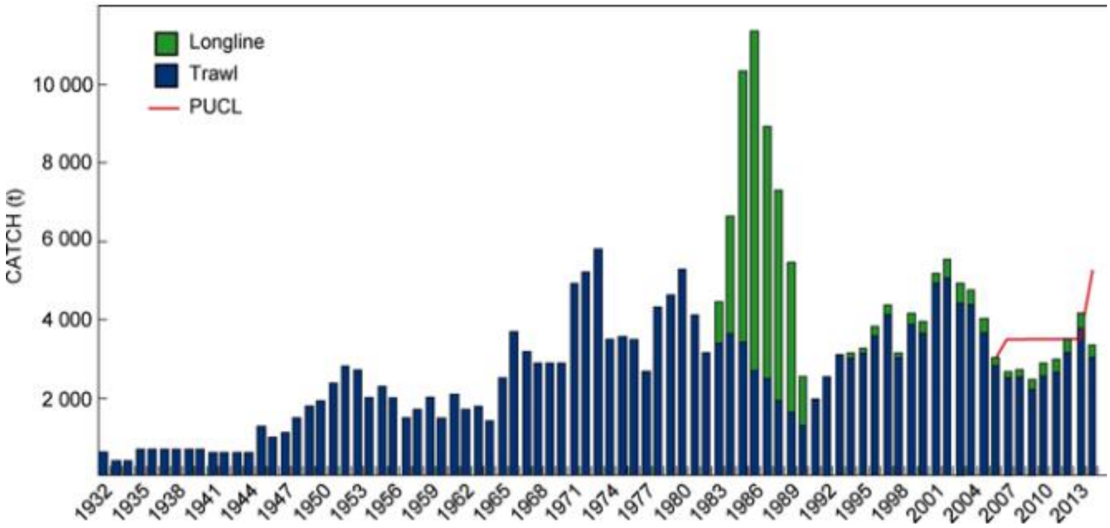

Figure 3: Annual catches of *Genypterus capensis* (tons) landed by the hake trawl 1932 - 2014 and longline 1983 - 2014 fisheries, and the Precautionary Upper Catch Limit (PUCL: red line) that was introduced in 2006 (DAFF 2016).

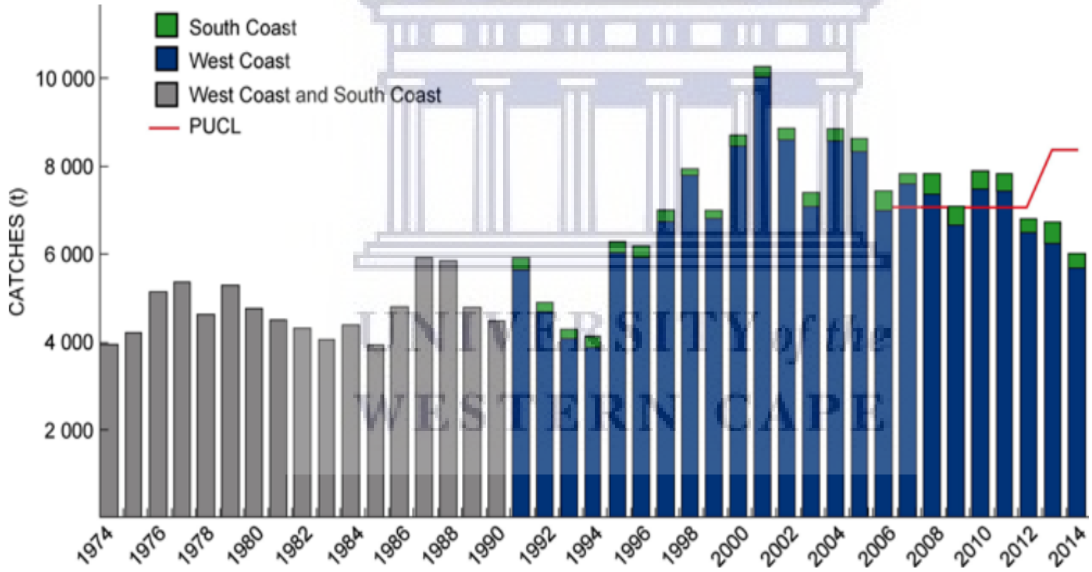

Figure 4: Annual catches of *Lophius vomerinus* (tons) landed by the hake trawl and longline fisheries by coast for the period 1932 – 2014, and the Precautionary Upper Catch Limit (PUCL: red line) that was introduced in 2006 (DAFF 2016).

Comparative studies focusing on the trophic ecologies of South African demersal species are rare, and no study has directly compared (i.e. using the same methods and samples of the two species collected in the same place and at the same time) the trophic ecologies of kingklip and monkfish. Both species occupy similar habitats and trophic levels but have different morphologies and different feeding methods. Previous studies looking into the diet of these species (especially kingklip) are possibly outdated as the pressure of constant fishing is known to have a substantial impact on demersal fish communities and have been observed off South Africa (Currie et al. 2020).

There are two ways in which the trophic ecology of organsims can be evaluated: indirectly through food web models or directly through dietary measurements such as stomach content analysis and stable isotope analysis (Jennings & Van Der Molen 2015). The study of the diet of marine fish has frequently relied on stomach content analysis (SCA) (Hyslop 1980). This method allows for diet items to be identified at relatively high levels of taxonomic resolution, however it also has the potential to overestimate certain prey items based on how difficult thery are to digest (e.g. otoliths or squid beaks) and also only provides a temporal snapshot of diet, defined by digestion time. Macpherson (1983) suggested that this method is fairly accurate for smaller predators and that overestimation is only a potential issue in larger fish, which often prey on large and/or less digestable prey. In the case of monkfish which are known to ambush prey present in the trawl net, there is a further complication as it becomes difficult to seperate natural prey consumed from prey ambushed in the net (Lopez 2014).

Whilst the diet and feeding patterns of both monkfish and kingklip off southern Africa have been studied through the use of stomach content analysis (Macpherson 1983, Walmsley et al. 2005), none have made use of stable isotope anaylsis (SIA). As noted above, stomach contents analysis only allows for the identification of recently consumed prey items with some prey items unidentifiable. Although stable isotope analysis gets around this problem by providing a temporally intergrated signal of the diet, it has the disadvantage that actual prey species cannot be directly identified, however dietary compositions can be estimated using stable isotope data from potential prey, in isotope mixing models (Phillips et al 2014). SIA has therefore become a complementary tool for ecologists as it provides information on both the predator and the assimilated prey (Ramos 2012, Hussey et al. 2014).

Isotopes are forms of the same element that are different with regards to the number of neutrons that are present within the nucleus (Fry 2010). It is this difference in neutrons that results in certain isotopes being considered “heavy” and others “light”. For example, an additional neutron in the ^{13}C isotope makes the nucleus heavier than that of a ^{12}C isotope (Fry 2010). The most frequently used elements for stable isotope analysis are nitrogen, carbon, oxygen, hydrogen and sulphur, and it is their isotopes that allow ecologists to reconstruct diets, study foodwebs and estimate trophic positions. The majority of the ecological studies present the isotopic compositions in terms of δ values that are derived using the formula:

$$\delta X = [(R_{samples}/R_{standard}) - 1] * 10^3 \qquad (1)$$

where the symbol *X* represents the standardised isotopic signature (e.g. $\delta^{13}C$, $\delta^{15}N$) in parts per thousand (‰), *R* represents the ratio of the heavy to light isotope (^{13}C, ^{15}N) in both the sample and standard respectively (Fry 2010). The δ values reflect the amount of light and heavy isotopes present in the sample. An increase in the δ value denotes an increase in the amount of heavy isotope components whereas a decrease in the δ denotes a decrease in the heavy isotope content (Fry 2010).

This technique is built on the idea that stable isotope ratios that are present in the prey items will also be reflected in those of the consumer (Bearhop et al. 2004). The reason for this lies in the metabolic process identified as fractionation (Fry 2010). Organisms preferentially sequester heavy isotopes relative to light isotopes with each trophic transfer through trophic fractionation, by the preferential loss of light isotopes during respiration and/or preferential sequestration of heavy isotopes during digestion and/or assimilation (Peterson & Fry 1987). Because of this process we are aware that predators (consumers) will preferentially assimilate heavier isotopes ($\delta^{15}N$) and eject lighter isotopes ($\delta^{14}N$), resulting in a known stepwise enrichment process (around 3,4 ‰) from the prey to the consumer (Peterson & Fry 1987). $\delta^{13}C$ is known to also increase from prey to predator but at a reduced rate (less than 1 ‰ per trophic level) than $\delta^{15}N$. The relatively large increase of $\delta^{15}N$ from prey to predator allows ecologists to compare and estimate an organism's trophic position in relation to that of others (DeNiro & Epstein 1978, Peterson & Fry 1987). Stable isotope analysis complements other methods of studying diets since the information reflects the assimilated diet in both slow and fast turnover tissues providing ecologists insight into food webs of the past and diets of animals that are difficult to observe (Peterson & Fry 1987, Fry 2010). In recent years this understanding has come under scrutiny with Hussey et al (2014) suggesting that the food webs and species interactions derived through nitrogen stable isotopes have been over simplified.

Whilst there is limited information regarding the stable isotope ecology of monkfish and kingklip, numerous studies have successfully used SIA to study both the diet and trophic pathways of other marine taxa. (Iitembu 2016, Bosley et al. 2014, van der Lingen & Miller 2014). Parkins (1993) used stable nitrogen and carbon isotope ratios to study the trophic relationships in Cape hake, *M. capensis* on both the West and South coasts of South Africa. It was found that small and large hake appear to feed at different trophic levels with the bone collagen and muscle tissue of large hake enriched in $\delta^{15}N$ by 2 - 4 ‰ relative to small hake tissues. Parkins (1993) suggested that smaller hake could be considered secondary consumers, having more positive $\delta^{15}N$ values relative to their prey (zooplankton). In the case of large hake, stable carbon and nitrogen isotope ratios are a useful tool for estimating diets longer than six months.

More recently, van der Lingen & Miller (2014) made use of SIA to compare the trophic ecology of economically important co-occurring hake species, *Merluccius capensis* and *M. paradoxus*. The study focused on determining the importance of inter- and intra-specific effects in explaining the variability seen in the trophic ecology of *M. capensis* and *M. paradoxus*. Through using SIA together with existing dietary knowledge gained from previous studies it was proposed that *M. capensis* fed at a trophic level (TL) higher than that of *M. paradoxus,* with both species displaying an ontogenetic shift in TL. Iitembu (2016) conducted a similar study looking into the diet of the same species off the coast of Namibia using both stable isotopes and stomach content analysis. This author noted that the results of SIA and SCA differed, and suggested that SCA was imprecise (Iitembu 2016). The study tried to address this issue with the use of stable isotopes in which SI values of hakes (predators) and SI values of potential prey were both used to estimate the diet using isotopic mixing models, and it was found that the data derived from the SCA seemed to overestimate the contributions of certain prey items in the diet of the two species. Using both techniques, the study supports the impression that it is possible to reduce the bias associated with stomach content analysis.

Elsewhere, Bosley et al. (2014) made use of both methods (SCA & SIA) to explore the feeding ecology of juvenile rockfishes (*Sebastes* spp.) off the coast of Oregon and Washington. The study found that the diet of the rockfishes consisted of items regularly found in the waters where they were captured, whilst the stable isotopic compositions reflected the diet of an offshore origin (Bosley et al. 2014). This suggested that the rockfish were new arrivals to the area. This study illustrates that used together, both analysis types can further assist in the understanding of the diet of a species in both the short and long term.

1.1. Objectives of the study

The aim of this study is to examine the trophic ecology of two southern African demersal species, *Genypterus capensis* and *Lophius vomerinus*, using stable isotope and stomach content analysis. The combination of both stable isotope analysis and stomach content analysis can potentially provide new insights into both species thus furthering our understanding of their trophic ecology.

The specific objectives are:

- to compare and contrast the diet compositions of two commercially important species, *G. capensis* and *L. vomerinus* collected off both the West and South coasts of South Africa using stomach content analysis, and to quantify the diet of both species in terms of their numerical abundance, frequency of occurrence, weight percentage and Index of Relative Importance.
- to assess whether there are inter-annual differences in diet and/or long-term changes in diet with reference to previously published results.
- to determine spatial variability in the isotopic composition ($\delta^{15}N$ and $\delta^{13}C$) of *G. capensis* and *L. vomerinus* around South Africa, and
- to investigate intra- and inter-specific differences in the trophic ecology of both species using both techniques.

Chapter 2: Methodology

2.1 Study location

The study area extends from the Namibian border with South Africa to Port Alfred in the Eastern Cape province of South Africa (Figure 5). The South coast is regarded here as extending from Cape Agulhas (20°E) to Port Alfred (27°E), stretching out from the coast to the 1 000 m depth contour. The West coast study site extends from Cape Agulhas to the Namibian border and also extends out from the coast to the 1 000 m depth contour (Figure 5).

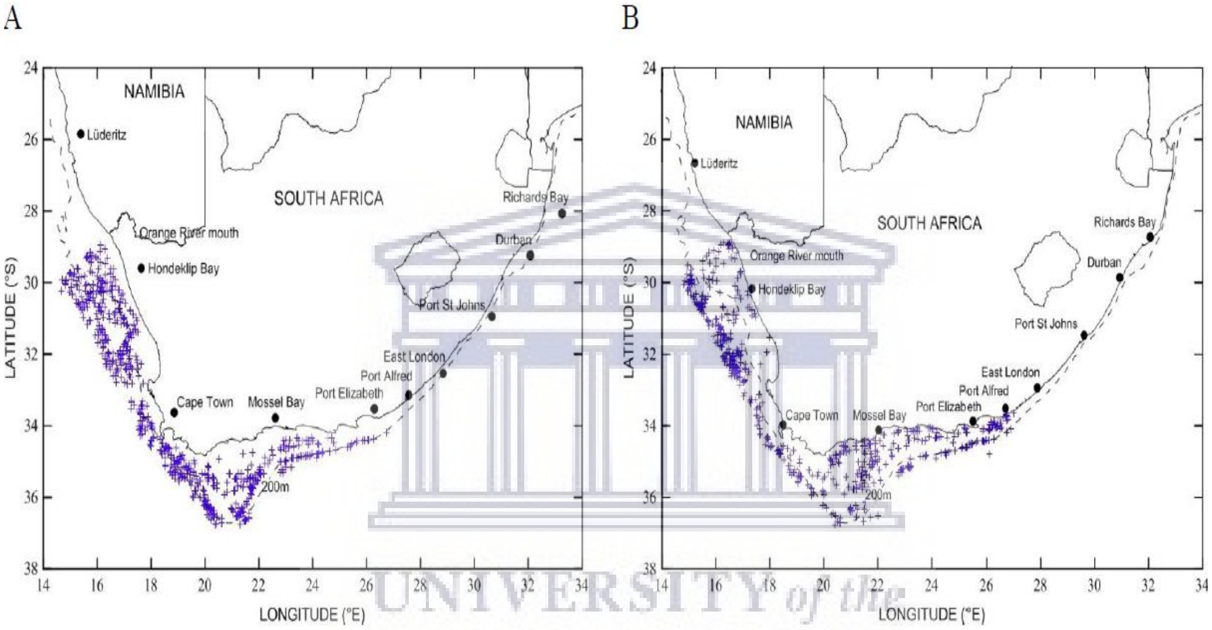

Figure 5: Locations (+) of demersal trawls from which *Lophius vomerinus* (**A**) and *Genypterus capensis* (**B**) were collected during research surveys performed during annual DEFF Demersal surveys from 1984 to 2017 (Guerra 2019)

2.2 *Survey design, sampling and sample analysis*

Most of the sampling took place on board the *FRV Africana*, with the more recent surveys performed on the commercial vessel *Compass Challenger*. West coast sampling took place during Summer (January through to February) whilst South coast sampling took place during Autumn (March – June) and Spring (September and October). Random trawling stations were selected for each depth stratum (0-100 m, 100-200 m, 200-300 m, 300-400 m, 400-500 m, 500-600 m, 600-700 m) along the coast with the number of stations proportionate to the area of each stratum (Atkinson et al. 2011). Each trawl was conducted during daylight hours and lasted 30 minutes from the time the net touched the seabed (Payne et al. 1985). Prior to 2003, the trawl gear consisted of 2-panel 180-foot German trawl nets coupled with a rope-wrapped cable footrope and 50 m sweeps, 32 mm diameter trawl warp and 1,5 t WV otter boards (Yemane et al. 2010). The equipment used from 2003 saw the replacement of the 2-panel net with a 4-panel 180 ft trawl net with a modified rockhopper footrope (DEFF, pers. Comm 2019).

Stomach content data for both species from both coasts have been recorded routinely from samples collected during annual surveys since 1984; the most recent set of biological data used in this study being collected in 2017. Biological data (length, sex and maturity stage) for all monkfish and kingklip that were caught were recorded on board, and a subsample of each species was selected for SCA. Each fish selected from a subsample was individually weighed (g), measured to the nearest 0,5 cm, Total Length (TL) and sexed. Stomachs were removed from the abdominal cavities and dissected in order to identify the various prey items, and to observe both the digestion state and stomach fullness state (L. Singh, DEFF, pers comm). The contents of each stomach sampled were assigned a digestion state ranging from 0 to 4 depending on the state of the prey items found in the stomach, with 0 referring to “eaten in net” and 4 referring to “only traces”. In this study, only the contents of stomachs in digestion state 1 (very fresh) and 2 (partially digested) were analysed, as this increases the chance of correctly identifying prey items. Stomach fullness state was estimated as 0%, 25%, 50%, 75% or 100%. Stomach contents were placed on a petri dish, identified (to the lowest taxonomic level where possible), counted, and weighed to the nearest 0,01 g. The number of prey items found in each stomach was recorded and prey items that were intact were measured to the nearest cm. It was not always possible to directly measure some prey items though in these cases identifiable anatomical parts were selected to estimate the prey size Richardson et al. (2000).

Stable isotope samples were collected over the period between 2016 and 2019 during research surveys conducted by the Department of Agriculture, Forestry and Fisheries (now DEFF – Department of Environment, Forestry and Fisheries). Samples of dorsal muscle tissue measuring between 2 – 4 cm^3 were removed from freshly caught specimens of both species for SIA, and immediately frozen at -20 °C. These samples were collected from specimens of a diverse size range caught at a variety of different depths on both coasts. For consistency, every effort was made to ensure that muscle tissue was removed from the same body regions for all specimens.

In the laboratory, muscles tissues were left at room temperature to thaw. Once thawed the epidermal layer of skin was removed leaving a clean piece of muscle tissue. Each sample was then placed into a 5 ml vial and then freeze-dried for 48-72 hours. Each piece of muscle tissue was then individually homogenised using a pestle and mortar that was cleaned between uses by rinsing with distilled water and then drying in a preheated oven at 70 °C for 20 minutes. Homogenised samples were then transferred to labelled 5 ml vials and sent to the Stable Light Isotope Laboratory at the University of Cape Town. Here, approximately 0,5 mg aliquots were transferred into tin cups and then precisely weighed to four decimal places on a Sartorius M2P microbalance. The cups were then enclosed and combusted in a Flash 2000 organic elemental analyser (Thermo Scientific, Bremen, Germany) coupled to a Delta V Plus isotope ratio mass spectrometer (IRMS) (Thermo Scientific, Bremen, Germany), via a Conflo IV gas control unit (Thermo Scientific, Bremen, Germany). The analytical accuracy of the instrument used was 0,10 ‰ for $\delta^{13}C$ and 0,04 ‰ for $\delta^{15}N$. Recognised standards were used to allow for comparison with sample units, with nitrogen being expressed relative to atmospheric nitrogen and carbon being expressed relative to Vienna Pee-Dee Belemnite (PDB). In SIA analyses it is normal procedure to employ a lipid normalisation equation to samples that display a C:N ratio > 3.5. In the present study however, lipid normalisation was not required as the C:N ratio was below 3.5 for all samples analysed.

2.3 Analysis of diet

To analyse the composition of the diet and contribution of each food item to the diet, four parameters were calculated, as described below.

Percentage Frequency of Occurrence (%FO)

This is perhaps the simplest method of summarising data as it is merely a process of recording the number of stomachs containing one or more individuals of each prey category (Hyslop 1980) and was calculated as

$$\%FO = \frac{ni}{n} \times 100 \qquad (2)$$

whereby dividing the total number of stomachs that contained a prey item from a specific prey category (*ni*) by the total number of stomachs (*n*) that contained prey, multiplied by 100 (Hyslop 1980). This method depends strongly on the correct identification of any prey item or its remains. Percent frequency of occurrence is particularly useful in circumstances where it is difficult to determine the exact numbers or weight of each prey category due to digestion and/or mastication (Buckland et al. 2017). By comparison with the other two methods (i.e. $\%W$ & $\%N$), this method regularly provides the most robust measure of the dietary structure as it is known to provide the most unambiguous and consistent results (Buckland et al. 2017).

Numerical percentage (%N)

This numerical method is a relatively simple provided the prey items can be correctly identified and counted. Percentage number ($\%N$) was calculated using the formula

$$\%N = \frac{n}{\sum n} \times 100 \qquad (3)$$

whereby dividing the total number of prey items from a prey category (*ni*) by the total number of all prey items from all prey categories (Σ*n*), multiplied by 100 (Hyslop 1980). A major limitation of this method is that the importance of small prey items can sometimes be overestimated when seen in great numbers (Hyslop 1980). This method also has the potential to get complicated when prey items are not eaten whole resulting in a reduced ability to quantify masticated prey (Buckland et al. 2017).

Percent by weight (%W)

When employing the percent by weight method certain aspects must be taken into consideration such as the digestion rate of prey items along with the order in which ingestion occurs and how much cannot be ingested (Hyslop 1980). This method has the potential to over emphasize the importance of rare and heavy prey items, whilst discounting the importance of abundant small prey items that are relatively easy to digest (Hyslop 1980). Here the total weight of a prey category is expressed as a percentage of the overall weight of stomach contents. Percentage by weight ($\%W$) was calculated using the formula

$$\%W = \frac{wi}{\sum w} \times 100 \qquad (4)$$

whereby dividing the total weight of all prey items from a prey group (*wi*) by the total weight of all prey items from all prey groups (Σ*w*), multiplied by 100 (Hyslop 1980).

Index of relative importance (%IRI)

The importance of individual prey groups in the diet of *Genypterus capensis* and *Lophius vomerinus* was estimated using the Index of Relative Importance (*IRI*). This method combines the percentage by number (%*N*), weight (%*W*) and frequency of occurrence (%FO) in the formula

$$IRI = (\%N + \%W) \times \%FO \qquad (5)$$

(Hyslop 1980, Dale et al. 2011). The IRI values are then converted to a percentage (*%IRI*) using the formula

$$\%IRI = \frac{IRIi}{\sum IRI} \times 100 \qquad (6)$$

which allows for comparisons between prey taxa (Dale et al. 2011). This measure also enables easy comparisons of fish diets with other studies (Cortés 1997). However, unquantifiable errors related with each separate measure coupled with differences in taxonomic resolution of prey quantities can make comparisons between studies impossible (Baker et al. 2014).

2.4. Statistical analysis

2.4.1 Stomach content data

Data from all the surveys were combined and then analysed by year. To properly analyse intra- and inter-specific diet patterns, histograms of *%IRI* were constructed for both species by pooling data by depth stratum, coast and size class. For the purposes of this of study, fish were divided into three different size classes based on length at birth and maturity: < 50 cm, 51-100 cm and 101-150 cm TL in the case of *Genypterus capensis*; and < 37 cm TL, 37-45 cm TL and >45 cm TL for *Lophius vomerinus*. Prey items that were recorded in more than 10% of the stomachs (i.e. *%FO* > 10) were considered important as were items for which *%IRI* was > 10.

In order to test for effects of species, coast, depth and size-class on diet, the stomach content data (N) were first square root transformed and a similarity matrix based on the Bray-Curtis Index was computed between specimens using PRIMER v6 +PERMANOVA (Clarke & Gorley 2001). The matrix was visualised using nonmetric multidimensional scaling (nmMDS) and hierarchical cluster analysis. An analysis of similarity (ANOSIM) was used to test whether there were significant differences in dietary composition between species, size, depth and coast. Resulting R values from the ANOSIM analysis range between 0 and 1 and indicate the level of similarity between groups, with values close to zero indicating similarity and values close to 1 indicating greater differences. Ordination plots were constructed to provide a clear and easy to interpret representation as they contain a point for each dietary sample. When significant differences were noted, similarity percentages routine (SIMPER) was applied to determine the main prey groups most responsible for any variation in diet within both species.

2.4.2 Stable isotope analysis

General Linear Models (GLMs) were used to examine inter- and intra-specific differences in the isotope data. δ^{15}N or δ^{13}C values were selected as the dependent variables in separate GLMs with Species, Coast and Year set as the independent variables and fish size and sampling depth used as the covariates. Interaction terms were also used to test for intraspecific differences in isotope data between species*coast. To visualizethe range of δ^{15}N and δ^{13}C isotope values the raw isotopic data were used to construct isotopic biplots of δ^{13}C against δ^{15}N. The effect of fish size on isotope ratios was examined by plotting δ^{15}N and δ^{13}C values against total length and fitting linear regressions to the data for each species off each coast. The correlation coefficients were used to assess the strength of the relationship along with p-values used to determine the significance. All statistical tests were conducted in IBM SPSS Statistics 23, with results being considered significant at an alpha level of 0,05.

Chapter 3: Results

3.1 Stomach content analysis

The stomach contents of 1 810 *Genypterus capensis* and 650 *Lophius vomerinus* were examined, with the earliest recorded sample dating back to 1984 and the most recent being 2017. In total 869 *G. capensis* and 214 *L. vomerinus* were sampled from the South coast and 941 *G. capensis* and 436 *L. vomerinus* were sampled from the West coast (Table 1). The average length of kingklip was 70 cm on the South coast and 71 cm on the West coast (Table 1), whilst equivalent measures for monkfish were 49 cm and 42 cm, respectively. The depth distribution of kingklip sampled differed by coast (Figure 6), with fish being caught at deeper depths on the West than on the South coasts. By contrast, most monkfish specimens sampled were caught within the 200 m depth class (1 m – 200 m), though they were more common at depth on the West than South coast (Figure 6).

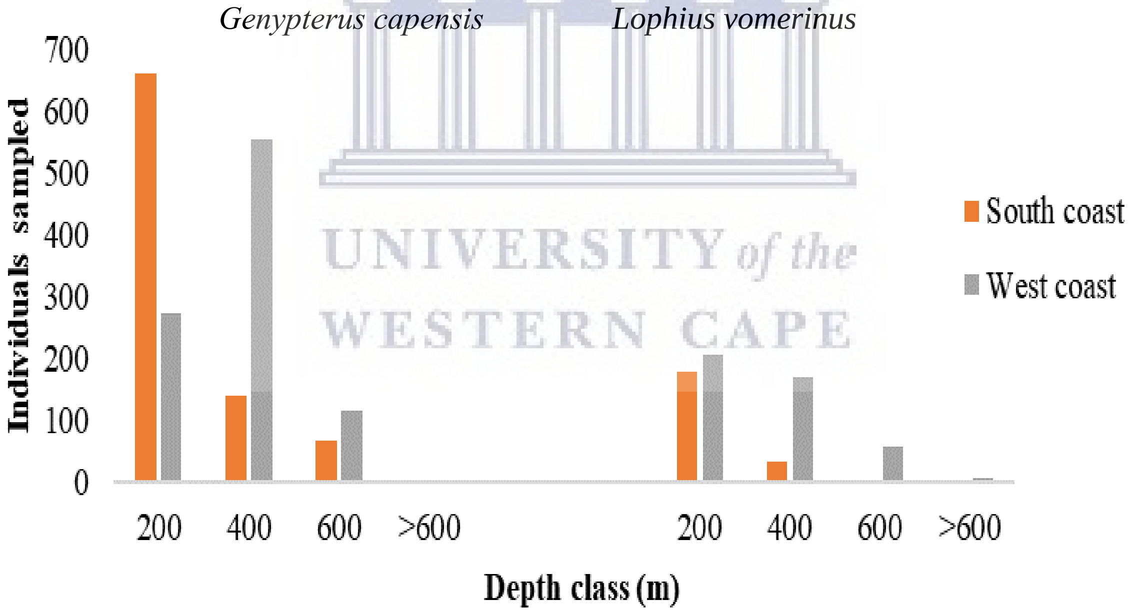

Figure 6: Histogram illustrating the distribution of individuals sampled at each depth stratum for *Genypterus capensis* and *Lophius vomerinus* on the South and West coasts.

Table 1: The number (*n*), average size and size range of *Genypterus capensis* and *Lophius vomerinus* sampled on the South and West coasts for stomach content analysis.

	Genypterus capensis			*Lophius vomerinus*		
Coast	n	Average size (cm, TL)	Size range (cm, TL)	n	Average size (cm, TL)	Size range (cm, TL)
South coast	869	69,7	19,0-133,0	214	49,3	18,0-96,0
West coast	941	71,3	25,0-130,0	436	41,5	8,0-82,0

Specimens of both species sampled on the South coast had a wider size range than those sampled on the West coast (Table 1). Most kingklip were between 60,1 – 70 cm TL accounting for 26% percent of the samples on both coasts combined (Table 3). The majority of monkfish were between 40,1 – 50 cm TL with 30% and 34% of the specimens sampled on the South coast and West coast, respectively, falling into this size class. Although there was much interannual variation in the number of specimens sampled, more tended to be collected during the 1990s (Table 2). In all years fewer monkfish were sampled than kingklip. It is important to note that these numbers are not representative of all samples collected, as this study only focused on fish displaying a digestion state of 1 (very fresh) and 2 (partially digested).

Table 2: Number of *Genypterus capensis* and *Lophius vomerinus* with digestion state of 1 and 2 collected on the South and West coasts of South Africa from 1984 to 2017.

Year	***Genypterus capensis***		***Lophius vomerinus***	
	West coast	South coast	West coast	South coast
1984	2	-	-	-
1986	-	18	32	-
1987	44	7	19	-
1988	-	28	-	-
1989	4	30	2	1
1990	30	30	11	-
1991	30	87	15	2
1992	64	50	12	6
1993	60	95	19	20
1994	29	58	18	9
1995	51	65	25	7
1996	61	8	15	3
1997	41	78	10	6
1998	-	-	-	-
1999	35	21	20	4
2000	38	25	11	-
2001	17	11	-	10
2002	37	-	-	-
2003	36	8	20	7
2004	41	7	29	3
2005	-	12	-	4
2006	53	50	24	8
2007	8	39	2	28
2008	50	49	15	32
2009	37	32	19	36
2010	46	23	14	2
2011	47	35	15	21
2012	71	-	48	-
2013	-	-	-	-
2014	-	-	-	-
2015	-	-	-	-
2016	-	3	-	5
2017	9	-	41	-
Total	**941**	**869**	**436**	**214**

Table 3: The number (*n*) of *Genypterus capensis* and *Lophius vomerinus* analysed for stomach contents onthe West and South coasts of South Africa, by size class; average size also shown.

	Genypterus capensis				***Lophius vomerinus***			
	South Coast		West Coast		South Coast		West Coast	
Size class (cm)	n	Average length (cm, TL)	n	Average length (cm, TL)	n	Average length (cm, TL)	n	Average length (cm, TL)
0 – 10	0	0,0	0	0,0	0	0,0	2	9,0
10,1 - 20	1	19,0	0	0,0	3	18,3	5	15,2
20,1 - 30	16	27,9	9	28,4	11	27,5	73	26,4
30,1 - 40	44	36,5	24	35,0	51	36,7	150	36,0
40,1 - 50	68	45,3	51	46,2	65	44,7	110	44,9
50,1 - 60	97	56,1	148	56,5	38	55,8	59	55,0
60,1 - 70	210	65,7	227	65,6	24	63,8	30	64,5
70,1 - 80	222	75,3	212	75,1	14	75,9	6	78,3
80,1 - 90	128	85,0	149	84,7	6	85,0	1	82,0
90,1 - 100	39	94,6	88	94,2	2	93,5	0	0,0
100,1 - 110	19	104,6	28	104,6	0	0,00	0	0,0
110,1 - 120	18	115,6	3	117,7	0	0,00	0	0,0
120,1 - 130	7	124,6	2	130,0	0	0,00	0	0,0

3.2. Diet of Genypterus capensis

Chordates (fishes) and arthropods (crustaceans) were identified as the most important phyla eaten, and made up the majority of the prey in terms of *%W*, *%N*, *%FO* and *%IRI*. Of the chordates, members of the class Actinopterygii were dominant and 57 different species of prey were recorded from fish across both coasts. The ladder-dragonet, *Paracallionymus costatus*, was the dominant prey species on both coasts (Appendix 3), followed by the benthic stomatopod *Pterygosquilla armata capensis*. Other prey items that were frequently consumed on the West coast include the prawn (Decapoda) *Funchalia woodwardi* and small teleosts such as the banded whiptail *Coelorinchus simorhynchus* and the bearded goby *Sufflogobius bibarbatus*. On the South coast, other frequently consumed prey items were the redspotted tonguefish *Cynoglossus zanzibarensis* and the cuttlefish *Sepia australis*. Numerous other prey species such as the deep-sea crab *Chaceon chuni*, shrimp *Plesionika martia* and sardine *Sardinops sagax* were recorded, but they were generally of negligible importance *(%IRI*) (Appendix 3).

As noted above, fish of the order Callionymiformes dominanted the diet on both coasts (Figure 7 and Appendix 3), with stomatopods and decapods and pleuronectiform fishes also important on the West and South coasts, respectively (Figure 7). Gadoid fishes were important prey only on the West coast (Figure 7).

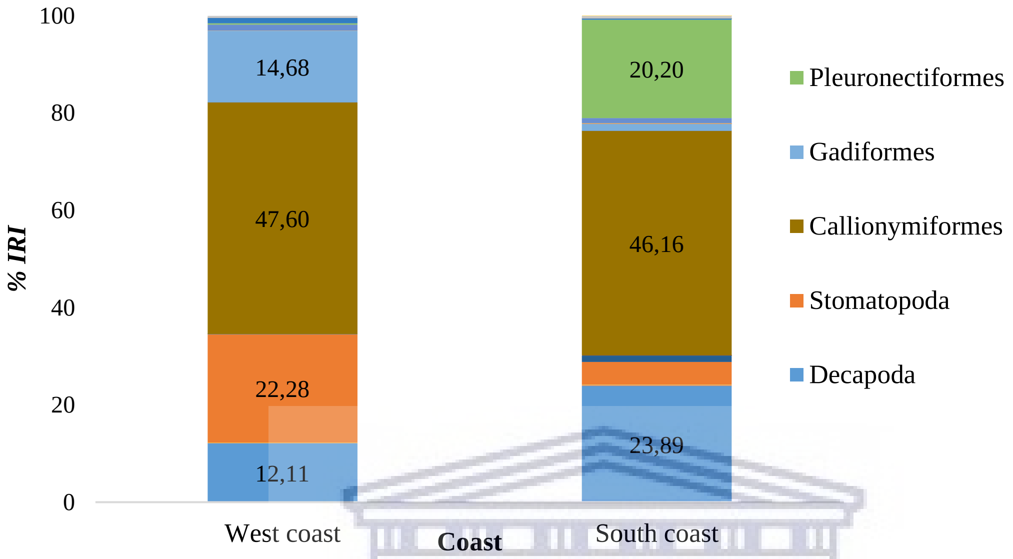

Figure 7: Major prey orders (*%IRI*) identified in the diet of *Genypterus capensis* on the West and South coasts. Data labels and legend represent prey orders that contributed IRI > 10 % of the diet on either coast.

3.2.1. Diet of Genypterus capensis by depth

West coast: at depths less than 200 m stomatopods dominated the diet (*P. armata capensis*), followed by Callionymiformes (*Paracallionymus costatus*) (Figure 8A, Appendix 4). The latter taxon was also important between 201 – 400 m depth, though Gadiformes and decapods were also eaten. At greater depths, Gadiformes dominated the diet (Figure 8A). **South coast:** species of Pleuronectiformes (*Cynoglossus zanzibarensis*), and not stomatopods, were the most important prey at the shallowest depths (Figure 8B, Appendix 3), but just as on the west coast, Callionymiformes (*Paracallionymus costatus*) dominated the diet at depths between 201 - 400 m (Figure 8B, Appendix 4). A relatively wide diversity of teleosts (ladder-dragonet, shovelnose grenadier *Coelorinchus braueri*, jacopever *Helicolenus dactylopterus, Coelorinchus simorhynchus* and the deep-water Cape hake *Merluccius paradoxus*) comprised the diet of fish caught between 401 - 600 m (Appendix 4), whilst species of Macrouridae (grenadier) were the only prey items recorded at depths >600 m. (Appendix 4).

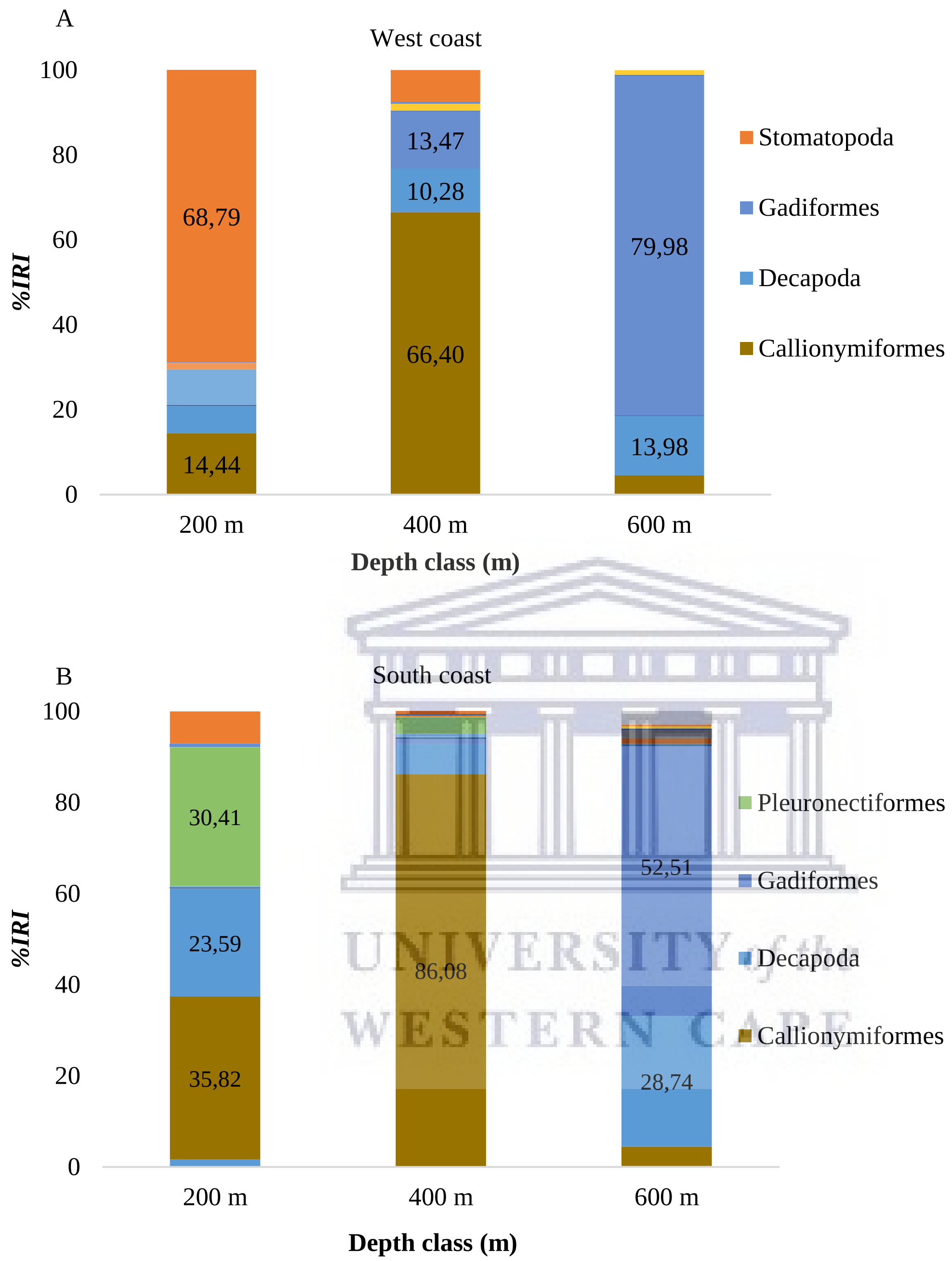

Figure 8: Major prey orders (*%IRI*) identified in the diet of *Genypterus capensis* on the West (**A**) and South (**B**) coasts in three different depth classes. Data labels and legend represent prey orders that contributed IRI > 10 % of the diet on either coast.

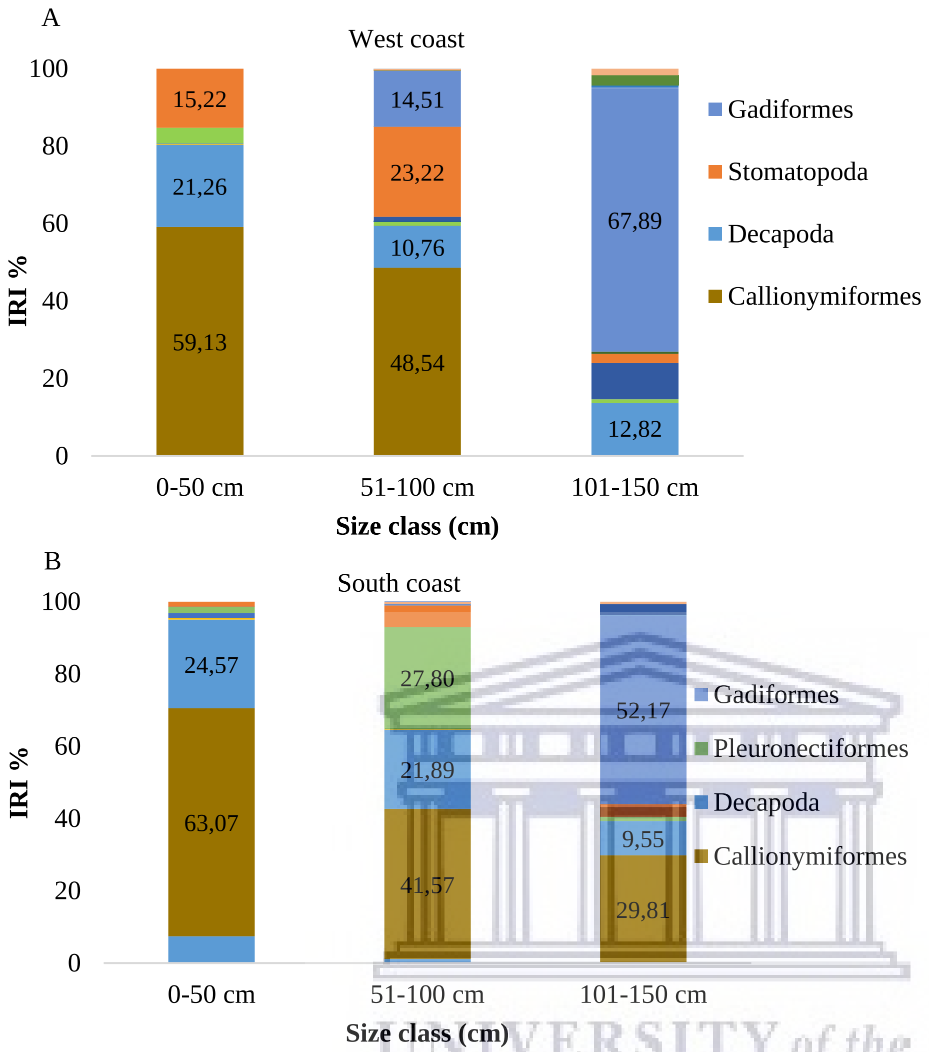

Figure 9: Major prey orders (*%IRI*) identified in the diet of *Genypterus capensis* on the West (**A**) and South (**B**) coasts by size class (TL). Data labels and legend represent prey groups that contributed to > 10 % of the diet in each size class.

3.2.2. Diet of Genypterus capensis by size

Callionymiformes were found to be an important prey order across all size classes, except for the largest size class on the West coast (Figure 9A). Kingklip less than 100 cm preyed predominantly on Callionymiformes and Decapoda (Appendix 7). Gadiformes and Pleuronectiformes were also frequently consumed in the 51 – 100 cm size class but to a lesser extent (Figure 9, Appendix 7). Within the 101 - 150 cm size class, on the West coast gadoids and decapods were found to be the most important prey orders (Figure 9A). Considering

%IRI, Callionymiformes appeared to be more important than Decapoda in the diet of small (< 50 cm) kingklip on the West coast likely due to their comparatively higher *%W* than that of Decapoda (Appendix 3, Appendix 7).

At the species level, *Paracallionymus costatus* was identified as the single most important prey item on both coasts having been recorded in all size classes with high *%FO* and *%IRI* values. *Pterygosquilla armata capensis*, *Paracallionymus costatus* and *Cynoglossus zanzibarensis* were found to be important prey items in the 51 - 100 cm size class. Larger teleosts such as *Merluccius paradoxus*, *Coelorinchus braueri* and *Coelorinchus simorhynchus* were important dietary items in the largest size class. The only occurrence of cannibalism was observed in the largest size class, with a notable *%W* but low *%FO* and *%N*. There appeared to be a pronounced decrease in the *%W* of Decapoda with increasing size on both coasts (Appendix 4, Appendix 7). Despite dominating the diet of *G. capensis* across all three size classes, Callionymiformes (*Paracallionymus costatus*) displayed a notable decrease in *%W* with increasing fish size.

Gadiformes displayed the most notable increase in average prey weight (g) in two of the three size classes on the West coast (Figure 10A). Gadiformes also contributed the most in terms average prey weight (g) on both coasts particularly in the largest size class. Pleuronectiformes only displayed a substantial prey weight in the 51 – 100 cm size class on the West coast (Figure 10A). Gadiformes and Pleuronectiformes displayed the highest average prey weight (g) on the South coast with large individuals the most common size (Figure 10B). The average prey weight of the various prey orders was also considerably higher on the South coast for the largest *G. capensis* (Figure 10B).

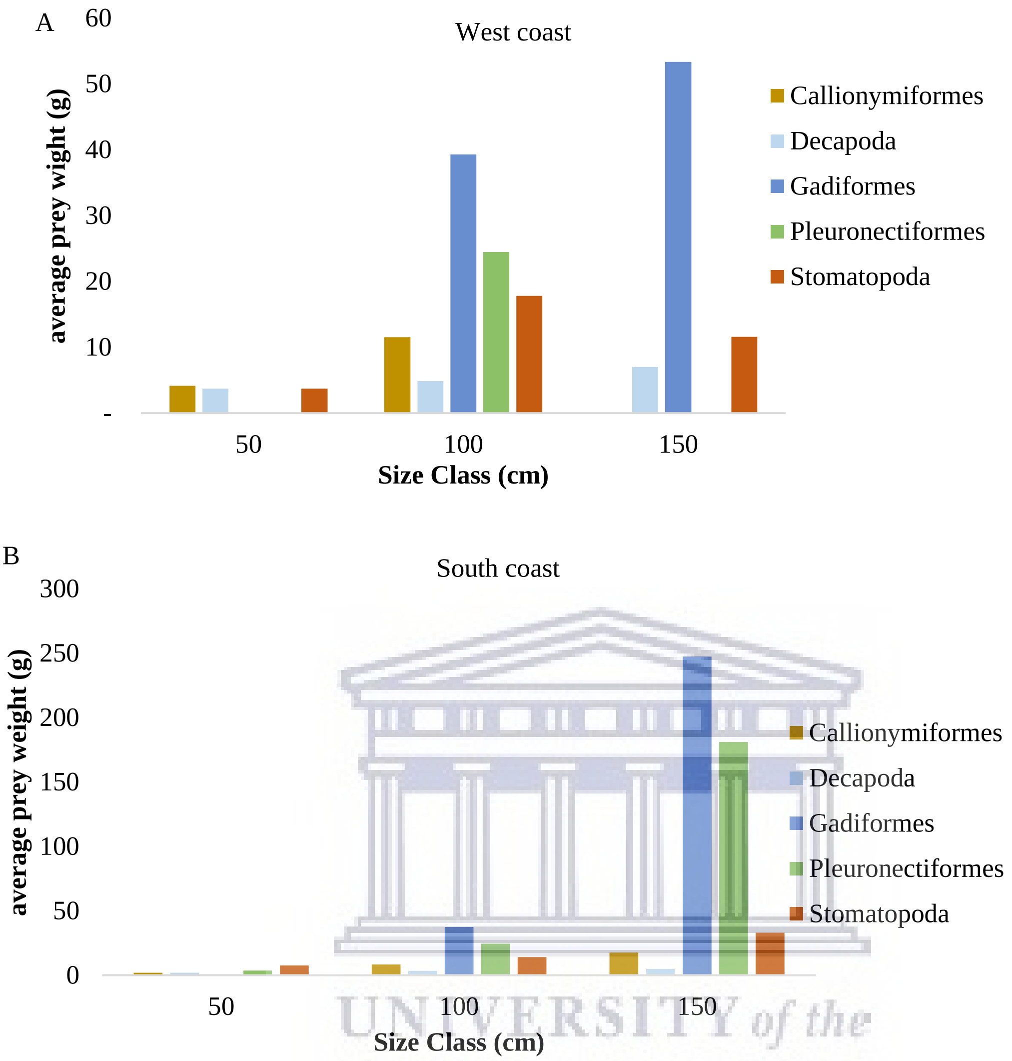

Figure 10: Illustrating the average weights (g) of the major prey orders consumed by small, medium and large *Genypterus capensis* on the West (**A**) and South (**B**) coasts.

3.2.3 Interannual variability in the diet of Genypterus capensis

A variety of different prey orders were recorded in the time period (1984 – 2015) with the five main orders (in terms of *%IRI*) being Callionymiformes, Gadiformes, Decapoda, Stomatapoda and Pleuronectiformes. Callionymiform fishes featured heavily in the diet on both coasts through the time period with Decapoda also common on both coasts. On the West coast Callionymiform fishes were frequently (but not always) the dominant prey order in the mid to late 1990s and featured throughout the 2000s. Decapoda were generally the lowest contributers of the top five prey orders on the West coast, only dominating in 1990 and again in 2006 (Figure 11A). Stomatopoda were also an important prey group in the time period featuring consistently in the 1990s and dominating the diet in 1984, 1989, 1993 and 2001. Gadiformes featured sporadically in the 1990s but became more important in the early 2000s dominating in 2002 (Figure 11A).

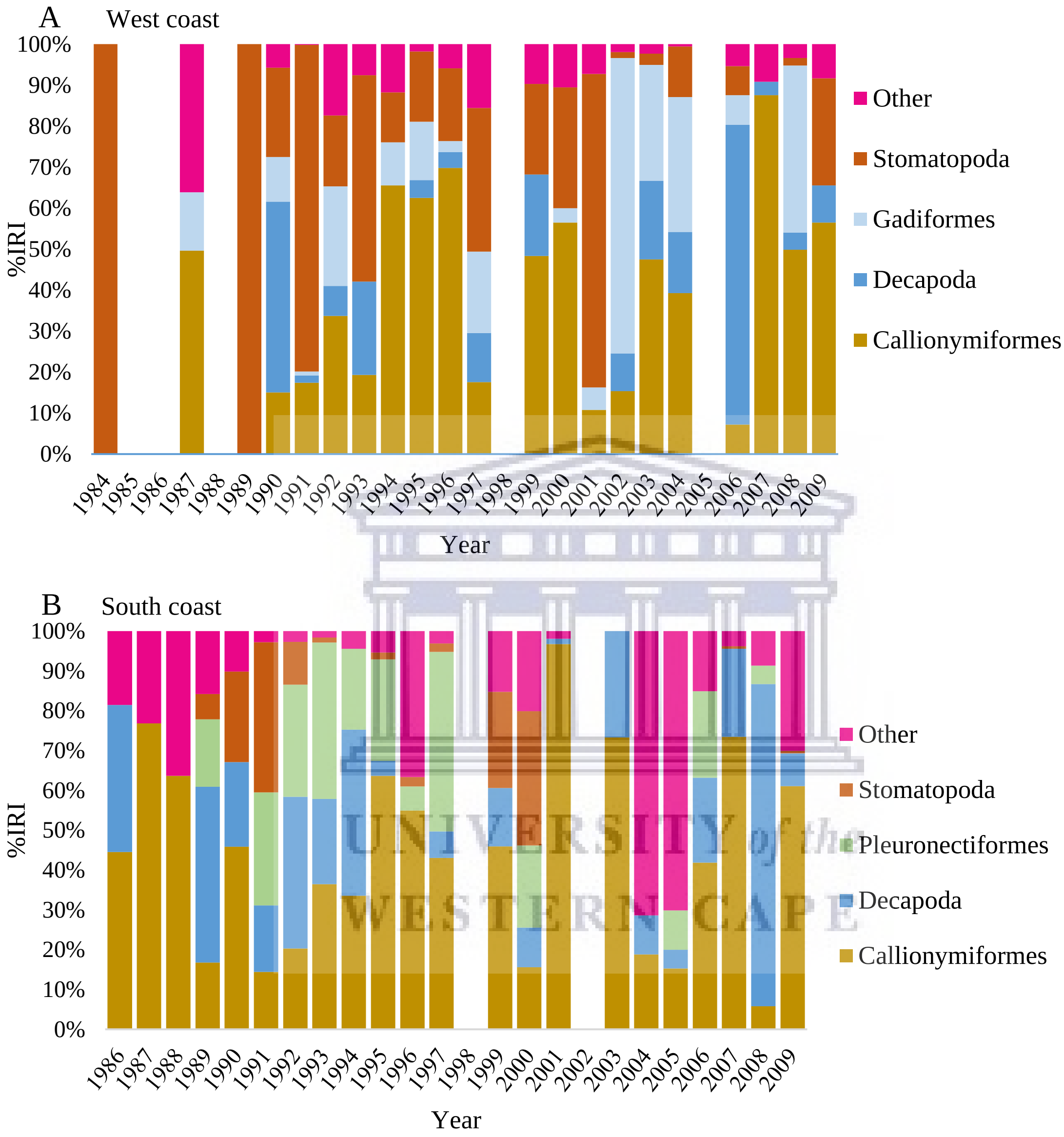

Figure 11: Time series displaying the top four prey orders (based on *%IRI*) featured in the diet of *Genypterus capensis* on the West (**A**) and South (**B**) coast. Gaps illustrate years where there were no data.

As seen on the West coast, Callionymiformes was an important prey order in almost every year of the study on the South coast dominating the diet of kingklip in the 1990s and several subsequent other years (Figure 11B). Stomatopods only featured in the 1990s and the early 2000s. Decapods also featured consistently, dominating in 1989, 1994 and 2008. Pleuronectiformes displayed similar results to Decapoda in the 1990s dominating in 1997 and appearing less in the 2000s.

3.3 Diet of Lophius vomerinus

Chordates (fishes) were found to be the most important prey phylum and constituted the majority of the prey items recorded (Appendix 1). Of the chordates, members of the class Actinopterygii contributed 96 % of all prey items; Gadoids were dominant on the West coast, but a greater diversity of taxa were more important on the South coast: Perciformes, Anguilliformes, Clupeiformes and Scorpaeniformes (Figure 12, Appendix 1). Despite the callionymiform fish *Paracallionymus costatus* being an important prey species at shallower depths, its importance overall was limited. Twenty-eight different prey species were recorded from both coasts with *Paracallionymus costatus* and *Merluccius paradoxus* being dominant on the West coast. Cape horse-mackerel *Trachurus trachurus capensis* and jacopever *Helicolenus dactylopterus* were the most dominant identifiable prey species on the South coast (Appendix 1). Overall, the most frequently occurring prey species were *P. costatus, M. paradoxus, H. dactylopterus* and the cuttlefish *Sepia australis*. Other common prey items on the South coast include shallow-water hake, *Loligo reynaudii* chokka squid and *Todarodes eblanae* Angolan flying squid. *Malacocephalus laevis* softhead Grenadier, *Lepidopus caudatus* silver scabbardfish and kingklip were also commonly eaten on the West coast (Appendix 1).

3.3.1. Diet of Lophius vomerinus by depth

West coast: at depths less than 200 m Gadoids dominated the diet, followed by Clupeiformes, Sepiida and Callionymiformes (Figure 13A). Gadiform fish almost exclusively dominated the diet at depths greater than 200 m.

South coast: at depths less than 200 m Perciformes, Anguilliformes, Clupeiformes and Scorpaeniformes all featured in the diet. Anguilliformes, Gadoids and Perciformes were all important prey orders in the 201 - 400 m depth class whilst Scorpaeniformes was the most important prey order in the 401 - 600 m depth class followed by Gadiformes and Oegopsida (Figure 13B; Appendix 6).

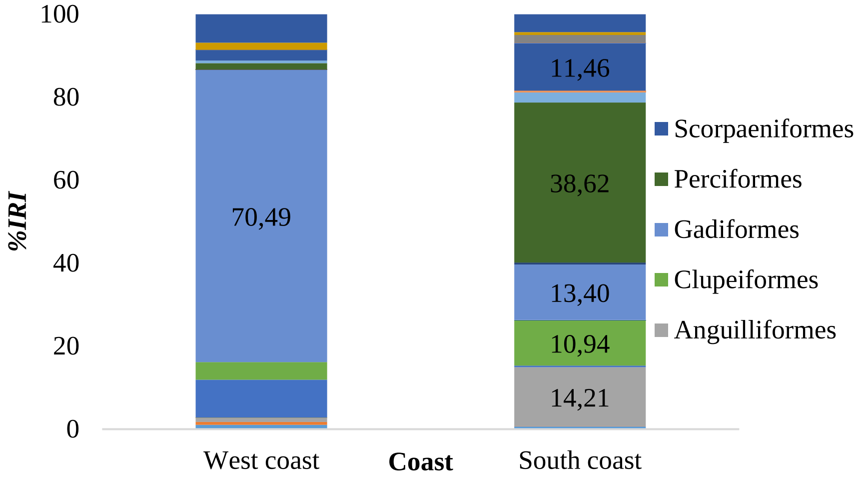

Figure 12: Major prey orders (*%IRI*) identified in the diet of *Lophius vomerinus* on the West and South coasts. Data labels and legend represent prey groups that contributed to > 10 % of the diet on either coast.

In terms of species, the ladder-dragonet constituted the majority of prey items in the diet across most depth classes on the West coast but did not feature much in the diet on the South coast. Other teleosts including deep-water hake and round herring all featured heavily in the diet of animals in the 1 - 200 m depth class on the West coast along with the cephalopod *Sepia australis* (Appendix 6). Deep-water hake and ladder-dragonets were the only two species to contribute significantly to the diet in the 201 - 400 m depth class on the West coast. Deep-water hake constituted the majority of prey items in the diet in the 401 - 600 m depth class on the West coast (Appendix 6).

Teleosts were the most regularly consumed prey items in the diet of monkfish on the South coast with the Southern conger eel *Gnathophis capensis*, round herring, Cape horse mackerel and jacopever all contributing to the diet in the 1 - 200 m depth class. Cape hakes and horse mackerel were the most important prey species consumed in the 201- 400 m depth class on the South coast (Appendix 1, Appendix 6). *Helicolenus dactylopterus*, *Todarodes angolensis* and *Merluccius paradoxus* were the only species to contribute significantly (*%IRI* > 10%) at depths over 600 m.

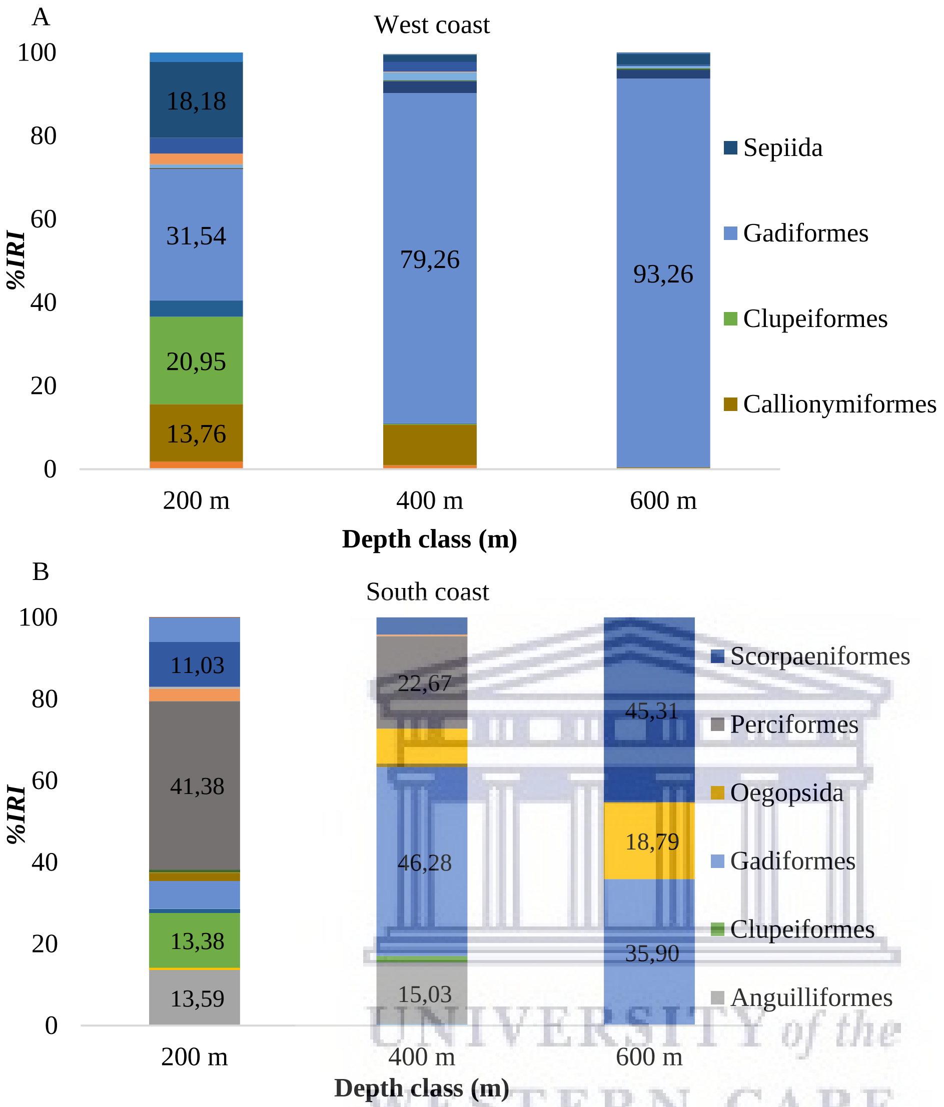

Figure 13: Major prey orders (*%IRI*) identified in the diet of *Lophius vomerinus* on the West (**A**) and South (**B**) coasts at 3 different depth classes. Data labels and legend represent prey groups that contributed to > 10 % of the diet on each coast in each depth class.

3.3.2. Diet of Lophius vomerinus by size

On the West coast Gadiformes were commonly consumed across all size classes (Figure 14; Appendix 5). Within the smallest size class on the West coast, Callionymiformes, Sepiidae and Gadiformes all contributed to the diet (Figure 14A, Appendix 5). In monkfish larger than 37 cm, Gadiformes was the only dominant prey order on the West coast. The smallest size class on the South coast displayed a similar trend to the West coast with Sepiida dominating (Figure 14B). Unlike on the West coast, Gadiformes did not dominate the diet on the South coast with Scorpaeniformes, Anguiliformes and Clupeiformes the most important prey items in the 37- 45 cm size class on the South coast. Perciformes was the dominant prey order in the > 45 cm size class, with Gadiformes only shown to be important in the largest size class on the South coast. (Figure 14B, Appendix 5).

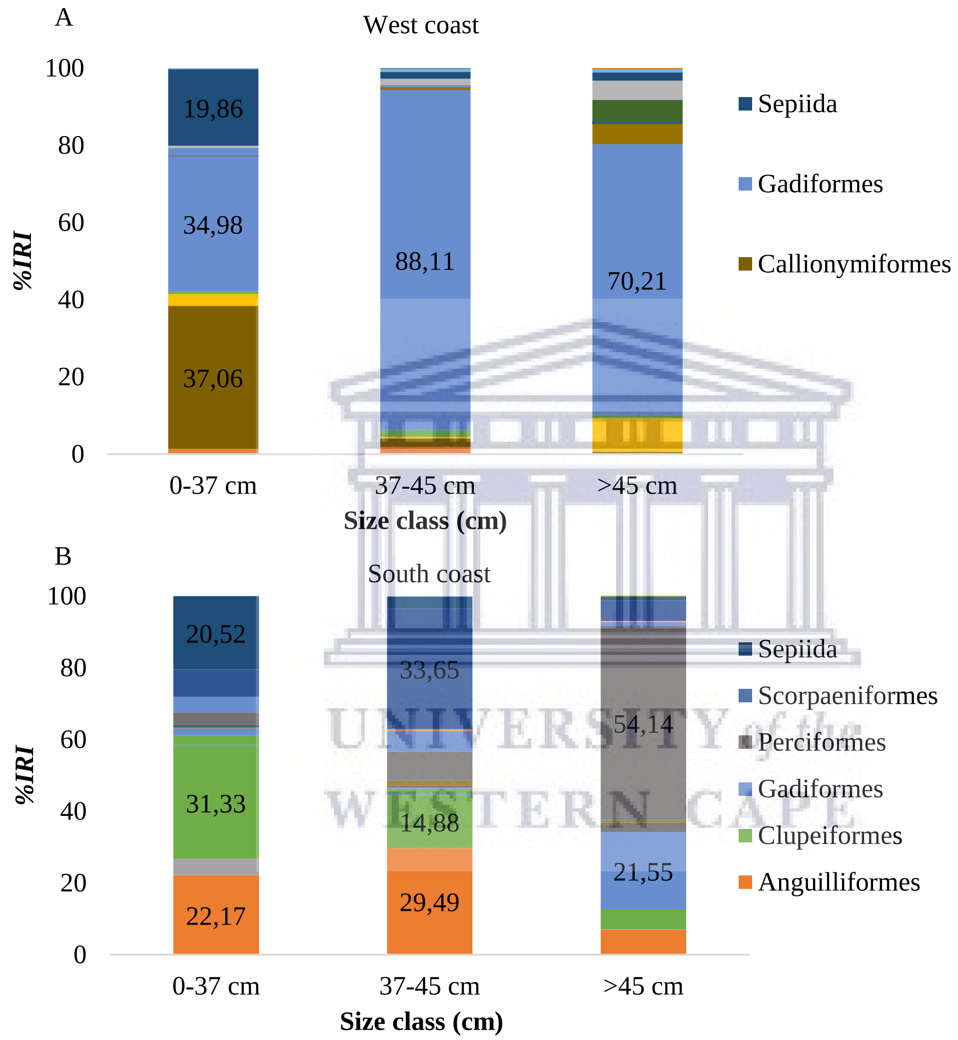

Figure 14: Major prey orders (*%IRI*) identified in the diet of *Lophius vomerinus* on the West (**A**) and South (**B**) coasts by fish size class. Data labels and legend represent prey groups that contributed to > 10 % of the diet on either coast in each size class.

Small monkfish predominantly fed on deep-water hake and ladder dragonet and to a lesser extent on *Sepia australis* on the West coast. The Cape hakes overwhelmingly dominated the diet of medium size fish on the West coast with *M. paradoxus* the more frequently occurring species of the two (Appendix 5). Similarly, *Merluccius* spp. were only consumed by the largest size class but their diet was dominated by Perciformes (*Todarodes eblanae* and *Trachurus trachurus capensis*) as well as *Helicolenus dactylopterus* being preyed on, but to a lesser extent (Appendix 5). Small monkfish on the South coast predominantly fed on *Etrumeus whiteheadi, Gnathophis capensis* and *Sepia australis*. *Gnathophis capensis* and *Etrumeus* spp. continued to dominate the diet of medium size fish with *Helicolenus dactylopterus* also contributing substantially (in terms of *%IRI*). Hakes only appeared to dominate the diet of large monkfish, though Cape horse mackerel were frequently consumed (Appendix 5). In terms of average weight (g) per order, teleosts dominated the diet of monkfish across all three size classes (Figure 15). Perciformes contributed the largest average weight in all three size classes on the West coast with medium sized monkfish consuming the largest average weight (Figure 15A). Monkfish on the South coast showed a gradual increase in the average prey weight of certain prey orders between small and medium sized fish, with a marked increase seen in the larger individuals (Figure 15B).

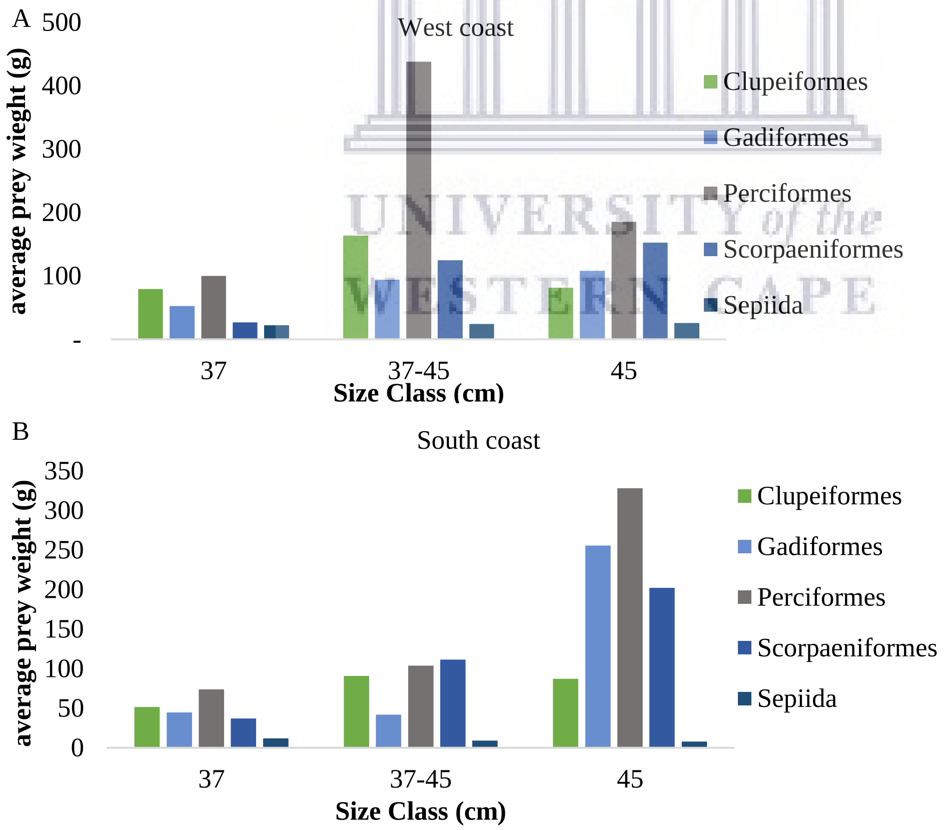

Figure 15: The average weights (g) of the major prey groups consumed by small, medium and large *Lophius vomerinus* on the West (**A**) and South (**B**) coasts.

3.3.3. Interannual variability in the diet of Lophius vomerinus

As seen with kingklip a variety of different prey orders were important in the diet of monkfish throughout the time period. On the West coast Gadiformes was the most important prey order in the 2000s dominating the diet in 1987, 1999, between 2009 and 2012, and in 2017. Callionymiform fishes featured throughout the 1990s and dominated the diet in 2000 with its importance dropping subtantially in the 2000s. Clupeiformes dominated the diet in 1986 and 1992 only featuring sporadically in other years. Similarly, Sepiida featured sporadically through the years never really dominating the diet (Figure 16A).

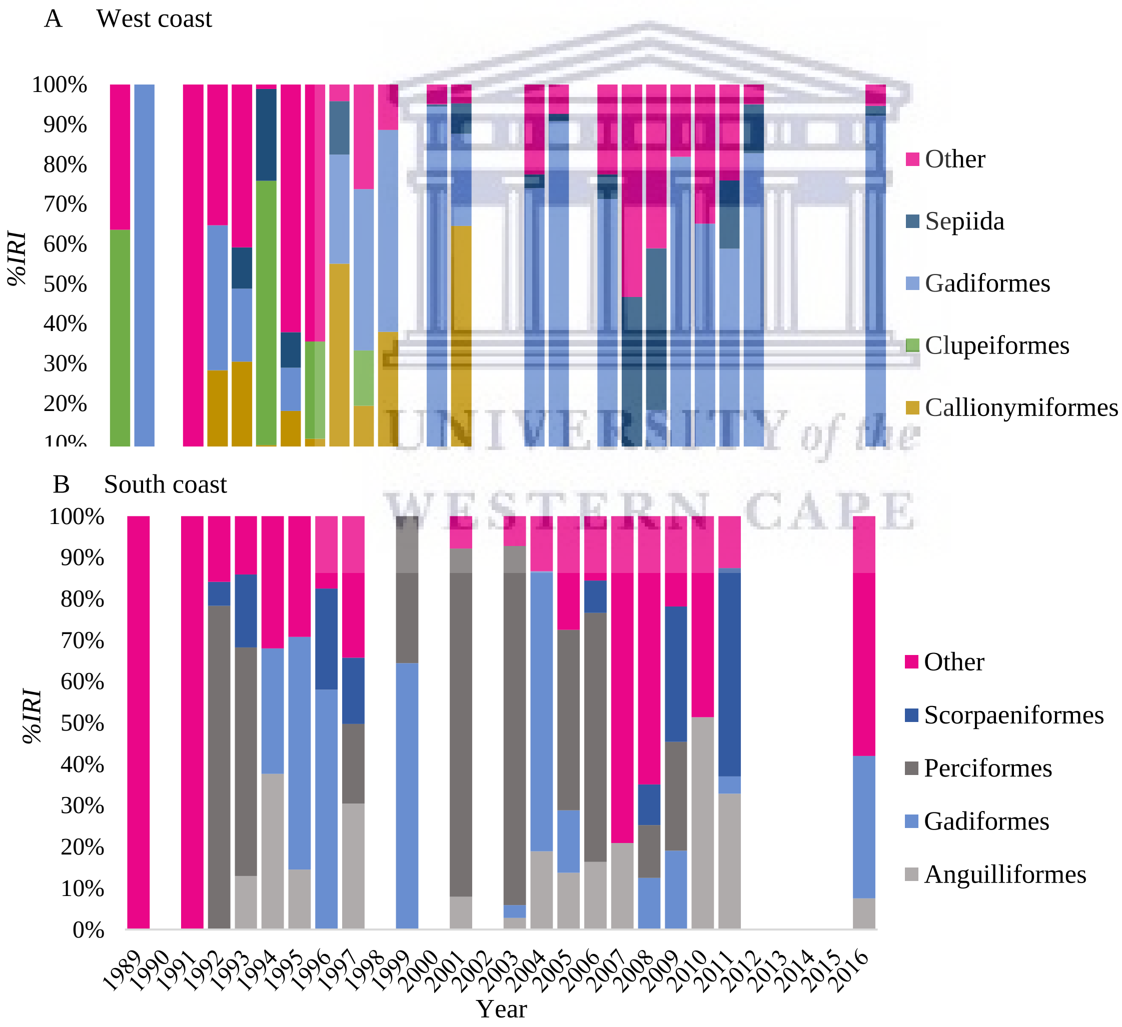

Figure 16: Time series displaying the top four prey orders (based on *%IRI*) featured in the diet of *Lophius vomerinus* on the West (**A**) and South (**B**) coast. Gaps illustrate years where there was no data.

On the South coast Perciformes featured throughout a large portion of the time period dominating the diet in 1992 and 1993 and throughout most of the early 2000s. Unlike on the West coast, Gadiformes only featured consistently in the late 1990s with a reduced occurrence in the 2000s. Anguilliformes consistently featured throughout the time period dominating the diet in 2010. Scorpaeniformes featured too, however they rarely dominated the diet, except for 2011 (Figure 16B).

3.4. Interspecific differences in diet

The NMDs ordination plot (Figure 17) and the cluster analysis revealed that there is a low degree of dietary overlap between *Genypterus capensis* and *Lophius vomerinus* with the cluster analysis showing > 40 % similarity between samples (Figure 18). The results of the ANOSIM reveal that there is a statistically significant difference in the diet of the two species (R = 0,59; p < 0,05), at the prey order level. The pairwise ANOSIM results showed that depth class (R = 0,40) and size class (R = 0,30) had slight but significant effects on the differences seen in diet, with coast not being influential. The cluster analysis produced no clear seperation based on species or coast. Small (< 50 cm) to medium (51- 100 cm) sized kingklip from both coasts clustered together in the 201 - 400 m depth class at 41 % similarity (Figure 18), and small (< 37 cm) and medium size (37 – 45 cm) monkfish also formed a cluster in the 1 – 200 m depth class, at 50 % similarity.

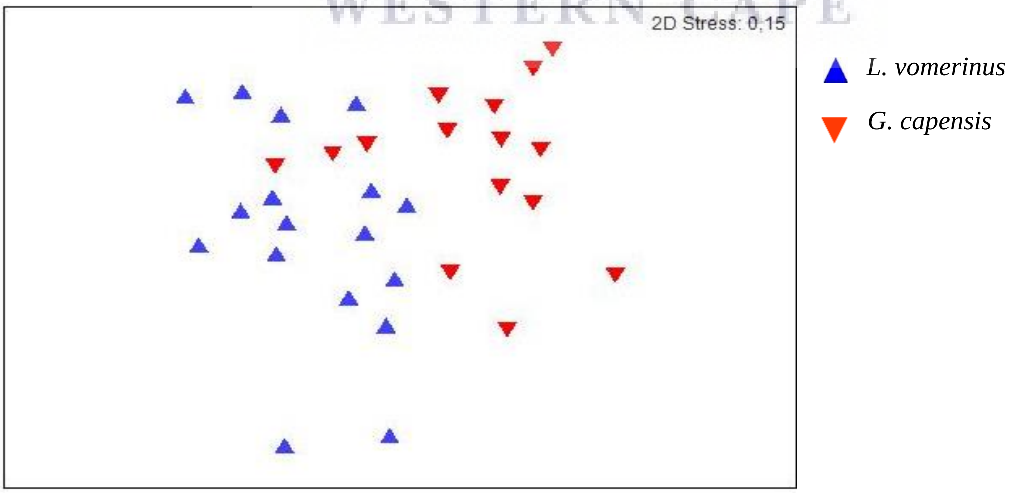

Figure 17: Non-metric multidimensional scaling ordination of the stomach contents (based on prey orders) of *Genypterus capensis*.and *Lophius vomerinus* pooled by coast, depth and size class.

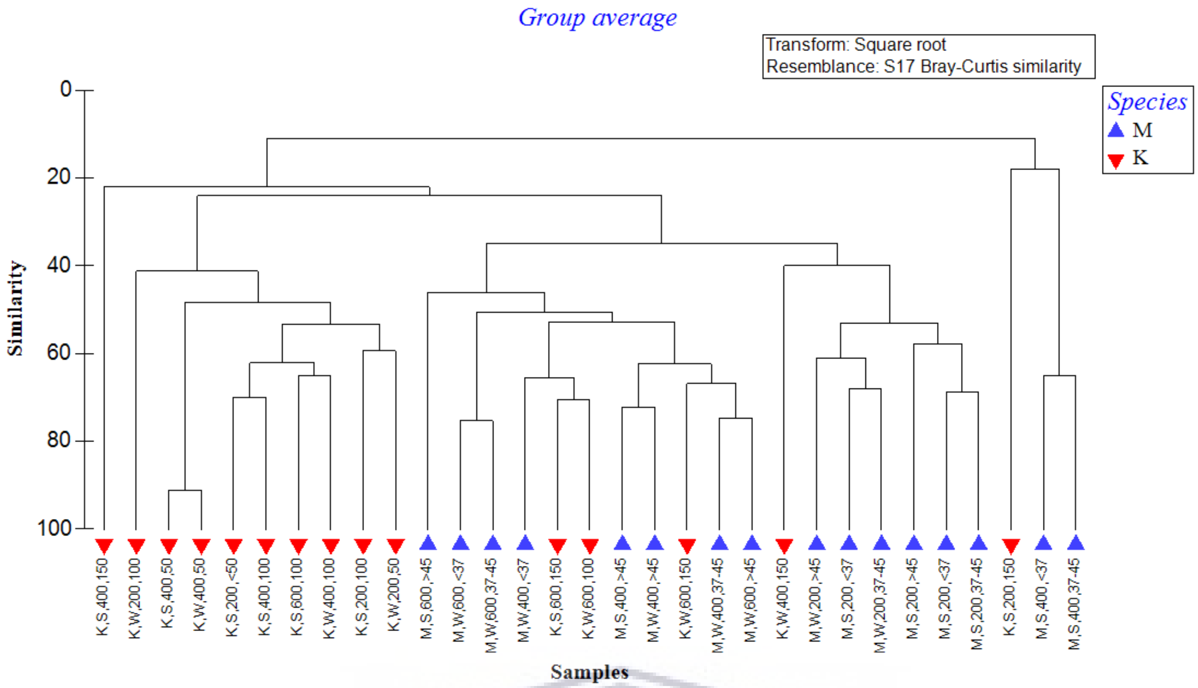

Figure 18: Dendogram illustrating the % similarity in the diet of *Genypterus capensis* (K) and *Lophius vomerinus* (M) subgroups. Each point represents a unique Species/Coast/Depth/Size code e.g., M, S, 400, <37 indicates monk, South coast, 201 - 400 m depth class and <37 cm TL. Dendrogram based on group-averaged cluster analysis of Bray-Curtis dissimilarities based on square root transformed dietary data (prey order), pooled by species, coast, depth and size.

3.5 Intraspecific differences in diet

The nMDS ordination plot for *Genypterus capensis* displays a high degree of overlap with no clear groupings visible (Figure 19). ANOSIM tests showed that there was no difference in the diet of *G. capensis* by Coast, Size or Depth stratum, at the order level of prey by contrast, the nMDS ordination plot for *Lophius vomerinus* suggests that diet does vary with Coast and Depth stratum (Figure 20), and the results of the ANOSIM tests support this; Coast (R = 0,29, p < 0,05) and Depth class (R = 0,49, p < 0,05) had a reasonable influence on the differences, while Size was not influential (R = 0,05, p > 0,05). The SIMPER analysis identified Gadiformes, Oegopsida, Callionymiformes and Anguilliformes as most responsible for the dietary differences seen within the species. Dissimilarity percentages greater than % 40 were recorded between the varying size and depth classes.

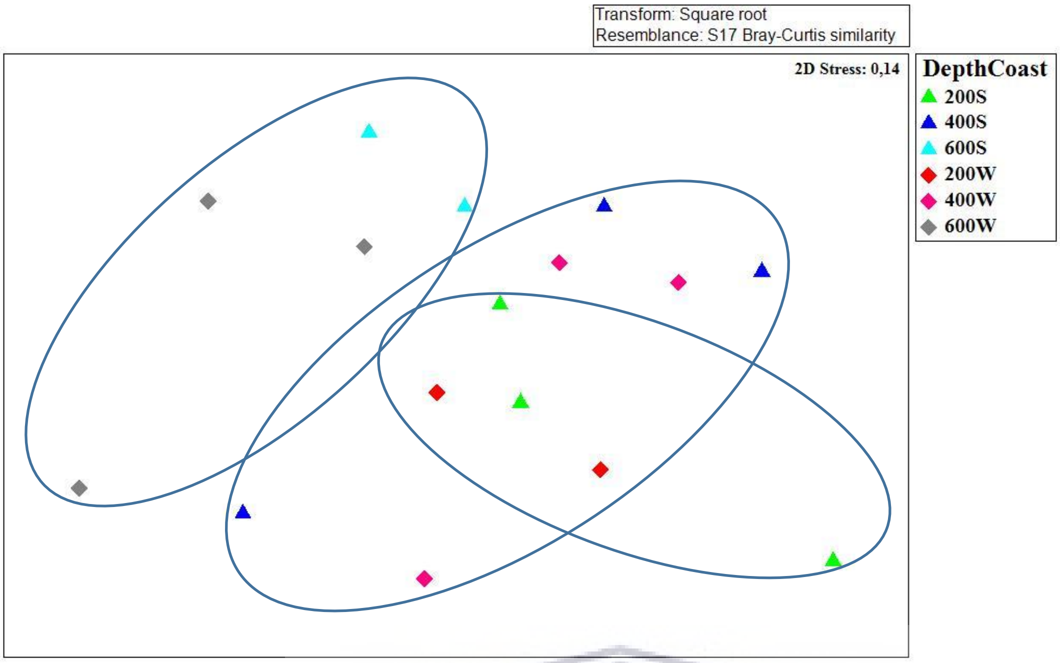

Figure 19: Non-metric multidimensional scaling ordination of the stomach contents of *Genypterus capensis* pooled by depth and coast.

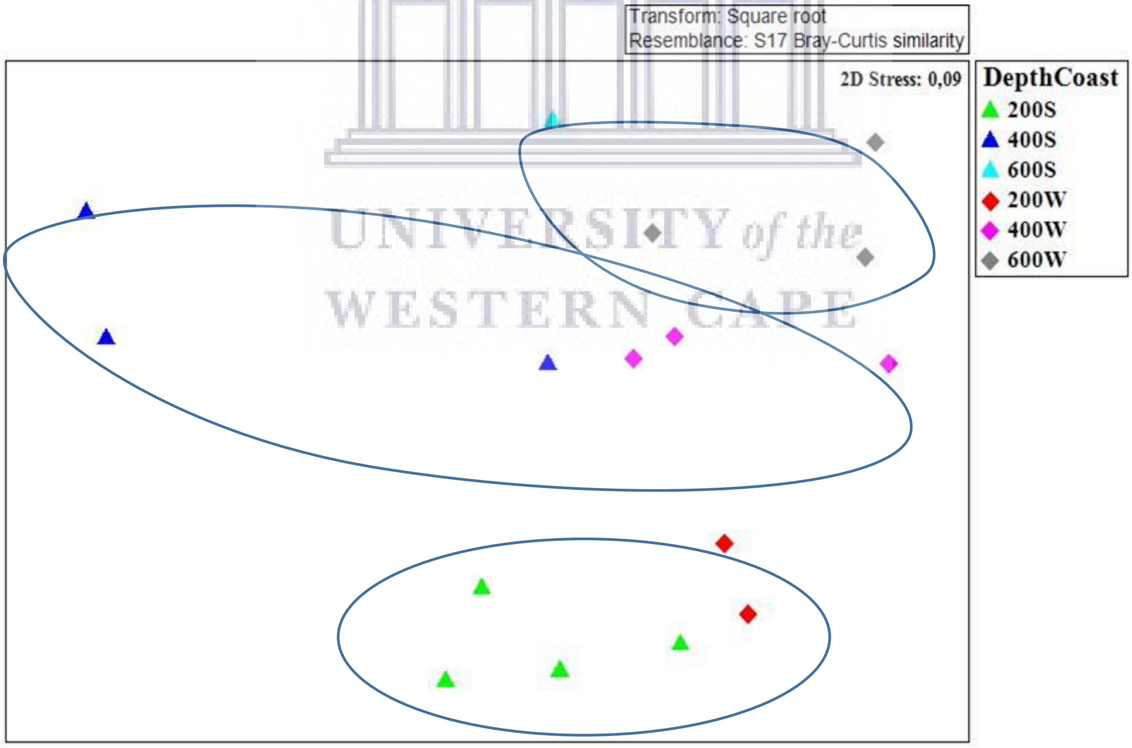

Figure 20: Non-metric multidimensional scaling ordination of the stomach contents of *Lophius vomerinus* pooled by depth and coast.

3.6. Stable isotope analysis

A total of 240 kingklip and 168 monkfish were processed for SIA; the largest fish of both species were recorded on the South coast (Table 4). There was a significant difference in mean size between coasts for kingklip ($F_{(1,238)}$ =5,61, $p < 0,05$), but not for monkfish. Most individuals of both species were sampled between 1 - 200 m on the South coast and between 201 - 400 m depth class on the West coast (Table 4). Kingklip displayed a clear increase in average size with increasing depth, though this was less clear for monkfish (Table 4). The majority of the larger individuals of both species were sampled on the South coast (Table 4).

Table 4: Number (*n*) and average size (± SE) of *Genypterus capensis* and *Lophius vomerinus* sampled on the West and South coasts in the various depth classes, for Stable Isotope analysis.

	Genypterus capensis						***Lophius vomerinus***					
	West coast			**South coast**			**West coast**			**South coast**		
Depth class (m)	**n**	**Average size (cm)**	**SE**	**n**	**Average size (cm)**	**SE**	**n**	**Average size (cm)**	**SE**	**n**	**Average size (cm)**	**SE**
1-200	32	44,9	2,8	68	47,7	1,8	8	42,8	5,8	87	47,9	1,3
201-400	66	53,0	2,1	6	76,1	8,1	27	47,3	4,0	13	53,4	1,3
401-600	25	79,6	4,7	36	90,2	3,6	9	54,7	5,9	15	56,4	2,4
>600	6	52,3	6.1	1	90.4	0	4	57.5	6,6	5	67,4	3.5

3.6.1 Variation in $\delta^{15}N$ and $\delta^{13}C$ values of Genypterus capensis

The isotopic bi-plot displays some overlap between coasts with higher $\delta^{15}N$ values corresponding to higher $\delta^{13}C$ values (Figure 21). Results of the GLMs for $\delta^{15}N$ and $\delta^{13}C$ show that fish Size, Coast and Year all had substantial effects on the isotopic ratios, but that Depth and the Coast*Year interaction did not (Table 5). Both $\delta^{15}N$ and $\delta^{13}C$ were positively correlated with Size, on both coasts (Figure 22). Whilst $\delta^{15}N$ and $\delta^{13}C$ increased with size on both the South ($R^2 = 0,57$, $p < 0,05$) and West ($R^2 = 0,17$, $p < 0,05$) coasts, there is a clear difference in the strength of this relationship between coasts (Figure 22).

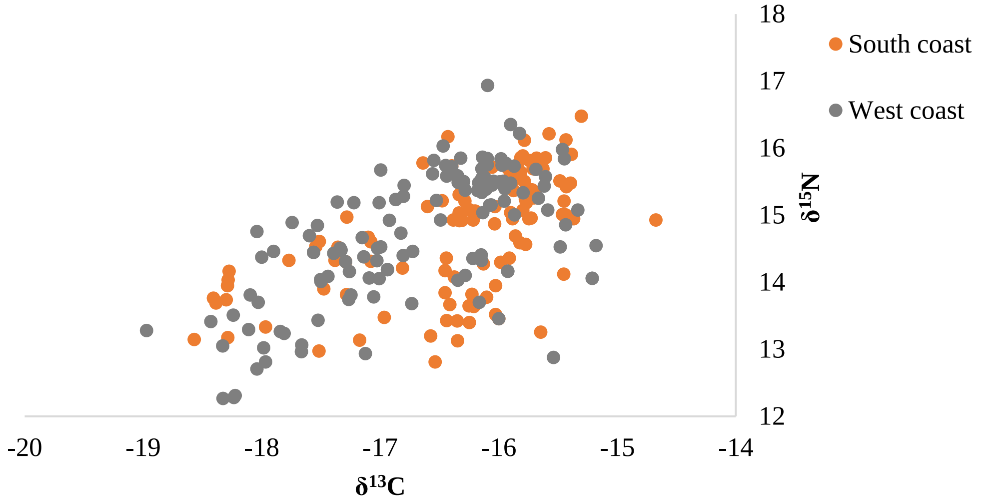

Figure 21: Isotopic bi-plot illustrating $\delta^{15}N$ and $\delta^{13}C$ values of *Genypterus capensis* on the West and South coasts.

Table 5: Summary of results obtained from univariate tests of significance testing for variation in the $\delta^{15}N$ (**A**) ($R^2 = 0{,}620$, Adjusted $R^2 = 0{,}610$) and $\delta^{13}C$ (**B**) ($R^2 = 0{,}309$, Adjusted $R^2 = 0{,}292$) values of *Genypterus capensis* between coasts, depth strata, year and size (TL) and the interaction between coast and year. Significant *p*-values ($p < 0{,}05$) are indicated in bold.

A	$\delta^{15}N$				
Parameters	**Df**	**SS**	**MS**	**F**	**Sig.**
Model	6	129,1	21,52	63,42	**p < 0,05**
Intercept	1	4800,88	4800,88	14149,52	**p < 0,05**
Coast	1	25,14	25,3	74,103	**p < 0,05**
Size (TL)	1	35,85	35,85	105,65	**p < 0,05**
Year	2	9,23	4,62	13,61	**p < 0,05**
Depth	1	0,62	0,62	1,83	p > 0,05
Coast* Year	1	0,16	0,16	0,465	p > 0,05
Error	240	79,56			
B	$\delta^{13}C$				
Parameters	**Df**	**SS**	**MS**	**F**	**Sig.**
Model	6	54,36	9,06	17,4	**p < 0,05**
Intercept	1	8038,74	8038,74	15431,95	**p < 0,05**
Coast	1	10,7	10,7	20,55	**p < 0,05**
Size (TL)	1	14,8	14,8	28,41	**p < 0,05**
Year	2	8,22	4,11	7,9	**p < 0,05**
Depth	1	0,05	0,5	0,09	p > 0,05
Coast* Year	1	0,914	0,91	1,76	p > 0,05
Error	233	121,37			

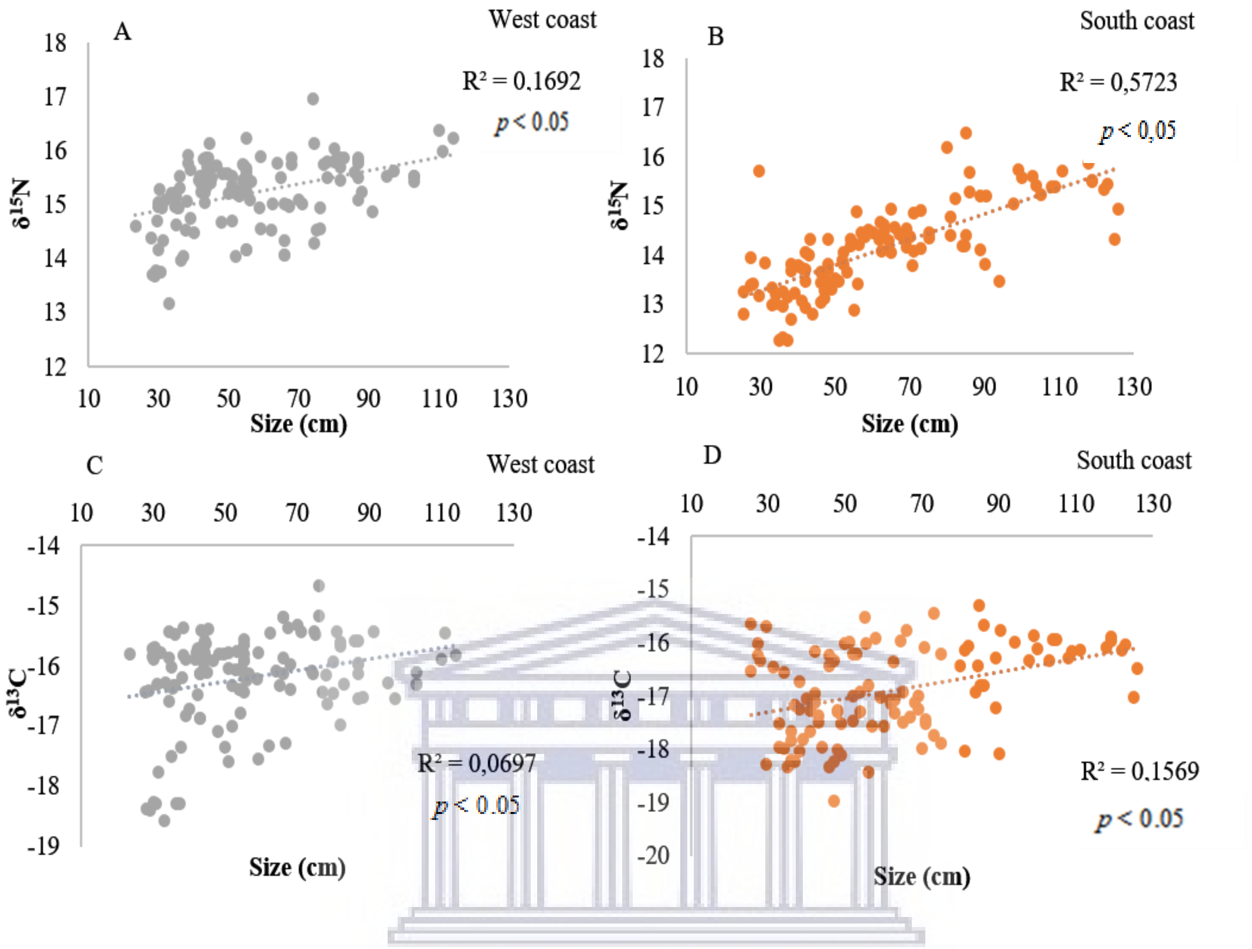

Figure 22: Individual scatterplots of δ^{15}N (**A** & **C**) and δ^{13}C (**B** & **D**) against size for *Genypterus capensis* on the West and South coasts. Graphs include linear trendlines, R^2 values and *p*-values.

Coast ($F_1 = 25{,}14$, $p < 0{,}05$) and Year ($F_1 = 13{,}61$, $p < 0{,}05$) was also shown to have a significant effect on the variance seen in δ^{15}N, but depth was not influential (Table 5). Mean δ^{15}N values were higher in samples from the West coast compared to the South Coast (15,20 ‰, SE ± 0,06) (14,15 ‰, SE ± 0,09) (Figure 23A). δ^{13}C mean values recorded for kingklip displayed a similar trend with higher δ^{13}C mean values recorded on the West (-16,21 ‰, SE ± 0,07) than the South coast (-16,90 ‰, SE ± 0,08) (Figure 23B). Again, fish size had an effect on δ^{13}C, ($F_1 = 28{,}41$, $p < 0{,}05$), though Coast ($F_1 = 20{,}55$, $p < 0{,}05$) and Year ($F_1 = 7{,}90$, $p < 0{,}05$) were also significant (Table 5). There was no significant change in δ^{13}C values with depth.

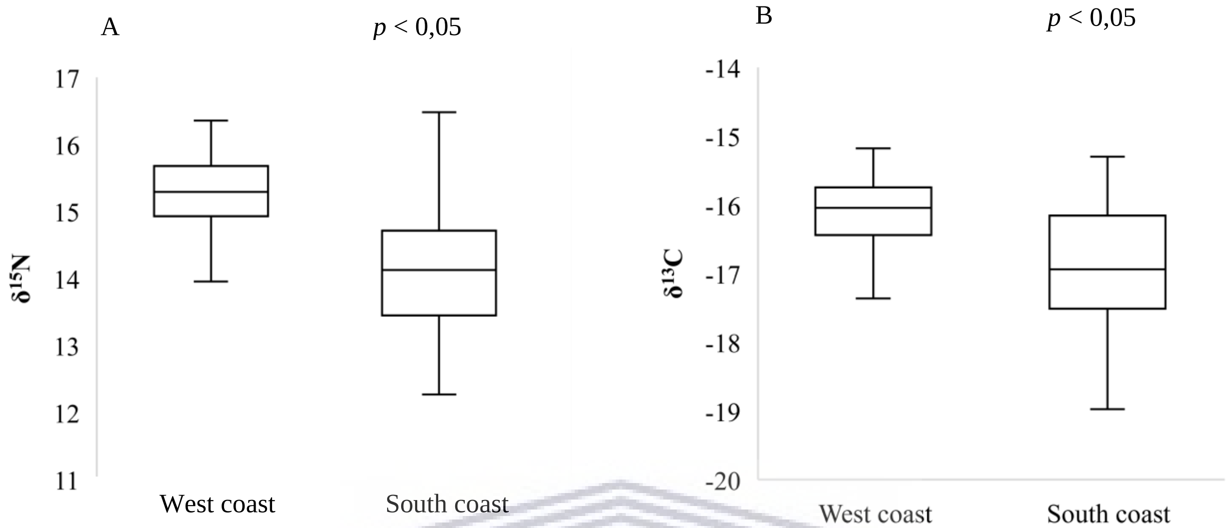

Figure 23: Boxplot illustrating mean $\delta^{15}N$ (**A**) and $\delta^{13}C$ (**B**) values (±SE) of *Genypterus capensis* on each coast. p < 0,05 indicates a significant difference between mean values.

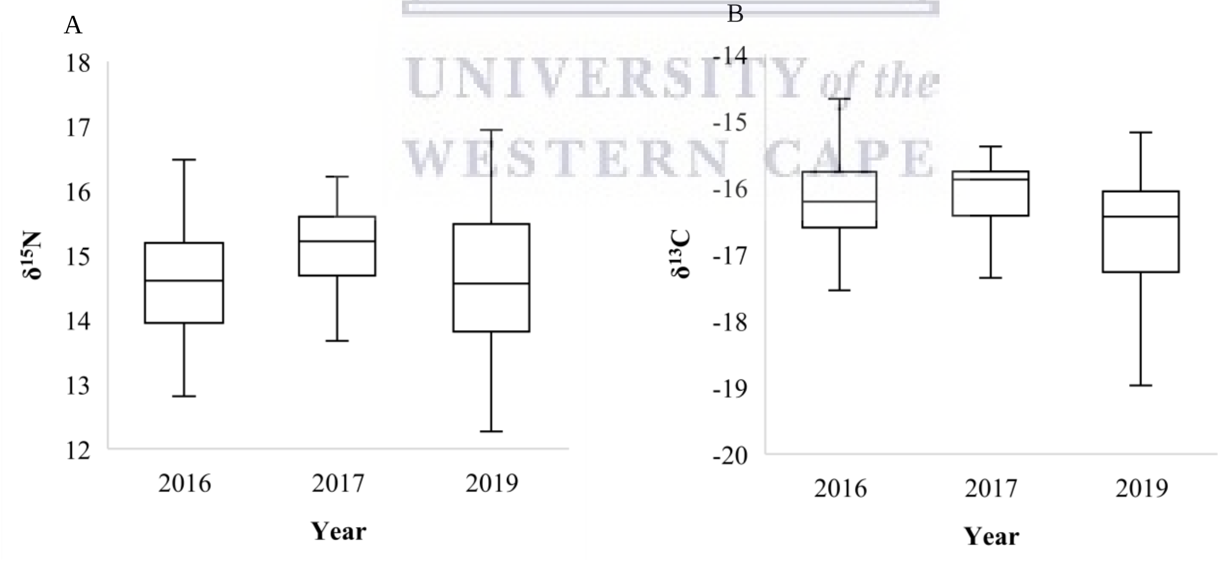

Figure 24: Boxplot illustrating mean $\delta^{15}N$ (**A**) and $\delta^{13}C$ (**B**) values (±SE) of *Genypterus capensis* for each year of sampling.

Whilst individual size was influential on $\delta^{13}C$ on both coasts it was notably stronger on the South coast (Figure 22C, D). For *Genypterus capensis,* the results generated from the GLMs showed that Year had a significant effect on both $\delta^{15}N$ ($F_1 = 13{,}61$, $p < 0{,}05$) and $\delta^{13}C$ ($F_1 = 7{,}90$, $p < 0{,}05$). The inter-annual differences were found to be inconsistent between $\delta^{15}N$ and $\delta^{13}C$ with 2017 displaying higher $\delta^{15}N$ values whereas 2019 displayed lower $\delta^{13}C$ values (Figure 24). The highest mean $\delta^{15}N$ values were recorded in 2017, with $\delta^{13}C$ showing the same (Figure 24).

3.6.2 Variation in $\delta^{15}N$ and $\delta^{13}C$ of Lophius vomerinus

Less than 20 individuals were caught at depths > 400 m on both the South and West coasts, and the few individuals sampled at depths > 600 m were the biggest (Table 4). The largest recorded specimen was 90 cm recorded off the South coast with the smallest specimen measuring 18 cm and recorded off the West coast.

The isotopic bi-plot of $\delta^{15}N$ and $\delta^{13}C$ values display partial spatial separation between coasts (Figure 25). $\delta^{13}C$ displays greater variability on the South coast with the West coast displaying higher $\delta^{13}C$ values. Results of the GLMs for $\delta^{15}N$ and $\delta^{13}C$ showed that Coast and Depth had significant effects on isotope ratios. The results of the GLMs showed that $\delta^{15}N$ differed slightly between coasts and that higher mean values were recorded on the West (15,27 ‰, SE ± 0,06) than the South (14,53 ‰, SE ± 0,04) coast (Figure 26). The results of the GLMs also indicated that the interaction of Coast and Year ($F_1 = 5{,}94$, $p < 0{,}05$) and Depth ($F_1 = 5{,}67$, $p < 0{,}05$) had a significant effect on the variance seen in $\delta^{15}N$ (Table 6). Neither fish Size nor Year had a significant effect on $\delta^{15}N$ values. Results from the GLM for $\delta^{13}C$ showed Year accounting for the most variance ($F_1 = 33{,}83$, $p < 0{,}05$) closely followed by Coast ($F_1 = 30{,}70$, $p < 0{,}05$), Size ($F_1 = 17{,}20$, $p < 0{,}05$) and Depth ($F_1 = 10{,}50$, $p < 0{,}05$) (Table 6).

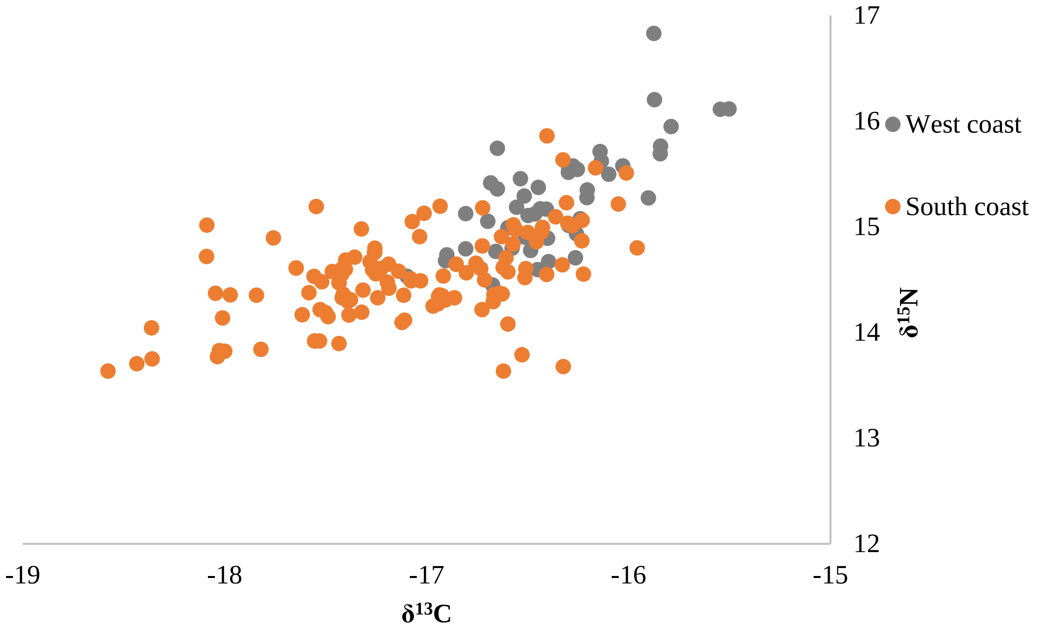

Figure 25: Isotopic bi-plot illustrating δ^{15}N and δ^{13}C values of Lophius vomerinus on the West and South coasts.

Table 6: Summary of results obtained from univariate tests of significance testing for variation in the δ^{15}N (**A**) (R^2 = 0,409; Adjusted R^2 = 0,391) and δ^{13}C (**B**) (R^2 = 0,491; Adjusted R^2 = 0,475) values of *Lophius vomerinus* between Coasts, Depth strata, Coast*year and Size (TL). Significant *p*-values ($p < 0,05$) are indicated in bold.

A	δ^{15}N				
Parameters	**Df**	**SS**	**MS**	**F**	**Sig.**
Model	5	21,38	4,28	22,46	**$p < 0,05$**
Intercept	1	2120,12	2120,12	11135,6	**$p < 0,05$**
Coast	1	9,91	9,91	52,06	**$p < 0,05$**
Size (TL)	1	0,08	0,084	0,44	$p > 0,05$
Year	2	0,45	0,45	2,36	$p > 0,05$
Depth	1	1,08	1,08	5,67	**$p < 0,05$**
coast* Year	1	1,13	1,13	5,94	**$p < 0,05$**
Error	162	30,84			
B	**δ^{13}C**				
Parameters	**Df**	**SS**	**MS**	**F**	**Sig.**
Model	5	31,12	6,22	31,28	**$p < 0,05$**
Intercept	1	2928,81	2928,81	14719,37	**$p < 0,05$**
Coast	1	6,11	6,11	30,7	**$p < 0,05$**
Size (TL)	1	3,43	3,43	17,2	**$p < 0,05$**
Year	2	6,73	6,73	33,83	**$p < 0,05$**
Depth	1	2	2	10,05	**$p < 0,05$**
coast* Year	1	0,19	0,19	0,94	$p > 0,05$
Error	162	32,24			

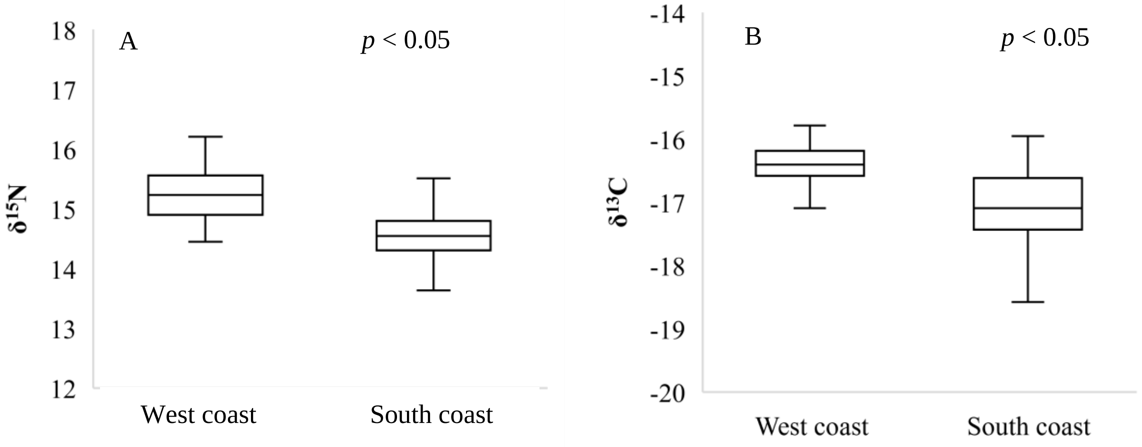

Figure 26: Boxplot illustrating mean $\delta^{15}N$ (**A**) and $\delta^{13}C$ (**B**) values (±SE) of *Lophius vomerinus* on each coast. $p < 0,05$ indicates a significant difference between the two coasts.

The lowest mean values of $\delta^{15}N$ were recorded from monkfish sampled in the 201 - 400 m depth class on the South coast whilst the highest mean $\delta^{15}N$ values were recorded at 401 - 600 m on the West coast (Figure 27A). The lowest mean $\delta^{13}C$ values were recorded in the 1 – 200 m depth class on the South coast with the highest mean $\delta^{13}C$ values observed in individuals sampled in the 401 - 600 m depth class on the West coast (Figure 27B). Mean $\delta^{15}N$ values displayed an increase with depth on the West coast up to the 401 – 600 m depth class, while mean $\delta^{13}C$ values were relatively consistent overall depths on the West coast.

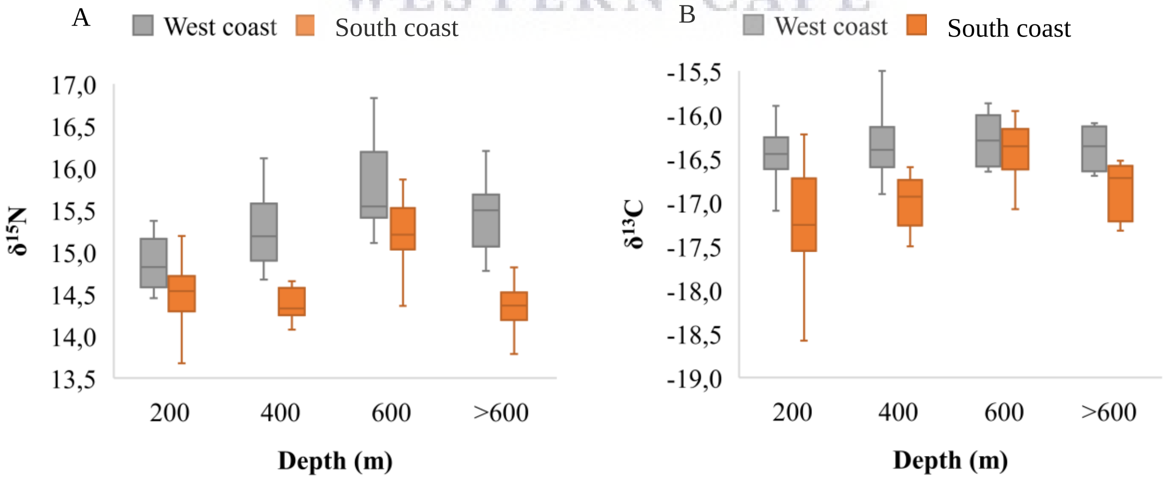

Figure 27: Boxplot illustrating mean $\delta^{15}N$ (**A**) and $\delta^{13}C$ (**B**) values (±SE) of *Lophius vomerinus* for each depth class on the West and South coasts.

Despite size not having an effect on the variance seen in δ^{15}N, δ^{13}C was significantly correlated with fish Size (Table 6B). The scatterplots displayed a significant correlation between δ^{13} C and size on both the South ($R^2 = 0,27$, $p < 0,05$) and West coast ($R^2 = 0,02$, $p < 0,05$), with the West coast displaying a particularly weak negative correlation (Figure 28A). There was no significant change in δ^{15}N with Year, though Year did have an effect on δ^{13} C ($F_1 = 33,83$, $p < 0,05$) (Figure 23A) with 2019 displaying lower mean δ^{13} C values than 2016 (Figure 29B). The significant interaction between Coast and Year on δ^{15}N is illustrated by the difference in the pattern between coasts between years. The inter-coast difference in 2016 is much larger than in 2019. The lack of a significant interaction between Year and Coast for δ^{13} C suggests the relative pattern is not very different between years.

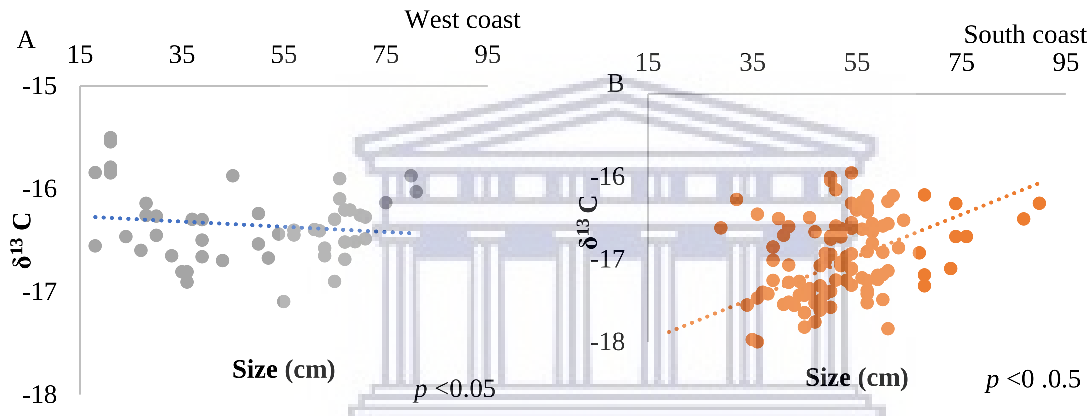

Figure 28: Scatterplots of δ^{13}C and size for *Lophius vomerinus* on the West (**A**) and South (**B**) coasts. Included are linear trendlines with, *p*-values.

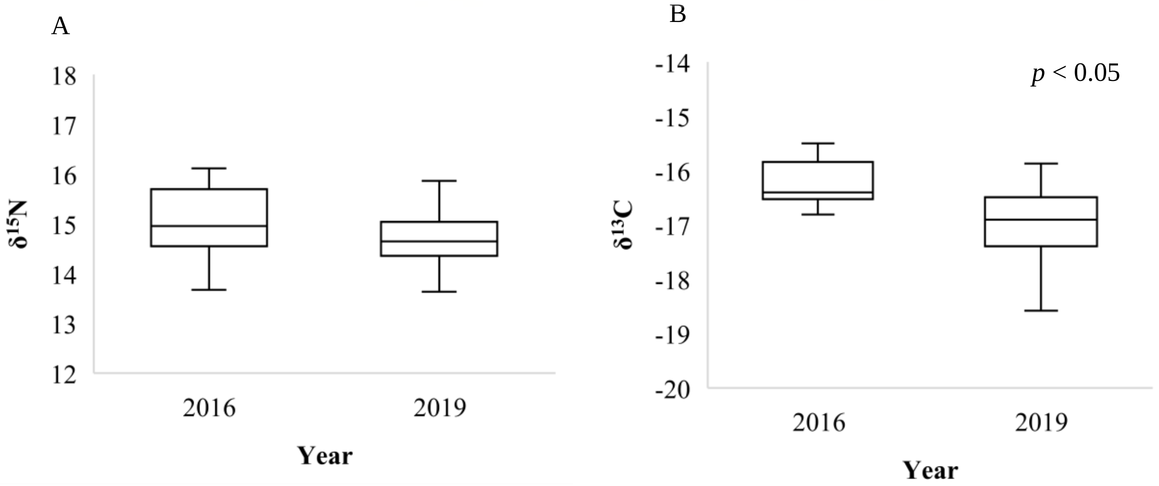

Figure 29: Boxplot illustrating mean δ^{15}N (**A**) and δ^{13}C (**B**) values (±SE) of *Lophius vomerinus* for each year of sampling.

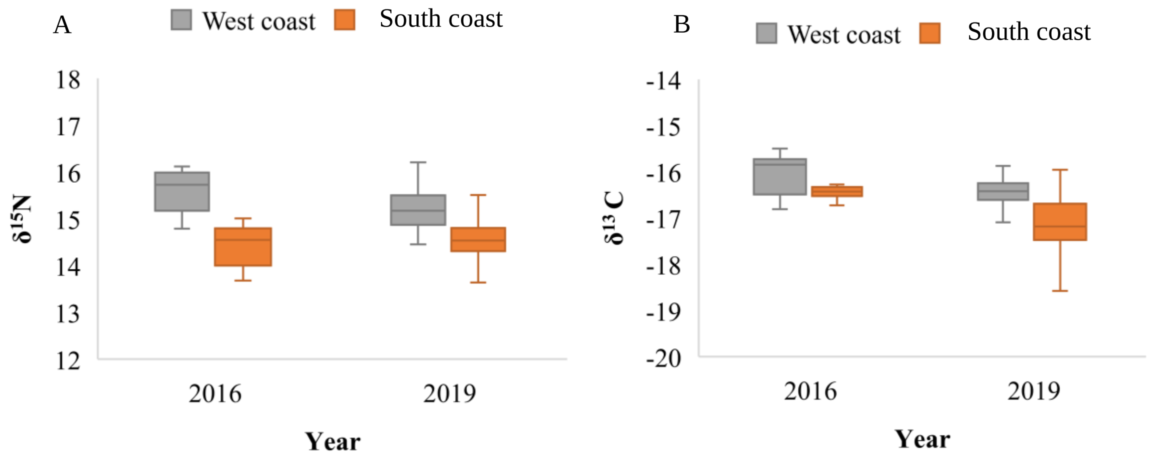

Figure 30: Boxplot illustrating mean δ^{15}N (**A**) and δ^{13}C (**B**) values (±SE) of *L. vomerinus* for each year of sampling on the West and South coasts.

3.7 Interspecific variation in δ^{15}N and δ^{13}C

Table 7: Summary of results obtained from univariate tests of significance for variation in the δ^{15}N (**A**) (R^2 = 0,545; Adjusted R^2 = 0,534) and δ^{13}C (**B**) (R^2 = 0,383; Adjusted R^2 = 0,368) values between Species, Coast, Depth strata and Size (TL). Significant interaction terms are included in the table and significant *p*-values (*p* < 0,05) are indicated in bold.

A	δ^{15}N				
Parameter	SS	Df	MS	F	Sig
Model	141,96	9	14,2	47,56	**P < 0,05**
Intercept	7463,4	1	7463,4	25005,07	**P < 0,05**
Depth	1,56	1	1,56	5,22	**P < 0,05**
Size	33,96	1	33,96	113,79	**P < 0,05**
Species	10,23	1	10,23	34,28	**P < 0,05**
Coast	43,01	1	43,01	144,12	**P < 0,05**
Year	7,09	2	3,55	11,88	**P < 0,05**
Coast*Year	3,44	1	3,44	11,54	**P < 0,05**
Error	118,49	397	0,3		
B	δ^{13}C				
Parameter	SS	Df	MS	F	Sig.
Model	96,336	9	9,63	24,69	**P < 0,05**
Intercept	11689,9	1	11689,9	29955,54	**P < 0,05**
Depth	0,76	1	0,76	1,96	P > 0,05
Size	16,91	1	16,91	43,32	**P < 0,05**
Species	0,51	1	0,51	1,3	P > 0,05
Coast	16,75	1	16,75	42,93	**P < 0,05**
Year	14,86	2	7,43	19,03	**P < 0,05**
Error	154,93	397	0,39		

The isotopic bi-plot displaying δ^{15}N and δ^{13}C values of *Genypterus capensis* and *Lophius vomerinus* displays a high level of overlap (Figure 31). *Genypterus capensis* displayed the highest and lowest δ^{15}N and δ^{13}C values on both coasts with *L. vomerinus* appearing more clustered than *G. capensis* in isospace.

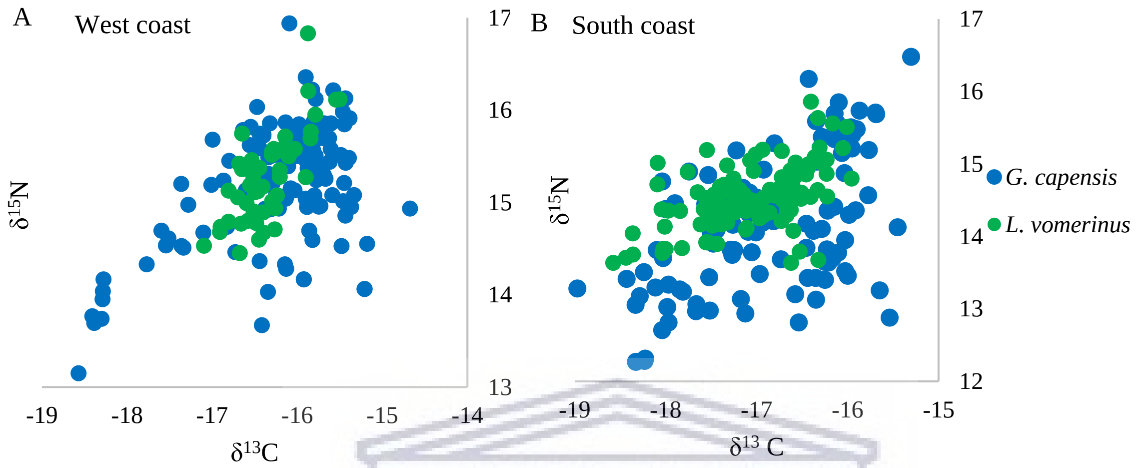

Figure 31: Isotopic bi-plot illustrating the δ^{15}N and δ^{13}C values of *Genypterus capensis* and *Lophius vomerinus* on the West (**A**) and South (**B**) coasts.

Despite the overlap, the results of the GLMs showed all tested factors to be influential in accounting forinterspecific differences in δ^{15}N, but not for δ^{13}C. Coast accounted for most of the variance seen in δ^{15}N followed by fish Size, Species, Year, Coast*Year interaction and Depth (Table 7). Coast also accounted for a large portion of the variance seen in δ^{13}C, however fish Size accounted for the majority of the variance δ^{13}C ($F_1 = 43{,}33$, $p < 0{,}05$), closely followed by Coast ($F_1 = 42{,}93$, $p < 0{,}05$) and then Year ($F_1 = 19{,}03$, $p < 0{,}05$) (Table 7). In both species, δ^{15}N values were higher on the South coast (Figure 32A). *Genypterus capensis* displayed higher mean δ^{15}N values on the West coast whilst *Lophius vomerinus* showed only marginally higher mean δ^{15}N values there (Figure 26A). Similarly, both species had higher δ^{13}C values onthe South coast with *Genypterus capensis* displaying higher mean δ^{13}C values on both coasts (Figure 32B).

Larger kingklip displayed higher δ^{15}N values than smaller size classes on both coasts, with the difference between small and large fish particularly marked on the South coast (Figure 33A). In contrast, the δ^{15}N values of monkfish showed much less variation between size classes and coasts (Figure 33B). The mean value of large monkfish was slightly lower than those of smaller size classes on the West coast, and large and medium-sized fish had similar values on the South coast that were not much higher than that of smaller ones. There was a trend in both species with $\delta^{13}C$ values showing a noticeable increase with fish size on the South coast, but a much lower increase with fish size on the West coast (Figure 33 C & D).

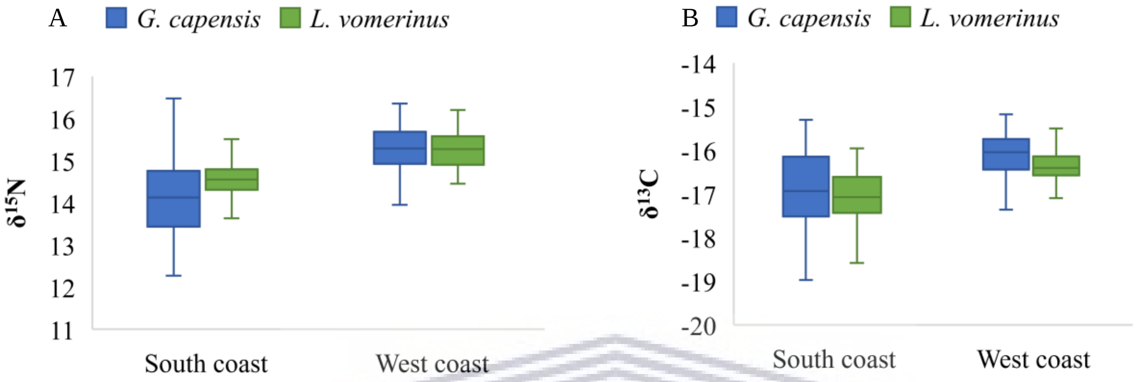

Figure 32: Boxplot illustrating mean $\delta^{15}N$ (**A**) and $\delta^{13}C$ (**B**) values (± SE) for *Genypterus capensis* and *Lophius vomerinus* on the South and West coasts.

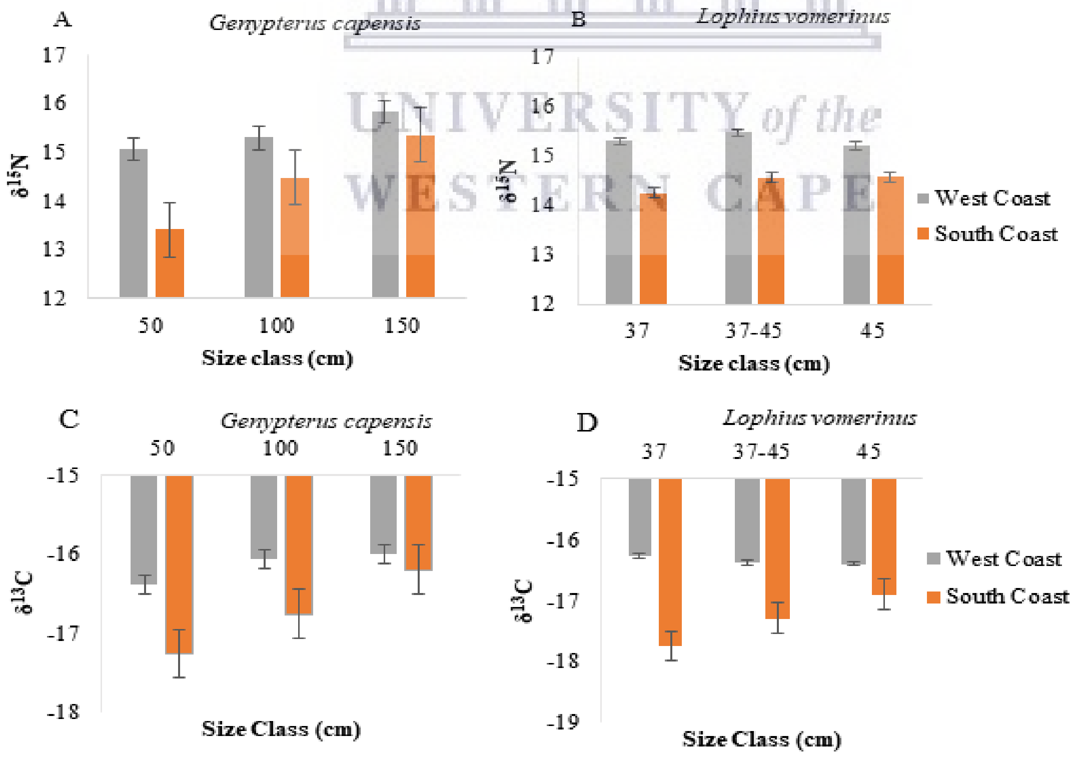

Figure 33: Mean $\delta^{15}N$ and $\delta^{13}C$ values (± SE) of *Genypterus capensis* (**A** & **C**) and *Lophius vomerinus* (**B** & **D**) at each size class on the West and South coasts.

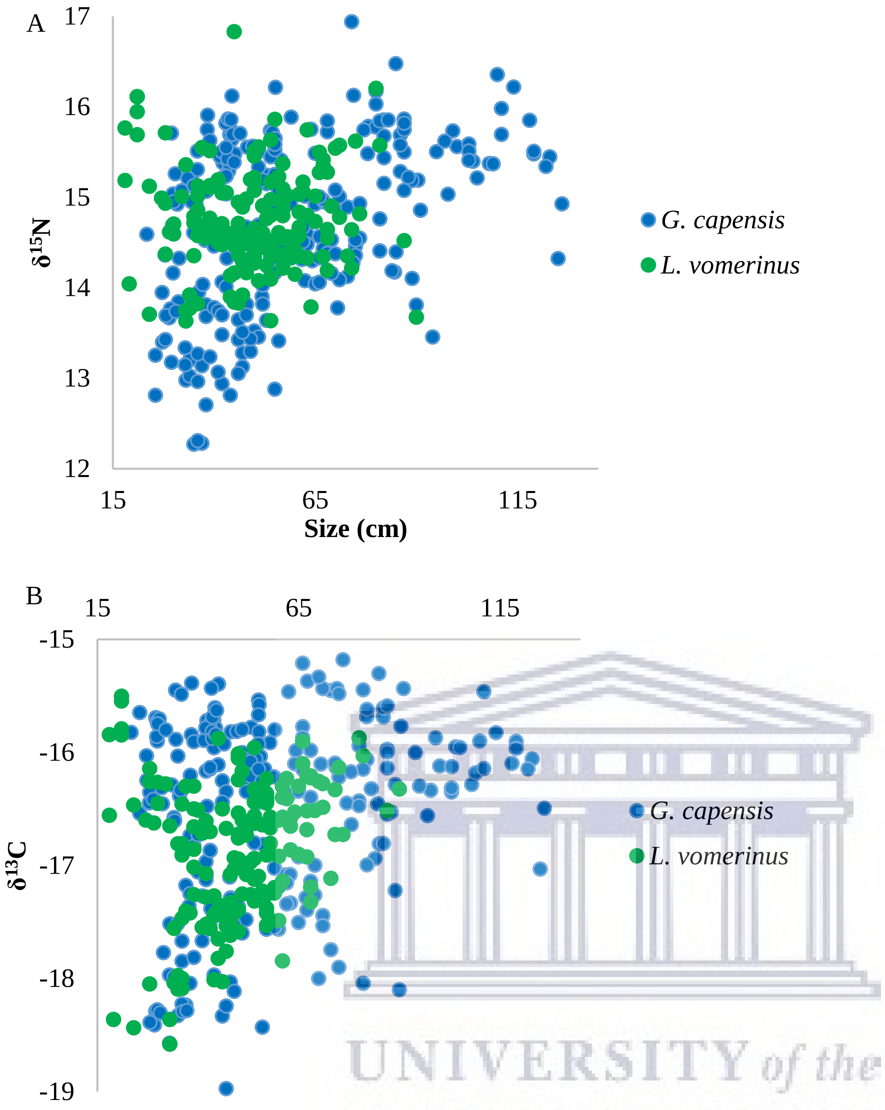

Figure 34: Scatterplots of $\delta^{15}N$ (**A**) and $\delta^{13}C$ (**B**) against size for *G. capensis* and *L. vomerinus.*

Genypterus capensis displayed a significant but weak positive relationship between Size and $\delta^{15}N$ ($R^2 = 0{,}18$, $p < 0{,}05$) whilst *L. vomerinus* displayed no relationship (Figure 34A). The results of the GLMs indicated that fish Size accounted for most of the variance in $\delta^{13}C$ (Table 7), with the scatterplots showing a weak correlation between $\delta^{13}C$ and size for both kingklip (R^2 0,06) and monkfish (R^2 =0,05) species (Figure 34B).

Results from the GLM indicated that Depth had a significant effect on the variance seen in $\delta^{15}N$ ($F_1 = 5{,}22$, $p < 0{,}05$) but not $\delta^{13}C$ ($p > 0{,}05$). The lowest mean $\delta^{15}N$ values were recorded from *G. capensis* sampled in the 1 - 200 m depth range on the South coast and the >

600 m depth range on the West coast (Figure 35), whilst the highest mean values were recorded in the > 600 m class on the South and the 600 m class on the West coasts (Figure 35). Overall, the West coast showed higher mean values across most of the depth classes than the South coast with both species showing similar average $\delta^{15}N$ values on the West Coast. Mean $\delta^{15}N$ values varied more between species on the South coast than those on the West coast.

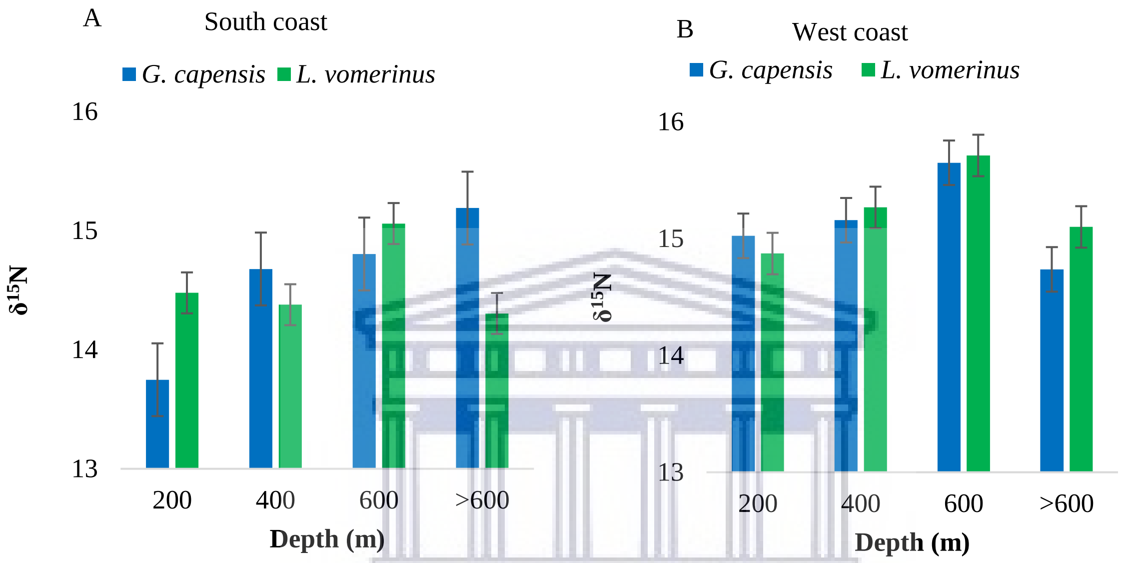

Figure 35: Mean $\delta^{15}N$ values (± SE) of *G. capensis* and *L. vomerinus* at each depth stratum on the South (**A**) and West coasts (**B**).

Chapter 4: Discussion

4.1 Stomach content analysis:

A total of 57 different prey species were identified in the diet of kingklip with 28 different species identified in the diet of monkfish. These observed changes in the variety of prey items observed are notable given that they are both considered “sit and wait ambush” predators occupying similar habitats (Macpherson 1983, Fariña et al. 2008). Body morphology is a major factor that directly affects foraging performance of fish with gape size known to be a factor limiting predation (Mittelbach & Persson 1998). *Genypterus capensis* grows to a considerably larger size than *Lophius vomerinus* but the former’s gape size is much smaller (Dunn et al. 2010). The body of monkfish is composed mainly of a huge gaping mouth which suggests that it is able to prey on a wider variety of prey species. Whilst *G. capensis* may have a smaller gape size they possess palatine teeth, which has been suggested to reduce the risk of prey escaping (Macpherson 1983). Frequency of feeding could also be a potential reason for the reduced prey diversity seen the diet of *Lophius vomerinus*. Monkfish are known to show a low frequency of feeding (Crozier 1985, Fariña et al. 2008), with Walmsley et al (2005) suggesting that the low frequency of feeding seen in *L. vomerinus* could be a tactic to ensure maximum energy intake with larger individuals often remaining inactive until previously ingested prey is completely digested.

Only two studies have focussed on the diet of kingklip off southern Africa (Macpherson 1983, Payne & Crawford 1989), although many have studied other members of this genus elsewhere in the world. Notably, Macpherson’s (1983) study of kingklip off the coast of Namibia found that the most abundant prey item eaten was *Merluccius capensis*. However the current study suggests that *Paracallionymus costatus* and *Pterygosquilla armata capensis* were the most important prey items overall, with *Merluccius capensis* occasionally featuring in the diet. This discrepancy could be attributed to the fact that Macpherson (1983) only studied samples collected off Namibia. This study sampled across the South and West coasts of South Africa and comprised stomach data ranging from 1984 - 2017 whereas Macpherson’s (1983) sample of 2 312 stomachs collected over only three years (1981-1983).

Despite depth not proving to be an important predictor in the diet of kingklip at order level, there appear to be differences at the species level. *Paracallionymus costatus* dominated the diet across the entire bathymetric range with *Pterygosquilla armata capensis* and *Cynoglossus capensis* found to dominate the diet at depths < 200 m, with distributional studies showing both species to be most common at these depths (Bianchi et al. 1999, Griffiths & Blaine 2010). *Coelorinchus simorhynchus* and *Helicolenus dactylopterus* appeared to feature heavily in the diet of *G. capensis* in the deeper waters (> 200 m) where both species are known to commonly occur (Eschmeyer 1969, Anderson & Iwamoto 1994). Macpherson's (1983) study found that *G. capensis* preyed primarily on shallow-water hake whilst this present study showed an almost exclusive preference for deep-water hake with the former featuring in the diet only at shallower depths.

Ontogenetic changes in diet are ubiquitous in demersal fishes (Werner 2019). *Paracallionymus costatus* dominated the diet of the small and medium size kingklip (50 – 100 cm). Macpherson (1983) reported similar findings regarding the proportion of small prey decreasing as kingklip size increased, with smaller species such as *P. costatus* frequently found in smaller individuals but less so in larger individuals. *Paracallionymus costatus* dominance in the diet of smaller individuals can be attributed to the fact that their maximum size is 15 cm. The diet of the larger (>100 cm) kingklip was dominated by larger teleosts such as *Merluccius paradoxus*, *Helicolenus dactylopterus* and notably other *Genypterus capensis.* This is not the first instance where cannibalism was shown to occur in *Genypterus,* with *Genypterus blacodes* off New Zealand also showing rare instances of cannibalism (Dunn et al. 2010).

The apparent shift in diet from small crustaceans towards fishes with increasing depth and size size is typical and supported by other studies conducted around other southern hemisphere species of *Genypterus* (Macpherson 1983, Nyegaard et al. 2004, Dunn et al. 2010, Mitchell 2010) (Table 8). *Genypterus blacodes* in New Zealand and Tasmanian waters also displayed a substantial crustacean component in the diet of smaller individuals (Nyegaard et al. 2004). Off the Argentinian shelf, small *Genypterus blacodes* fed on crustaceans with larger individuals preying primarily on fish (Renzi 1986). Interestingly, Macpherson (1983) and Nyegaard et al. (2004) also noted that larger kingklip frequently displayed partial predation, with only the head of larger prey being eaten, suggesting scavenging has taken place on discards from fishing vessels when available.

Table 8: Major dietary components for three different *Genypterus* species.

Species	**Region**	**Main dietary components**	**Ontogenetic shifts in diet**	**Reference**
G. blacodes	Falkland Islands	Teleosts: *Patagonotothen* spp. Crustacea: Unidentified Isopoda	Diet shifts from crustaceans to teleosts.	Nyegaard et al. 2004
G. blacodes	4 Different NZ fishing grounds	Teleosts: *Macruronus novaezelandiae* Crustacea: *Munida gregaria*	Diet shifts from crustaceans to teleosts.	Mitchell 2010
G. blacodes	Off the coast of NZ	Teleosts: demersal macrourids Crustacea: *Munida gracilis*	Teleosts frequency increased in larger fish	Dunn et al. 2010
G. chiliensis	Off the coast of Talcahuano, Chile	Crustacea: *Pleuroncodes monodon* Teleosts less important	Ontogeny not discussed.	Chong et al. 2006
G. capensis	Off the coast of Namibia	Teleosts: *Merluccius capensis* Crustacea: *Todarodes sagittatus*	Proportion of fishes increased with predator length.	Macpherson 1983
G. capensis	**W & S coasts of SA**	**Teleosts: *Paracallionymus costatus*** **Crustacea: *Pterygosquilla armata capensis***	**Proportion of fishes increased with predator length.**	**This study**

The diet of kingklip is similar to that of other South African demersal species such as Cape hakes, *Malacocephalus laevis* smooth-scaled rattail and cape gurnard (Meyer & Smale 1991). The dominance of the stomatopod, *Pterygosquilla armata capensis* in small kingklip on the West coast has also been seen in the diet of *M. laevis* (Meyer & Smale 1991). *Paracallionymus costatus* and *P. capensis* were also important species in the diet of small *M. laevis.* Cape gurnard are also known to prey on both *P. costatus* and *P. capensis* with both species occurring in the diet of small and large fish caught off the West coast of South Africa (Meyer & Smale 1991). *Paracallionymus costatus* is preyed on by a variety of demersal fish (with kingklip no exception) and is usually the dominant prey in small benthic predators mainly due to its widespread distribution and abundance (Prosch et al. 1989).

The dominance of *Pterygosquilla armata capensis* in the diet of smaller kingklip was limited to the West coast with distributional studies showing them to be most common on the West coast at depths less than 200 m (Abelló & Macpherson 1990). The increased dominance of larger teleosts specifically *Merluccius paradoxus* in the diet of medium and large (>100 cm) individuals may be attributed to the “bigger-deeper pattern” with large individuals occupying deeper waters and as a result increasing the encounter rate with larger prey species (Merrett & Marshall 1980). Deeper water species such as *Helicolenus dactylopterus* and *M. paradoxus* were frequently consumed by larger individuals, whilst *P. capensis* dominance in the diet decreased as the size increased.

Previous studies reporting on the diets of *Lophius* species have described their diet as size dependent, with invertebrates the main dietary item of juveniles and larger individuals shifting to a more ichthyophagous diet (Fariña et al. 2008) (Table 9). This study displays different findings, with teleosts such as hakes and dragonets dominating the diet of smaller fish on the West coast and invertebrates shown not to be as important. More recently Haubrock et al.'s (2020) paper focusing on the diet of *Lophius budegassa* in the south-eastern Mediterranean Sea also found that fish were the most important prey items in the diet of small monkfish with invertebrates, such as cephalopods, a rare occurrence in the diet.

Table 9: Major dietary components for 4 different *Lophius* species.

Species	**Region**	**Main dietary components**	**Ontogenetic shifts in diet**	**Reference**
L. americanus	NW Atlantic	Teleosts. *Ammodytes* spp.	Diet shifts away from invertebrates as they grew larger	Armstrong et al. 1996
L. budegassa	NE Atlantic	Demersal teleosts. *Micromesistius poutassou*	Diet shifts according to length-age	Preciado et al. 2006
L. piscatorius	NE Atlantic	Demersal teleosts. Gadoids specifically Norway pout	Not discussed	Crozier 1985
L. vomerinus	Namibia	Demersal teleosts. *Merluccius* spp. Crustacea. *Todarodes sagittatus*	Not discussed	Macpherson 1985
L. vomerinus	W & S coasts of SA	Demersal teleosts. *Merluccius* spp. Pelagic teleosts. *Paracallionymus costatus*	Prey size increased with increase in predator length	Walmsley et al. 2005
L. vomerinus	**W & S Coasts of SA**	**Demersal teleosts.** ***Merluccius paradoxus*** ***Paracallionymus costatus***	**Size not shown to have significant effect. Teleost dominant throughout**	**This study**

The results of this study agree with those of both Macpherson (1985) and Walmsley et al. (2005). Macpherson (1985), who examined the feeding habits of three demersal fishes off

Namibia, noted that the diet of *Lophius vomerinus* was dominated by hakes (*Merluccius*) and to a lesser extent cephalopod (Todarodes sagittatus). Walmsley et al. (2005), who studied the feeding of *L. vomerinus* off South Africa reported that hakes and dragonets dominated the diet. It is interesting to note that despite the studies being 20 years apart, the diet of this species has not materially changed over the last ~40 years (1981 – 2019) as this study showed similar findings.

The diet of monkfish was similar to that of another commercially important demersal species *Merluccius capensis*, with teleosts dominating the diet of both species (Pillar & Wilkinson 1995b). Pillar & Wilkinsons's (1995) paper focusing on the diet of the Cape hakes off the South coast of South Africa found that teleost fish accounted for 92% of the food ingested with horse mackerel the most common species (Pillar & Wilkinson 1995a). In this study, horse mackerel was also found to be important in the diet of monkfish on the South coast. These similarities don't carry over on to the West coast of South Africa, with crustaceans known to be of great importance in diet of both species of Cape hake (Payne et al. 1987). With fish size shown to not have a noticeable effect on the diet of monkfish, and teleosts dominating on both coasts, the current study suggests that monkfish do not display an ontogenetic shift in feeding. This has been seen in other South African demersal species such as the Cape gurnard *Chelidonichthys capensis* where fish were found to be of major importance in their diet on the West and South coasts (Meyer & Smale 1991).

Depth was found to be an important source of dietary variation in monkfish in this study. Similar changes in the diets of demersal fish with depth have been observed in several other studies and can be attributed to various aspects such as changes in prey availability and abundance (Crozier 1985, Walmsley et al. 2005, Fariña et al. 2008). The apparent reduction in the diversity of dominant prey groups with depth is reflective of species richness decreasing with depth (Costello & Chaudhary 2017). Notably Gadiformes dominated the diet (almost exclusively) on the West coast up to 600 m whereas the same depth range on the South coast showed an increase in the variety of dominant prey groups in the diet. This could be explained by the higher diversity associated with the Indian Ocean compared to that of the Atlantic Ocean (Meyer & Smale 1991).

Teleosts increased in frequency in the diet with an increase in fish size. *Lophius vomerinus* of all three size classes fed on a wide range of prey items a. Whilst *P. costatus* was common on both coasts *Gnathophis capensis* and *Etrumeus* spp dominated the diet on the

South coast in agreement with their known distributions (Roel & Armstrong 1991, Anderson 2005). Interestingly, larger prey items such as *Merluccius paradoxus* also contributed substantially to the diet of smaller individuals however this was restricted to the West coast where *M. paradoxus* is known to be more abundant. Distribution data on *L. vomerinus* off South Africa suggests that there is an overlap in the depth distributions of the three size-classes (Walmsley et al. 2005), suggesting that whilst depth does have an effect on diet, smaller fish have access to similar prey items as larger fish in the varying depth ranges. Lopez (2014) noticed similar findings in *L. budegassa* where there was no size related distribution according to depth.

Overall *Lophius vomerinus* and *Genypterus capensis* can be considered as euryphagous ambush predators feeding primarily on merluccids, Callionymidae, Squillidae, Carangidae and Decapods. Both species spend the majority of their time near or on the sea floor where they feed mainly on demersal teleosts. Both species also showed evidence of movements into the water column in order to feed on pelagic teleost species such as *Trachurus trachurus capensis* and *Etrumeus* spp. These pelagic prey items could also have been predated on during the day when they are known to be found closer to the sea floor (Axelsen et al. 2003). Walmsley et al. (2005) suggested that *L. vomerinus* may have alternate methods of feeding, and that the illicium may be lain flat on the seabed with the fleshy tip looking like a benthic worm. Such may explain the occurrence of *Cynoglossus zanzibarensis* flatfish in the diet as *C. zanzibarensis* is known to be an active benthic feeder and unlikely to be attracted by a flapping lure above the seabed.

The dominance of the Callionymiform fish *Paracallionymus costatus* in the diet of kingklip throughout the entire duration of sampling across both coasts highlights their importance as major prey item. Callionymiformes featured in almost every year of sampling with no other prey order featuring as consistently. The increased appearance of gadiformes in the 2000s could be linked to the generally positive recruitment index of Cape hakes seen in the early 2000s (Mbatha 2016). Apart from the increased appearance of Gadiformes there was no marked persistent interannual change in the diet of kingklip throughout the sampling period. What was common was for certain prey orders to frequently feature over 3 – 5 years and then decline only to reappear later on.

The importance of teleosts in the diet of monkfish is clearly seen in the time series, with them dominating throughout the sampling period. In the early 1990s and 2000s Perciformes frequently dominated the diet, particularly on the South coast. *Trachurus trachurus capensis* was identified as the species most responsible for this dominance, and is reflected in their increased contributions to demersal trawl catch proportions in the mid-2000s (Mussgnug 2013). Mussgnug's (2013) study on long term changes on the inshore trawling grounds of the Agulhas Bank has suggested that fastgrowing generalists such as horse mackerel are better suited to withstand increased fishing pressure than large slow growing taxa.

Although the spatial distribution of the demersal fishery off South Africa has not changed over the last three decades (Fairweather et al. 2006), changes in demersal communities are well documented (Yemane et al. 2014, Kirkman et al. 2016). Heavy fishing pressure can result in drastically transformed demersal assemblages both directly through fish removal and indirectly through alterations to benthic habitats. Whilst these factors may have contributed to changes in the fish community, so too may environmental drivers such as surface warming, increased stratification of the water column and changes in wind stress (Currie et al. 2020). Currie et al. (2020) have recently completed an analysis of long-term fluctuations in demersal fish assemblages over the Agulhas Bank, and have noted a substantial change in the demersal fish fauna over a 111-year time period, with species such as *Argyrosomus spp.* kob and *Austroglossus pectoralis* sole that were once dominant now being heavily depleted in recent resurveys.

This study has filled substantial gaps in the feeding ecology of *Lophius vomerinus* and *Genypterus capensis* around the coast of southern Africa. These species have the potential to play an important role in the regulation of benthic ecosystems through predation on the most abundant prey items. Future studies focussing on evaluating the diet of both species should seek to utilise both long-line and trawling as a means of sampling. Long-line fishing allows for samples to be collected over rocky substrata (the known preferred habitat of *G. capensis*) the likes of which are limited to access by trawling. Due to the importance that locality plays in prey availability one can assume that the different sampling methods will be reflected in the different prey items recorded in such a study. Further partnerships with the commercial trawling industry will assist as this would allow for year-round sampling which will undoubtedly allow for the explanation of *L. vomerinus* and *G. capensis trophic ecology* on a significantly larger temporal and spatial scale.

4.2 Stable isotope analysis

A substantial spatial effect was seen in both nitrogen and carbon isotope ratios of both species, with higher δ^{15}N and δ^{13}C values seen in fish from the West coast compared to the South coast. Interestingly, these results are in contrast to the results of van der Lingen & Miller (2014) and van der Heever (2017) whose studies reported lower δ^{13}C values (in hake and catsharks respectively) on the West coast. Barquete (2012) reported similar findings to that of this study with higher δ^{13}C values seen in seabirds off the West coast than those on the South coast. These spatial differences could reflect an isotopic gradient between the West and South coast. The South coast is a temperate shelf system, with the Agulhas Current leading to seasonal stratification and dynamic upwelling (Hutchings et al. 2009). The South coast is commonly characterised by poor chlorophyll *a* levels, flagellate-dominant phytoplankton and a dependency on N-fixed nitrogen and recycled nitrogen as the main source of this critical element (Hutchings et al. 2009). In contrast, the West coast is dominated by the cold Benguela Current which is characterised by diatom dominated phytoplankton communities, wind-driven coastal upwelling leading to eutrophic waters with often high chlorophyll *a* levels and a dependence on nitrate as the key source of nitrogen (Hutchings et al. 2009, Kirkman et al. 2016). The higher δ^{15}N values seen on the West coast for both species strongly supports the idea of spatially differentiated isotopic baselines along with biogeographic differences in sources of nitrogen around the West and South coasts of South Africa (van der Lingen & Miller 2014).

The differences seen in δ^{15}N values may also be as a result of spatial variability in the composition of the diet, with fish on the West coast preying on higher trophic level species than on the South coast. Various marine organisms are able to alter their trophic position in response to changes in food availability (Meyer & Smale 1991, Pillar & Wilkinson 1995b). A study by Pillar & Wilkinson (1995b), focusing on the diet of *Merluccius capensis* on the South coast of South Africa, reported a shift in prey items consumed. Van der Heever (2017) proposed that differences in δ^{15}N of the catsharks *Holohalaelurus regani* and *Scyliorhinus capensis* feeding on higher trophic level organisms such as teleosts and cephalopods on the West coast, whilst lower trophic level species (crustaceans) were more abundant in the diet on the South coast. Thus, in the current study, higher trophic level species such as *Merluccius paradoxus* were abundant in the diet of *Lophius vomerinus* on the West coast, with smaller, lower trophic level prey species being more common in the diet on the South coast.

Coast had a significant effect on $\delta^{13}C$ for both species, with lower $\delta^{13}C$ values recorded off the South coast than seen on the West coast. This could be explained by the increased rate of upwelling and diatom-based production off the West coast referred to above. Both species displayed a positive relationship between size and $\delta^{13}C$, with those from the South coast displaying a stronger positive relationship than those from the West coast. These findings are in contrast to the results of van der Lingen & Miller (2014), in which $\delta^{13}C$ values of Cape hakes were lower for fishes off the West coast compared to the South coast. An explanation for this difference could be *Merluccius* proximity to prey that are heavily reliant on $\delta^{13}C$ enriched microphytobenthic sources of production on the South coast compared to the West coast (Nerot et al. 2012).

Clear ontogenetic shifts in $\delta^{15}N$ were noted for *Genypterus capensis,* with larger fish having higher $\delta^{15}N$ values than smaller fish. Similar changes have been observed in other demersal species found around the coast of South Africa (Parkins 1993, Iitembu et al. 2012, van der Lingen & Miller 2014). Parkins's (1993) study on *Merluccius* spp. reported that $\delta^{15}N$ values in bone and muscle tissue increased with increasing fish length. Similarly, van der Lingen & Miller (2014) reported a significant linear increase in $\delta^{15}N$ values of *Merluccius capensis* and *Merluccius paradoxus* with size. A potential reason for this increase can be attributed to the changes in metabolic rates with smaller individuals having faster metabolic rates than that of larger individuals (Schmidt-Nielsen 1997). It is well known that bathypelagic fish show a decrease in metabolic rates with an increase in depth, and with larger fish known to occupy deeper water than smaller fish, it is expected that this may lead to increased fractionation of $\delta^{15}N$ in small fish with, the slower metabolism of larger fish resulting in more integration of isotopic nitrogen (Parkins 1993). Although *Genypterus blacodes* on the Patagonian shelf also displayed ontogenetic variation in their diet, the SIA data did not support this and spatio-temporal heterogeneity in the diet was cited as the main reason for this (Zhu et al. 2018).

Whilst the effect of depth on $\delta^{15}N$ was not significant for *Genypterus capensis,* there was an apparent increase in $\delta^{15}N$ values with an increase in depth on the West coast. The nonsignificance of the result could be becausebaseline δ^{15}N values did not vary enough to be expressed. Similarly, Iitembu's (2014) study on *Merluccius* spp. off Namibia also reported that depth had no effect on δ^{15}N values despite taking size into consideration.

Whilst literature focusing on the trophic ecology of species within the genus *Genpyterus* is scarce, there appears to be a notable level of variation in average nitrogen and carbon levels between species (Table 10). There are a variety of different sources of variation such as temporal variability of particulate organic matter, depth, size and potentially dietary opportunism displayed by most fish (Davenport & Bax 2002). Whilst all these sources contribute to the variation seen, the limited sample sizes of the various studies must also be taken into account. This study sampled muscle tissue from over 200 individual fish from varying depths, sizes and different regions and provides a robust assessment. The variation in values for congenerics suggests dietary trends are similar , but it must be remembered that diet only makes up one of many variables influencing isotopic ratios (Davenport & Bax 2002).

Table 10: Mean nitrogen and carbon values from the muscle tissue of 4 different *Genypterus* species from different regions in the world. When available, Standard Deviation (SD) or Standard error (SE) was provided.

Species	Region	n	Mean δ^{15}N (‰) (SD)	Mean δ^{13}C (‰) (SD)	Reference
G. blacodes	Coast of central Chile	6	20,71	-13,68	Hückstädt et al. 2007
G. blacodes	SE Australia	18	13,1	-17,2	Davenport & Bax 2002
G. blacodes	Southern Patagonian Shelf	5	17,7 (0,2)	-17,5 (0,2)	Ciancio et al. 2008
G. blacodes	Patagonian shelf break	9	16,69 (0,63)	-17,15 (0,30)	Zhu et al. 2018
G. brasiliensis	SW Atlantic, Brazil	1*	14,7	-16,1	Bugoni et al. 2010
G. chilensis	Western Chilean Patagonia	2	15,09 (0,47)	-16,42 (0,06)	Espejoab et al. 2018
G. capensis	Coast of South Africa	1*	15,83	-16,21	Weston 2018
G. capensis	**W & S coast of South Africa**	**240**	**14,72** **SE ± 0.07**	**-16,53** **SE ± 0.09**	**This study**

* Not mean

The lack of a marked change in nitrogen isotope values with size for *Lophius vomerinus* is unusual, as other species within the genus display clear ontogenetic changes. *Lophius budegassa* in the Mediterranean Sea displays an increase in δ^{15}N values with size, despite showing similar dietary compositions to *L. vomerinus* (Badalamenti et al. 2002). While size did not have an effect on δ^{15}N it did have a significant effect on δ^{13}C for *Lophius vomerinus,* though the low R^2 values indicate that the relationship between size and δ^{13}C is not clear. Interestingly, *Lophius budegassa* in the Mediterranean Sea displayed the opposite relationship, and Lopez (2014) reported an increase in δ^{13}C with an increase in fish size. Landa et al (2001) suggests that the variation seen in δ^{13}C reflect seasonal onshore offshore movements common amongst lophiiform species in response to prey availability, and that these movements contribute to seasonal variations in diet that are reflected in δ^{13}C. These findings are similar to those of other studies focusing on the fractionation of carbon isotopes (Mcconnaughey & Mcroy 1979, France 1995).

A significant effect of depth on δ^{15}N was noted for *Lophius vomernius* on the West coast, with increases being noted with an increase in depth. Various studies have suggested that the variations seen in the δ^{15}N and δ^{13}C values with depth could be attributed to the variability in isotopic baseline values, as well as trophic pathways present in both the offshore and inshore environments (Parkins 1993, Hussey et al. 2012). Often, offshore (deeper) marine environments are heavily dependent on phytoplanktonic production sources that are depleted in δ^{13}C whilst shallow marine environments depend more on microphytobenthic production sources which are known to be rich in δ^{13}C (Mcconnaughey & Mcroy 1979).

As seen in *Genypterus*, species within *Lophius* display variation in average nitrogen and carbon levels (Table 11). As mentioned above, a range of aspects influence isotopic ratios. Sherwood & Grabowski's (2007) study on the diet and habitat of *Lophius americanus* off the coast of New England USA explored the impact of habitat on isotopic ratios. When comparing the isotopic ratios of fish sampled from complex (i.e. rocky/ledge) vs. soft (i.e. sand/mud) habitats it was found that fish were substantially larger in complex habitats and displayed higher δ^{15}N ratios than those from the soft habitats. Fish sampled from the complex habitat were also found to prey on higher trophic level species. Whilst the link between size and δ^{15}N is well documented in fish it is interesting to note that the smallest of the seven species (*L. vomerinus*) displays the highest average δ^{15}N values (Table 11).

Table 11: Mean nitrogen and carbon isotope values from the muscle tissue of four different *Lophius* species from different regions in the world. When available Standard error (SE) was provided.

Species	Region	n	Mean δ^{15}N (‰) (SE)	Mean δ^{13}C (‰) (SE)	Reference
L. americanus	N Atlantic, Georges Bank	2	14,0 (±0,4)	-17,3 (±0,6)	Fry 1988
L. budegassa	NW Mediterranean Sea	150	10,60 (±1,32)	-18,49 (±0,4)	Lopez 2014
L. budegassa	Gulf of Castellammare, NW Sicily	6	11,1 (±0,0)	-18,2 (±0,0)	Badalamenti et al. 2002
L. piscatorius	N Atlantic, Iceland	5	14,3 (±0,2)	-16,7 (±0,3)	Sarà et al. 2009
L. piscatorius	Bay of Biscay, Spain	61	13,3 (± 1,2)	-17,1 (±0,5)	Chouvelon et al. 2014
L. litulon	Haizhou Bay China	5	11,3 (±4,8)	-18,8 (±0,8)	Ji et al. 2019
L. vomerinus	Namibia	23	14,91 (±1,06)	-15,79 (±0,90)	Erasmus 2015
L. vomerinus	**W & S coast of South Africa**	**168**	**14,74 (±1,45)**	**-16,88 (±0,72)**	**This study**

Significant interspecific isotopic differences between *Genypterus capensis* and *Lophius vomerinus* were noted for δ^{15}N but not δ^{13}C, with *L. vomerinus* feeding at a marginally higher trophic level than *G. capensis*. This is likely due to differing proportions of particular dietary groups. Despite *G. capensis* feeding on a wider variety of prey groups its diet was largely dominated by Callionymiform fishes (over 50 *%IRI*), an order comprising solely of the small and lower trophic level species *Paracallionymus costatus* (Jarre-Teichmann et al. 1998). The higher proportion of teleosts in the diet of *L. vomerinus* is a potential explanation as to why *L. vomerinus* exhibited higher δ^{15}N values than *G. capensis*. Large *G. capensis* displayed higher δ^{15}N values than large *L. vomerinus* on both coasts. One potential reason for this could be the size differences. The largest recorded *L. vomerinus* (81 cm) is substantially smaller than that of the largest (126 cm) *G. capensis.* Similar trends have been noted in other marine taxa with Vaudo & Heithaus's (2011) study on the diet of meso-predatory sharks in Australia reporting lower δ^{15}N values in small *Neotrygon* spp., when compared to bigger batoids in an identical environment. The study suggested that the small size of Neotrygon spp confine their dietary options to small lower trophic level species compared totheir larger counterparts (Vaudo & Heithaus 2011).

In general the results of the Stomach Content Analysis and Stable Isotope Analysis corroborate each other, with both analyses providing further insight into the diet of both species. The clear ontogenetic shifts noted with $\delta^{15}N$ values with increasing kingklip size can be attributed to the dietary shifts associated with growth. The higher proportion of higher trophic level species such as large teleosts (e.g. hake) are known to result in higher $\delta^{15}N$ values in the predator. The absence of a relationship between $\delta^{15}N$ and size for monkfish could be explained by the general dominance of teleosts in the diet of all size classes. Monkfish did not display the noticeable dietary shift often seen in other demersal species, whereby smaller fish prey on crustaceans and as they grow the diet shifts to a more ichthyophagous diet.

The higher average $\delta^{15}N$ values seen on the West coast for both species are largely supported by the results from the SCA. Whilst the isotopic gradient between coasts may also be partly responsible, the importance of the dietary differences between coasts must also be considered. The frequency with which large teleosts such as hake occurred in diet of both species was notably higher on the West coast than the South coast. Hence, it is possible that the spatial variability in their diets also resulted in the comparatively higher $\delta^{15}N$ values observed on the West Coast. The increase in $\delta^{13}C$ with size for both species was more pronounced on the South coast. The South coast continental shelf edge is abrupt, with slope depth increasing sharply; this marked shelf break creates a steeper gradient between benthic and pelagic-based production with an increase in depth, compared to that seen off the West coast, which is more diffuse (van der Lingen & Miller 2014).

The effect of depth on the diet of both species was not as obvious as seen with the other parameters. Whilst the diet of kingklip did not change substantially with depth, larger fish occupying deeper waters generally preyed on larger teleosts. Despite this, their average $\delta^{15}N$ values remained fairly consistent across all depth classes on the West coast with the South coast displaying slightly more variation. The results of the SIA matched that of the SCA, with depth not having a substantial effect on $\delta^{15}N$. Whilst depth did have an effect on the diet of monkfish in the SIA, itwas weak with average $\delta^{15}N$ values showing little variation on both coasts. This could be attributed to the constant presence of large teleost species in their diet in most depth ranges.

Chapter 5: Conclusion

The objectives of this study were to examine and compare the diet and trophic ecology of two species, *Lophius vomerinus* and *Genypterus capensis* commonly caught as by-catch by the hake-directed demersal trawling industry off the West and South coast of South Africa. In terms of their diet, kingklip diet was dominated by Callionymiformes, Decopoda, Stomatapoda, Pleuronectiformes and Gadiformes whilst Gadiformes, Perciformes, Anguilliformes, Scopaeniformes and Clupeiformes were dominant prey orders in the diet of monkfish. Both species consumed different prey categories off the West and South coasts, with the dominance of individual prey species differing between coasts. Both species displayed greater variety in the diet on the South coast than on the West coast. Their dietary differences accounted for the two species displaying restricted trophic interactions, with *Paracallionymus costatus* identified as one of the few important shared prey species in the diet of both species. *Merluccius paradoxus* also featured in the diet of both species with *L. vomerinus* the main predator. Whilst predation of each other is seen, it was of negligible importance.

This is the first study to explore and compare the trophic ecology of *Genypterus capensis* and *Lophius vomerinus* using SIA. Based on these findings, there seems to be spatial and ontogenetic variability in δ^{15}N and δ^{13}C values which is supported by the results of the SCA, showing significant spatial and ontogenetic differences in the diet. In addition, significant interspecific differences in δ^{15}N corroborate dietary differences between the two species. Overall, the stable isotope data were in agreement with the dietary data for *L. vomerinus* with the effect of coast and depth being significant for δ^{15}N. Mean δ^{15}N values for *L. vomerinus* were higher on the West Coast and increased with depth. This may also be reflective of spatially different isotopic baselines due to local differences in nitrogen and carbon production. These differences in trophic levels may also be attributed to the varying prey items consumed and their respective trophic levels. These findings suggest that overall *Lophius vomerinus* feeds at a higher trophic level than *Genypterus capensis* on the West coast.

It is argued that ecosystem dynamic models such as ECOPATH (Pauly et al. 2000), often underestimate trophic position as they assign arbitrary baseline trophic levels to species (Hussey et al. 2014). Trophic levels as assessed using SCA are also known to routinely truncate trophic level estimates, with the calculated trophic level displaying bias towards shorter chain lengths, which can limit trophic level estimates (Dame & Christian 2008). Both methods produce average trophic level estimates and don't often reflect the true trophic position of the individual species and the system as a whole (Hussey et al. 2014). In this study the use of stomach content data collected over 30 years, coupled with the recent complementary stable isotope data, improves our understandings of trophic interactions and can be used further refine trophic level assignments (Navarro et al. 2011) in future ecosystem modelling.

The Shannon et al. (2003) study on the trophic flows in the southern Benguela off the West coast in the 1980s and 1990s lumped several benthic feeding demersal fishes together, including *Genypterus capensis* and *Lophius vomerinus,* in Ecopath models and suggested they feed at a lower trophic level than Cape hakes (Shannon et al. 2003). The stomach content data presented here overlap the same time period of the Shannon et al. (2003) study and also contain more recent data. The results of the SCA suggest both *Genypterus capensis* and *Lophius vomerinus* occupy a similar or slightly higher trophic level than hakes, with δ^{15}N values of *G. capensis, L. vomerinus* and *M. capensis* off the West coast almost exactly the same and higher than *M. paradoxus* (Shannon et al. 2003). Off the South coast, δ^{15}N values of *G. capensis* and *L. vomerinus* were higher than both Cape hake species which suggests that future Ecopath modelling should be altered to reflect this equivalence and slightly higher trophic level of both species. Future stable isotope data will undoubtably assist in further validating and refining Ecopath models with more long-term sampling an area for future research.

Whilst the results of this study have further highlighted the benefits of SIA to investigate trophic relations, there is room for improvement. Owing to the fact that trophic interactions are non-linear and highly complex (Croll et al. 2005), there is a need for more long-term studies. Future studies should look into obtaining isotope data from ingested prey items when the items are unable to be identified as this allows for a better understanding of the role that these demersal teleosts have in the demersal food web. Furthermore, samples should be collected in different seasons to explain temporal differences in not only the biological but the physical processes operating off each coast. Using stable isotopes does come with a fair amount of uncertainty associated with fractionation factors and isotopic turnover rates, which are known to vary between species and size (Iitembu 2014). A potential future area of research could be trying to understand species-specific fractionation and isotopic turnover rates.

Genypterus capensis and *Lophius vomerinus* are long lived slow maturing species and are extremely vulnerable to overfishing and overexploitation. This study has identified important prey species in the diet of both species. Owing to the lack of data on the majority of these prey species, and increasing commercial fishing pressure (Walmsley et al. 2005), I recommend further studies focusing on prey abundance as well as continued monitoring of prey population trends. The failure to do so correctly could have a severe reprecussions, with impacts on demersal fish communities as well as the demersal fishing sector. This information has the potential to support sustainable fisheries research and can be seen as an attempt to improve fisheries management through the Ecosystem Approach to Fisheries management. To date we have data for both SCA and SIA for hakes, monkfish and kingklip and two catshark species (van der Heever 2017). Continued integrated (i.e., SCA and SIA) research on other important demersal species (jacopever, dragonet, soles, etc.) will enable a more comprehensive understanding of the benthic food web structure and functioning in the West and South coast ecosystems off South Africa.

Appendices

Appendix 1: Percentage number (*%N*), Percentage frequency (*%FO*), percentage weight (*%W*) and percentage IRI (*%IRI*) data for prey items found in the stomachs of *Lophius vomerinus* on the West and South coasts along with overall. Values in bold denote frequently occurring (*%FO*)/important taxa (*%IRI*) (>10%). The minimum displayable value "-"denotes to null values.

	West				**South**				**Overall**			
	%N	***%F***	***%W***	***%IRI***	***%N***	***%F***	***%W***	***%IRI***	***%N***	***%F***	***%W***	***%IRI***
Arthropoda	10,61	8,64	1,54	0,87	3,81	4,81	0,13	0,14	7,73	7,33	0,87	0,50
Malacostraca	10,61	8,61	1,54	0,89	3,81	4,81	0,13	0,14	7,73	7,31	0,87	0,51
Decapoda	5,62	5,45	0,39	1,08	3,63	4,00	0,11	0,70	4,78	4,94	0,26	1,12
Natantia	0,73	0,79	0,05	0,04	0,26	0,50	0,01	0,01	0,54	0,69	0,03	0,03
Pandalidae	0,57	0,27	0,02	0,01	0,79	0,51	0,00	0,02	0,66	0,36	0,01	0,02
Plesionika	0,55	0,26	0,02	0,01	0,78	0,50	0,00	0,02	0,65	0,35	0,01	0,02
martia	0,95	0,45	0,03	0,02	1,36	0,86	0,00	0,05	1,12	0,59	0,01	0,04
Penaeidae	4,34	4,38	0,32	1,11	2,62	3,03	0,10	0,48	3,62	3,91	0,21	1,03
Funchalia	3,84	3,97	0,31	0,97	2,61	3,00	0,10	0,48	3,33	3,63	0,21	0,94
woodwardi	6,65	6,73	0,48	2,05	4,52	5,17	0,13	1,08	5,77	6,19	0,30	2,20
Penaeidae	0,37	0,26	0,00	0,01	-	-	-	-	0,22	0,17	0,00	0,00
Stomatopoda	5,06	3,27	1,15	0,67	0,26	0,50	0,02	0,01	3,04	2,29	0,61	0,38

Squillidae	5,09	3,29	1,15	1,11	0,26	0,51	0,02	0,01	3,07	2,31	0,61	0,59
Pterygosquilla	2,93	2,12	0,55	0,43	0,26	0,50	0,02	0,01	1,83	1,56	0,30	0,24
capensis	5,06	3,59	0,84	0,91	0,45	0,86	0,03	0,02	3,17	2,65	0,43	0,56
Squillidae	2,01	1,06	0,60	0,16	-	-	-	-	1,18	0,69	0,32	0,08
Chordata	72,25	**73,26**	84,13	**94,44**	75,13	**78,61**	92,71	**96,78**	73,47	**75,09**	**88,23**	**95,56**
Actinopterygii	70,58	**72,22**	83,57	**94,29**	74,11	**77,01**	92,19	**96,68**	72,07	**73,86**	**87,68**	**95,43**
Anguilliformes	4,49	4,90	1,71	1,01	12,95	**18,00**	3,90	**14,21**	8,04	9,52	2,76	4,61
Congridae	4,53	4,93	1,63	1,65	12,07	**16,67**	3,70	**15,17**	7,68	9,06	2,62	6,43
Gnathophis	4,39	4,76	1,63	1,69	12,01	**16,50**	3,70	**15,15**	7,53	8,82	2,62	6,53
capensis	3,48	4,04	1,14	0,80	3,17	3,45	0,48	0,56	3,35	3,83	0,80	0,93
Aulopiformes	0,19	0,27	0,06	0,00	-	-	-	-	0,11	0,18	0,03	0,00
Chlorophthalmidae	0,19	0,27	0,06	0,00	-	-	-	-	0,11	0,18	0,03	0,00
Chlorophthalmus	0,18	0,26	0,06	0,00	-	-	-	-	0,11	0,17	0,03	0,00
Callionymiformes	14,42	**16,35**	2,58	9,20	2,85	3,00	0,10	0,41	9,57	**11,64**	1,40	5,72
Callionymidae	14,53	**16,44**	2,58	**15,27**	2,89	3,03	0,10	0,52	9,66	**11,72**	1,40	8,93
Paracallionymus	14,08	**15,87**	2,58	**15,63**	2,87	3,00	0,10	0,52	9,46	**11,42**	1,40	9,05
costatus	24,37	**26,91**	3,88	**32,48**	4,98	5,17	0,13	1,19	16,39	**19,47**	1,96	**20,92**
Clupeiformes	7,68	6,27	12,45	4,17	13,99	**11,00**	7,25	**10,94**	10,33	7,94	9,97	7,22
Dussumieriidae	6,04	5,48	5,12	3,32	13,39	**10,10**	6,80	**11,76**	9,11	7,10	5,92	7,36

Etrumeus	5,85	5,29	5,12	3,43	13,32	10,00	6,79	**11,75**	8,92	6,92	5,91	7,50
Engraulidae	1,70	0,82	7,35	0,40	0,79	1,01	0,47	0,07	1,32	0,89	4,07	0,33
Engraulis	1,65	0,79	7,34	0,42	0,78	1,00	0,47	0,07	1,29	0,87	4,06	0,34
Cypriniformes	-	-	-	-	0,78	1,00	0,38	0,05	0,33	0,35	0,18	0,01
Cyprinidae	-	-	-	-	0,79	1,01	0,38	0,07	0,33	0,36	0,18	0,01
Gonorhynchus	-	-	-	-	0,78	1,00	0,38	0,07	0,32	0,35	0,18	0,01
gonorhynchus	-	-	-	-	1,36	1,72	0,51	0,14	0,56	0,59	0,26	0,03
Gadiformes	29,96	**30,52**	39,84	**70,49**	9,07	10,00	19,55	**13,40**	21,20	**23,28**	**30,16**	**53,61**
Macrouridae	10,94	**11,78**	10,43	**13,67**	2,62	3,03	1,23	0,67	7,46	8,70	6,04	8,10
Coelorinchus	9,69	**10,32**	8,91	**11,35**	2,61	3,00	1,23	0,67	6,77	7,79	5,25	6,83
Malacocephalus	0,91	1,06	1,50	0,15	-	-	-	-	0,54	0,69	0,79	0,07
laevis	1,58	1,79	2,31	0,30	-	-	-	-	0,93	1,18	1,13	0,14
Merluccidae	18,87	**18,63**	29,33	**48,74**	5,77	6,57	17,83	8,94	13,39	**14,39**	**23,85**	**36,90**
Merluccius	18,28	**17,99**	29,30	**50,59**	5,74	6,50	17,81	8,95	13,12	**14,01**	**23,82**	**37,78**
capensis	4,43	4,93	15,61	4,22	4,98	6,03	14,82	5,37	4,66	5,31	**15,20**	6,17
Paradoxus	21,84	**20,18**	27,75	**42,77**	3,62	4,31	5,80	1,83	14,34	**14,75**	**16,52**	**26,65**
Moridae	0,38	0,55	0,14	0,02	0,79	1,52	0,53	0,11	0,55	0,89	0,32	0,05
Physiculus	0,37	0,53	0,14	0,02	0,78	1,50	0,52	0,11	0,54	0,87	0,32	0,05
capensis	0,32	0,45	0,15	0,01	0,90	1,72	0,48	0,11	0,56	0,88	0,32	0,05

Myctophiformes	0,75	0,82	0,05	0,02	-	-	-	-	0,43	0,53	0,03	0,01
Myctophidae	0,75	0,82	0,05	0,04	-	-	-	-	0,44	0,53	0,03	0,02
Myctophidae	0,73	0,79	0,05	0,04	-	-	-	-	0,43	0,52	0,03	0,02
Notacanthiformes	0,37	0,27	1,14	0,01	-	-	-	-	0,22	0,18	0,59	0,01
Halosauridae	0,38	0,27	1,14	0,02	-	-	-	-	0,22	0,18	0,60	0,01
Ophidiiformes	0,56	0,82	3,91	0,12	1,30	1,50	4,72	0,42	0,87	1,06	4,29	0,24
Ophidiidae	0,57	0,82	3,91	0,20	1,31	1,52	4,73	0,53	0,88	1,07	4,30	0,38
Genypterus	0,55	0,79	3,91	0,21	1,31	1,50	4,72	0,53	0,86	1,04	4,29	0,39
capensis	0,95	1,35	6,01	0,40	2,26	2,59	6,32	1,00	1,49	1,77	6,17	0,79
Perciformes	3,75	3,27	9,21	1,40	14,51	**16,00**	37,04	**38,62**	8,26	7,76	**22,48**	**10,70**
Callanthiidae	0,19	0,27	0,16	0,01	-	-	-	-	0,11	0,18	0,09	0,00
Callanthias	0,18	0,26	0,16	0,01	-	-	-	-	0,11	0,17	0,09	0,00
Carangidae	1,32	1,37	5,20	0,48	13,91	**14,65**	30,77	**37,76**	6,59	6,04	**17,39**	9,97
Trachurus	1,28	1,32	5,19	0,51	13,84	**14,50**	30,73	**37,78**	6,45	5,88	**17,37**	**10,23**
capensis	1,58	1,79	5,89	0,57	21,72	**21,55**	33,03	**53,01**	9,87	8,55	**19,78**	**14,85**
Emmelichthyidae	1,70	0,82	0,64	0,10	-	-	-	-	0,99	0,53	0,33	0,05
Emmelichthys	1,65	0,79	0,63	0,11	-	-	-	-	0,97	0,52	0,33	0,05
Epigonidae	-	-	0,01	-	-	-	-	-	-	-	0,01	-
Epigonus	-	-	0,01	-	-	-	-	-	-	-	0,01	-

Gobiidae	0,38	0,55	0,02	0,01	-	-	-	-	0,22	0,36	0,01	0,01
Sufflogobius	0,37	0,53	0,02	0,01	-	-	-	-	0,22	0,35	0,01	0,01
bibarbatus	0,63	0,90	0,03	0,03	-	-	-	-	0,37	0,59	0,02	0,01
Sparidae	-	-	-	-	0,79	1,52	6,35	0,62	0,33	0,53	3,03	0,12
Pterogymnus	-	-	-	-	0,78	1,50	6,34	0,62	0,32	0,52	3,02	0,13
laniarius	-	-	-	-	1,36	2,59	8,49	1,14	0,56	0,88	4,34	0,25
Trichiuridae	0,19	0,27	3,19	0,05	-	-	-	-	0,11	0,18	1,67	0,02
Lepidopus	0,18	0,26	3,19	0,05	-	-	-	-	0,11	0,17	1,67	0,02
caudatus	0,32	0,45	4,91	0,10	-	-	-	-	0,19	0,29	2,40	0,04
Pleuronectiformes	2,81	3,54	2,98	0,68	6,99	5,50	2,59	2,47	4,57	4,23	2,79	1,40
Cynoglossidae	2,83	3,56	2,98	1,12	7,09	5,56	2,60	3,10	4,61	4,26	2,80	2,17
Cynoglossus	2,74	3,44	2,98	1,16	7,05	5,50	2,59	3,10	4,52	4,15	2,79	2,22
Scombriformes	-	-	-	-	1,55	1,50	3,44	0,35	0,65	0,53	1,64	0,05
Scombridae	-	-	-	-	1,57	1,52	3,44	0,44	0,66	0,53	1,64	0,08
Scomber	-	-	-	-	1,57	1,50	3,44	0,44	0,65	0,52	1,64	0,09
japonicus	-	-	-	-	2,71	2,59	4,60	0,85	1,12	0,88	2,36	0,18
Scorpaeniformes	5,43	5,18	9,34	2,53	10,88	**10,50**	12,43	**11,46**	7,72	7,05	**10,81**	5,86
Sebastidae	4,53	4,38	6,97	2,74	9,71	9,09	10,60	**10,66**	6,70	6,04	8,70	6,40
Helicolenus	4,39	4,23	6,96	2,84	9,66	9,00	10,59	**10,65**	6,56	5,88	8,69	6,55

dactylopterus	7,59	7,17	10,71	5,61	16,74	**15,52**	14,17	**21,55**	11,36	**10,03**	**12,48**	**14,00**
Triglidae	0,94	0,82	2,38	0,15	1,31	1,52	1,85	0,28	1,10	1,07	2,13	0,24
Chelidonichthys	0,91	0,79	2,38	0,15	1,31	1,50	1,85	0,28	1,08	1,04	2,13	0,24
Stomiiformes	0,56	0,54	0,34	0,02	-	-	-	-	0,33	0,35	0,18	0,01
Phosichthyidae	0,19	0,27	0,34	0,01	-	-	-	-	0,11	0,18	0,18	0,00
Photichthys	0,18	0,26	0,34	0,01	-	-	-	-	0,11	0,17	0,18	0,00
argenteus	0,32	0,45	0,52	0,02	-	-	-	-	0,19	0,29	0,26	0,01
Sternoptychidae	0,38	0,27	0,00	0,01	-	-	-	-	0,22	0,18	0,00	0,00
Maurolicus	0,37	0,26	0,00	0,01	-	-	-	-	0,22	0,17	0,00	0,00
walvisensis	0,63	0,45	0,01	0,01	-	-	-	-	0,37	0,29	0,00	0,01
Tetraodontiformes	-	-	-	-	0,78	0,50	0,87	0,04	0,33	0,18	0,42	0,01
Tetraodontidae	-	-	-	-	0,79	0,51	0,88	0,05	0,33	0,18	0,42	0,01
Sphoeroides	-	-	-	-	0,78	0,50	0,87	0,05	0,32	0,17	0,42	0,01
pachygaster	-	-	-	-	1,36	0,86	1,17	0,10	0,56	0,29	0,60	0,02
Chondrichthyes	1,30	0,83	0,30	0,01	0,51	0,53	0,11	0,00	0,97	0,73	0,21	0,01
Selachii	0,55	0,26	0,04	0,01	-	-	-	-	0,32	0,17	0,02	0,00
Rajiformes	0,37	0,27	0,03	0,00	-	-	-	-	0,22	0,18	0,01	0,00
Rajidae	0,38	0,27	0,03	0,01	-	-	-	-	0,22	0,18	0,01	0,00
Raja	0,37	0,26	0,03	0,01	-	-	-	-	0,22	0,17	0,01	0,00

Squaliformes	0,37	0,27	0,23	0,01	0,52	0,50	0,11	0,01	0,43	0,35	0,17	0,01
Squalidae	0,38	0,27	0,23	0,01	0,52	0,51	0,11	0,02	0,44	0,36	0,17	0,01
Squalus	0,37	0,26	0,23	0,01	0,52	0,50	0,11	0,02	0,43	0,35	0,17	0,02
acutipinnis	0,63	0,45	0,35	0,02	0,90	0,86	0,15	0,04	0,74	0,59	0,25	0,03
Elasmobranchii	0,37	0,28	0,27	0,00	0,51	1,07	0,41	0,01	0,43	0,55	0,34	0,00
Carcharhiniformes	0,37	0,27	0,27	0,01	0,52	1,00	0,41	0,04	0,43	0,53	0,34	0,02
Scyliorhinidae	0,38	0,27	0,27	0,01	0,52	1,01	0,41	0,05	0,44	0,53	0,34	0,03
Holohalaelurus	0,37	0,26	0,27	0,01	0,52	1,00	0,41	0,05	0,43	0,52	0,34	0,03
regani	-	-	-	-	0,90	1,72	0,55	0,11	0,37	0,59	0,28	0,02
Echinodermata	-	-	-	-	2,03	0,53	0,08	0,01	0,86	0,18	0,04	0,00
Asteroidea	-	-	-	-	2,03	0,53	0,08	0,01	0,86	0,18	0,04	0,00
Mollusca	17,13	**18,11**	14,33	4,70	19,04	**16,04**	7,07	3,07	17,94	**17,40**	**10,87**	3,94
Cephalopoda	17,13	**18,06**	14,33	4,81	19,04	**16,04**	7,07	3,16	17,94	**17,37**	**10,87**	4,05
Myopsida	1,12	1,36	0,04	0,05	6,99	3,50	4,37	1,86	3,59	2,12	2,11	0,54
Loliginidae	1,13	1,37	0,04	0,09	7,09	3,54	4,38	2,34	3,62	2,13	2,11	0,84
Afrololigo	1,10	1,32	0,04	0,09	-	-	-	-	0,65	0,87	0,02	0,04
Loligo	-	-	-	-	7,05	3,50	4,37	2,34	2,90	1,21	2,08	0,44
reynaudii	-	-	-	-	12,22	6,03	5,85	4,90	5,03	2,06	3,00	0,97
Oegopsida	3,93	3,54	10,28	1,67	2,33	3,50	2,01	0,71	3,26	3,53	6,34	1,52

Ommastrephidae	3,96	3,56	10,30	2,76	2,36	3,54	2,01	0,89	3,29	3,55	6,35	2,36
Todarodes	3,84	3,44	10,29	2,87	2,35	3,50	2,01	0,89	3,23	3,46	6,34	2,42
angolensis	1,27	1,35	6,83	0,47	-	-	-	-	0,74	0,88	3,33	0,21
eblanae	5,38	4,48	9,01	2,76	4,07	6,03	2,69	1,83	4,84	5,01	5,78	3,12
Sepiida	12,17	**12,81**	4,00	6,86	10,10	8,50	0,70	4,30	**11,30**	**11,29**	2,43	6,95
Sepiidae	9,06	9,32	2,94	6,07	10,24	8,59	0,70	5,42	9,55	9,06	1,87	7,13
Sepia	8,78	8,99	2,94	6,23	10,18	8,50	0,70	5,41	9,35	8,82	1,87	7,23
australis	10,76	**10,76**	3,18	6,41	10,41	**10,34**	0,58	5,11	**10,61**	**10,62**	1,85	7,75
hieronis	0,63	0,90	0,32	0,04	-	-	-	-	0,37	0,59	0,15	0,02
Sepiolidae	3,21	3,56	1,07	0,83	-	-	-	-	1,87	2,31	0,56	0,39
Austrorossia	1,83	2,12	0,86	0,34	-	-	-	-	1,08	1,38	0,45	0,15
Rondeletiola	0,37	0,26	0,02	0,01	-	-	-	-	0,22	0,17	0,01	0,00
capensis	0,63	0,45	0,03	0,01	-	-	-	-	0,37	0,29	0,02	0,01
Rossia	0,91	1,06	0,18	0,07	-	-	-	-	0,54	0,69	0,10	0,03
Macrouridae	0,55	0,53	0,09	0,03	-	-	-	-	0,32	0,35	0,05	0,01
Teleost	1,65	2,12	1,06	0,33	0,26	0,50	0,15	0,01	1,08	1,56	0,62	0,19

Appendix 2: Percentage number (*%N*), Percentage frequency (*%FO*), percentage weight (*%W*) and percentage IRI (*%IRI*) data for prey items found in the stomachs of *Lophius vomerinus* at different depths on both coasts overall. Values in bold denote frequently occurring (*%FO*)/important taxa (*%IRI*) (>10%). The minimum displayable value "-"denotes to null values.

	200				**400**				**600**			
Row Labels	***%N***	***%F***	***%W***	***%IRI***	***%N***	***%F***	***%W***	***%IRI***	***%N***	***%F***	***%W***	***%IRI***
Arthropoda	9,59	**10,25**	1,24	0,92	3,98	2,86	0,36	0,09	5,17	4,55	0,37	0,20
Malacostraca	9,59	**10,22**	1,24	0,93	3,98	2,86	0,36	0,09	5,17	4,55	0,37	0,21
Decapoda	6,26	7,02	0,39	2,55	2,02	1,70	0,09	0,10	1,72	2,27	0,04	0,06
Natantia	0,66	0,87	0,03	0,04	0,40	0,56	0,06	0,01	-	-	-	-
Pandalidae	1,00	0,59	0,02	0,04	-	-	-	-	-	-	-	-
Plesionika	0,99	0,58	0,02	0,04	-	-	-	-	-	-	-	-
martia	1,66	0,96	0,02	0,09	-	-	-	-	-	-	-	-
Penaeidae	4,66	5,62	0,34	1,84	1,63	1,14	0,03	0,09	1,72	2,27	0,04	0,12
Funchalia	4,61	5,54	0,34	1,85	0,80	0,56	0,03	0,02	1,56	2,04	0,04	0,12
woodwardi	7,76	9,09	0,53	4,22	1,31	0,91	0,04	0,04	4,35	5,00	0,05	0,87
Penaeidae	-	-	-	-	0,80	0,56	0,01	0,02	-	-	-	-
Stomatopoda	3,46	2,92	0,85	0,69	2,02	1,14	0,27	0,07	3,45	2,27	0,33	0,13
Squillidae	3,49	2,96	0,85	0,84	2,04	1,14	0,28	0,12	3,45	2,27	0,33	0,25
Pterygosquilla	1,65	1,75	0,30	0,23	2,00	1,11	0,28	0,12	3,13	2,04	0,33	0,25

capensis	2,77	2,87	0,46	0,52	3,27	1,82	0,38	0,23	8,70	5,00	0,39	1,81
Squillidae	1,81	1,17	0,55	0,19	-	-	-	-	-	-	-	-
Chordata	**70,24**	**71,12**	**92,06**	**95,23**	**80,08**	**81,14**	**86,14**	**96,54**	**75,86**	**77,27**	**76,51**	**93,71**
Actinopterygii	**69,43**	**70,28**	**91,68**	**95,15**	**77,69**	**79,43**	**85,47**	**96,38**	**72,41**	**75,00**	**75,54**	**93,27**
Anguilliformes	9,56	**11,11**	3,62	7,98	6,45	9,09	2,46	2,25	-	-	-	-
Congridae	9,32	**10,95**	3,60	9,27	5,71	7,95	2,01	2,78	-	-	-	-
Gnathophis	9,23	**10,79**	3,59	9,32	5,60	7,78	2,05	2,92	-	-	-	-
capensis	3,32	3,35	0,91	0,79	3,92	5,45	1,10	0,94	-	-	-	-
Aulopiformes	0,16	0,29	0,05	0,00	-	-	-	-	-	-	-	-
Chlorophthalmidae	0,17	0,30	0,05	0,00	-	-	-	-	-	-	-	-
Chlorophthalmus	0,16	0,29	0,05	0,00	-	-	-	-	-	-	-	-
Callionymiformes	8,40	**10,53**	1,23	5,53	**14,11**	**15,91**	2,43	7,31	3,45	4,55	0,14	0,25
Callionymidae	8,49	**10,65**	1,24	6,79	**14,29**	**15,91**	2,44	**12,03**	3,45	4,55	0,14	0,48
Paracallionymus	8,40	**10,50**	1,23	6,82	**14,00**	**15,56**	2,49	**12,60**	3,13	4,08	0,14	0,47
costatus	**14,13**	**17,22**	1,82	**15,39**	**22,88**	**25,45**	3,35	**22,87**	8,70	10,00	0,17	3,53
Clupeiformes	**14,33**	**11,40**	**16,01**	**18,87**	3,23	3,41	2,76	0,57	-	-	-	-
Dussumieriidae	**12,65**	**10,36**	8,98	**14,68**	2,86	2,84	2,73	0,72	-	-	-	-
Etrumeus	**12,52**	**10,20**	8,96	**14,78**	2,80	2,78	2,78	0,76	-	-	-	-
Engraulidae	1,83	1,18	7,04	0,69	0,41	0,57	0,04	0,01	-	-	-	-

Engraulis	1,81	1,17	7,02	0,69	0,40	0,56	0,04	0,01	-	-	-	-
Cypriniformes	0,49	0,58	0,31	0,03	-	-	-	-	-	-	-	-
Cyprinidae	0,50	0,59	0,31	0,03	-	-	-	-	-	-	-	-
Gonorhynchus	0,49	0,58	0,31	0,03	-	-	-	-	-	-	-	-
gonorhynchus	0,83	0,96	0,48	0,07	-	-	-	-	-	-	-	-
Gadiformes	**10,38**	**11,70**	**20,22**	**19,52**	**36,29**	**34,66**	**43,51**	**76,78**	**60,34**	**59,09**	**41,85**	**92,02**
Macrouridae	-	-	-	-	**15,51**	**15,91**	**13,05**	**20,54**	**39,66**	**36,36**	**13,43**	**56,43**
Coelorinchus	-	-	-	-	**13,20**	**13,33**	**11,11**	**15,92**	**35,94**	**32,65**	**11,73**	**54,87**
Malacocephalus	-	-	-	-	2,00	2,22	2,17	0,46	-	-	1,38	-
laevis	-	-	-	-	3,27	3,64	2,92	0,77	-	-	1,67	-
Merluccidae	9,82	**10,65**	**19,77**	**20,66**	**21,22**	**20,45**	**30,69**	**48,02**	**18,97**	**20,45**	**28,06**	**28,12**
Merluccius	9,72	**10,50**	**19,73**	**20,84**	**20,80**	**20,00**	**31,25**	**51,13**	**17,19**	**18,37**	**27,40**	**28,87**
capensis	5,82	7,18	**20,95**	**10,77**	1,31	1,82	7,71	0,56	8,70	5,00	9,88	3,70
paradoxus	7,48	7,18	6,17	5,49	**28,76**	**26,36**	**32,00**	**54,87**	**26,09**	**30,00**	**22,95**	**58,54**
Moridae	0,67	1,18	0,47	0,09	-	-	-	-	1,72	2,27	0,36	0,14
Physiculus	0,66	1,17	0,47	0,09	-	-	-	-	1,56	2,04	0,35	0,14
capensis	0,55	0,96	0,46	0,05	-	-	-	-	4,35	5,00	0,42	0,95
Myctophiformes	0,66	0,88	0,05	0,03	-	-	-	-	-	-	-	-
Myctophidae	0,67	0,89	0,05	0,04	-	-	-	-	-	-	-	-

Myctophidae	0,66	0,87	0,05	0,04	-	-	-	-	-	-	-	-
Notacanthiformes	-	-	-	-	0,81	0,57	2,17	0,05	-	-	-	-
Halosauridae	-	-	-	-	0,82	0,57	2,18	0,08	-	-	-	-
Ophidiiformes	0,82	0,88	3,91	0,23	0,81	1,14	3,49	0,14	1,72	2,27	7,50	0,32
Ophidiidae	0,83	0,89	3,91	0,28	0,82	1,14	3,51	0,22	1,72	2,27	7,50	0,61
Genypterus	0,82	0,87	3,90	0,28	0,80	1,11	3,57	0,24	1,56	2,04	7,32	0,64
capensis	1,39	1,44	6,02	0,60	1,31	1,82	4,81	0,38	4,35	5,00	8,83	2,62
Perciformes	9,06	9,36	**27,87**	**18,84**	8,06	6,25	**17,43**	4,42	1,72	2,27	**11,49**	0,46
Callanthiidae	0,17	0,30	0,15	0,01	-	-	-	-	-	-	-	-
Callanthias	0,16	0,29	0,15	0,01	-	-	-	-	-	-	-	-
Carangidae	8,49	8,28	**22,48**	**16,82**	3,67	3,41	**16,23**	3,07	-	-	-	-
Trachurus	8,40	8,16	**22,44**	**16,97**	3,60	3,33	**16,52**	3,29	-	-	-	-
capensis	**12,74**	**11,48**	**26,90**	**25,51**	4,58	4,55	**18,64**	3,61	-	-	-	-
Emmelichthyidae	-	-	-	-	3,67	1,70	1,22	0,38	-	-	-	-
Emmelichthys	-	-	-	-	3,60	1,67	1,24	0,40	-	-	-	-
Epigonidae	-	-	-	-	-	-	0,03	-	-	-	-	-
Epigonus	-	-	-	-	-	-	0,03	-	-	-	-	-
Gobiidae	-	-	-	-	0,82	1,14	0,04	0,04	-	-	-	-
Sufflogobius	-	-	-	-	0,80	1,11	0,04	0,05	-	-	-	-

bibarbatus	-	-	-	-	1,31	1,82	0,05	0,08	-	-	-	-
Sparidae	0,50	0,89	5,25	0,33	-	-	-	-	-	-	-	-
Pterogymnus	0,49	0,87	5,24	0,34	-	-	-	-	-	-	-	-
laniarius	0,83	1,44	8,09	0,72	-	-	-	-	-	-	-	-
Trichiuridae	-	-	-	-	-	-	-	-	1,72	2,27	**11,49**	0,88
Lepidopus	-	-	-	-	-	-	-	-	1,56	2,04	**11,22**	0,92
caudatus	-	-	-	-	-	-	-	-	4,35	5,00	**13,54**	3,56
Pleuronectiformes	6,10	5,85	4,05	3,23	2,02	2,27	1,69	0,23	-	-	-	-
Cynoglossidae	6,16	5,92	4,05	3,96	2,04	2,27	1,70	0,38	-	-	-	-
Cynoglossus	6,10	5,83	4,04	3,98	2,00	2,22	1,73	0,41	-	-	-	-
Scombriformes	0,99	0,88	2,85	0,18	-	-	-	-	-	-	-	-
Scombridae	1,00	0,89	2,85	0,22	-	-	-	-	-	-	-	-
Scomber	0,99	0,87	2,84	0,23	-	-	-	-	-	-	-	-
japonicus	1,66	1,44	4,38	0,49	-	-	-	-	-	-	-	-
Scorpaeniformes	8,90	7,89	**10,85**	8,50	6,05	6,25	9,59	2,71	3,45	4,55	**13,34**	1,16
Sebastidae	7,49	6,51	7,77	6,51	5,71	5,68	8,36	3,62	3,45	4,55	**13,34**	2,23
Helicolenus	7,41	6,41	7,75	6,56	5,60	5,56	8,51	3,85	3,13	4,08	**13,03**	2,32
dactylopterus	**12,47**	**10,53**	**11,96**	**14,41**	9,15	9,09	**11,46**	6,42	8,70	10,00	**15,72**	9,71
Triglidae	1,50	1,48	3,09	0,44	0,41	0,57	1,28	0,04	-	-	-	-

Chelidonichthys	1,48	1,46	3,08	0,45	0,40	0,56	1,30	0,05	-	-	-	-
Stomiiformes	-	-	-	-	0,81	0,57	0,01	0,01	1,72	2,27	1,22	0,10
Phosichthyidae	-	-	-	-	-	-	-	-	1,72	2,27	1,22	0,20
Photichthys	-	-	-	-	-	-	-	-	1,56	2,04	1,19	0,20
argenteus	-	-	-	-	-	-	-	-	4,35	5,00	1,44	1,15
Sternoptychidae	-	-	-	-	0,82	0,57	0,01	0,02	-	-	-	-
Maurolicus	-	-	-	-	0,80	0,56	0,01	0,02	-	-	-	-
walvisensis	-	-	-	-	1,31	0,91	0,01	0,04	-	-	-	-
Tetraodontiformes	0,49	0,29	0,72	0,02	-	-	-	-	-	-	-	-
Tetraodontidae	0,50	0,30	0,72	0,02	-	-	-	-	-	-	-	-
Sphoeroides	0,49	0,29	0,72	0,02	-	-	-	-	-	-	-	-
pachygaster	0,83	0,48	1,11	0,05	-	-	-	-	-	-	-	-
Chondrichthyes	0,65	0,62	0,30	0,00	1,99	1,14	0,13	0,02	-	-	-	-
Selachii	-	-	-	-	1,20	0,56	0,08	0,03	-	-	-	-
Rajiformes	-	-	-	-	0,81	0,57	0,05	0,01	-	-	-	-
Rajidae	-	-	-	-	0,82	0,57	0,05	0,02	-	-	-	-
Raja	-	-	-	-	0,80	0,56	0,06	0,02	-	-	-	-
Squaliformes	0,66	0,58	0,30	0,03	-	-	-	-	-	-	-	-
Squalidae	0,67	0,59	0,30	0,04	-	-	-	-	-	-	-	-

Squalus	0,66	0,58	0,30	0,04	-	-	-	-	-	-	-	-
acutipinnis	1,11	0,96	0,46	0,08	-	-	-	-	-	-	-	-
Elasmobranchii	0,16	0,31	0,08	0,00	0,40	0,57	0,54	0,00	3,45	2,27	0,97	0,08
Carcharhiniformes	0,16	0,29	0,08	0,00	0,40	0,57	0,54	0,01	3,45	2,27	0,97	0,15
Scyliorhinidae	0,17	0,30	0,08	0,00	0,41	0,57	0,54	0,02	3,45	2,27	0,97	0,29
Holohalaelurus	0,16	0,29	0,08	0,00	0,40	0,56	0,55	0,03	3,13	2,04	0,94	0,29
regani	0,28	0,48	0,13	0,01	0,65	0,91	0,74	0,04	-	-	-	-
Echinodermata	1,30	0,31	0,07	0,00	-	-	-	-	-	-	-	-
Asteroidea	1,30	0,31	0,07	0,00	-	-	-	-	-	-	-	-
Mollusca	**18,86**	**18,32**	6,63	3,85	**15,94**	**16,00**	**13,50**	3,37	**18,97**	**18,18**	**23,12**	6,09
Cephalopoda	**18,86**	**18,27**	6,63	3,91	**15,94**	**16,00**	**13,50**	3,50	**18,97**	**18,18**	**23,12**	6,43
Myopsida	4,61	2,34	2,92	0,96	2,02	2,27	1,55	0,23	-	-	-	-
Loliginidae	4,66	2,37	2,92	1,18	2,04	2,27	1,56	0,37	-	-	-	-
Afrololigo	0,33	0,58	0,02	0,01	1,60	1,67	0,03	0,13	-	-	-	-
Loligo	4,28	1,75	2,89	0,85	0,40	0,56	1,55	0,05	-	-	-	-
reynaudii	7,20	2,87	4,46	1,88	0,65	0,91	2,09	0,09	-	-	-	-
Oegopsida	0,82	1,17	0,80	0,10	8,47	7,39	**10,25**	3,84	6,90	6,82	**21,17**	2,92
Ommastrephidae	0,83	1,18	0,80	0,13	8,57	7,39	**10,30**	6,30	6,90	6,82	**21,17**	5,59
Todarodes	0,82	1,17	0,80	0,13	8,40	7,22	**10,49**	6,70	6,25	6,12	**20,68**	5,81

angolensis	-	-	-	-	0,65	0,91	3,74	0,14	**13,04**	10,00	**12,80**	**10,28**
eblanae	1,39	1,91	1,23	0,28	**13,07**	**10,91**	**10,38**	8,76	4,35	5,00	**12,14**	3,28
Sepiida	**13,67**	**14,04**	2,92	**12,70**	5,65	6,25	1,71	1,28	**12,07**	**11,36**	1,94	2,43
Sepiidae	**13,64**	**13,91**	2,89	**15,08**	2,04	2,27	0,76	0,29	-	-	-	-
Sepia	**13,51**	**13,70**	2,89	**15,15**	2,00	2,22	0,77	0,30	-	-	-	-
australis	**15,79**	**17,22**	3,45	**18,57**	-	-	-	-	-	-	-	-
hieronis	-	-	-	-	1,31	1,82	0,54	0,12	-	-	-	-
Sepiolidae	0,17	0,30	0,03	0,00	3,67	3,98	0,96	0,83	**12,07**	**11,36**	1,94	4,66
Austrorossia	0,16	0,29	0,03	0,00	2,00	2,22	0,70	0,30	6,25	6,12	1,67	1,71
Rondeletiola	-	-	-	-	0,80	0,56	0,04	0,02	-	-	-	-
capensis	-	-	-	-	1,31	0,91	0,06	0,04	-	-	-	-
Rossia	-	-	-	-	0,80	1,11	0,23	0,06	4,69	4,08	0,23	0,71
Macrouridae	-	-	-	-	0,40	0,56	0,12	0,01	3,13	2,04	0,10	0,23
Teleost	0,33	0,58	0,17	0,02	0,80	1,11	0,17	0,05	6,25	8,16	2,25	2,44

Appendix 3: Percentage number (*%N*), Percentage frequency (*%FO*), percentage weight (*%W*) and percentage IRI (*%IRI*) data for prey items found in the stomachs of *Genypterus capensis* on the West and South coasts along with overall. Values in bold denote frequently occurring (*%FO*)/important taxa (*%IRI*) (>10%). The minimum displayable value "-"denotes to null values.

	West coast				**South coast**				**Overall**			
	%N	***%F***	***%W***	***%IRI***	***%N***	***%F***	***%W***	***%IRI***	***%N***	***%F***	***%W***	***%IRI***
Annelida	-	-	-	-	0,14	0,13	0,00	0,00	0,08	0,07	0,00	0,00
Polychaeta	-	-	-	-	0,14	0,13	0,00	0,00	0,08	0,07	0,00	0,00
Arthropoda	**39,83**	**43,09**	**24,32**	**28,62**	**37,29**	**38,60**	**12,45**	**19,12**	**38,35**	**40,80**	**18,72**	**23,72**
Hexanauplia	-	-	-	-	0,14	0,26	0,03	0,00	0,08	0,14	0,01	0,00
Malacostraca	**38,01**	**41,05**	**24,01**	**26,16**	**36,25**	**37,25**	**11,76**	**17,84**	**36,98**	**39,11**	**18,24**	**21,92**
Decapoda	**17,47**	**18,14**	4,85	**12,11**	**24,19**	**23,90**	4,42	**23,89**	**21,41**	**21,10**	4,65	**19,19**
Calappidae	0,69	0,63	0,25	0,02	0,67	0,45	0,06	0,01	0,68	0,54	0,16	0,02
Mursia	0,67	0,61	0,26	0,02	0,63	0,43	0,06	0,01	0,65	0,52	0,16	0,02
cristiata	-	-	-	-	-	-	0,01	-	-	-	0,00	-
Callianassidae	-	-	-	-	0,17	0,15	0,01	0,00	0,10	0,08	0,00	0,00
Galatheidae	-	-	0,07	-	-	-	-	-	-	-	0,04	-
Geryonidae	0,15	0,16	0,12	0,00	-	-	-	-	0,06	0,08	0,07	0,00
Chaceon	0,15	0,15	0,13	0,00	-	-	-	-	0,06	0,07	0,07	0,00
chuni	0,18	0,18	0,12	0,00	-	-	-	-	0,08	0,10	0,06	0,00

Goneplacidae	-	-	-	-	-	-	0,08	-	-	-	0,04	-
Goneplax	-	-	-	-	-	-	0,08	-	-	-	0,04	-
rhomboides	-	-	-	-	-	-	0,10	-	-	-	0,05	-
Mathildellidae	-	-	-	-	-	-	0,12	-	-	-	0,06	-
Neopilumnoplax	-	-	-	-	-	-	0,12	-	-	-	0,06	-
heterochir	-	-	-	-	-	-	0,15	-	-	-	0,07	-
Munididae	-	-	0,35	-	-	-	0,03	-	-	-	0,20	-
Munida	-	-	0,35	-	-	-	0,03	-	-	-	0,20	-
sanctipauli	-	-	0,04	-	-	-	-	-	-	-	0,02	-
Munidopsidae	0,15	0,16	0,10	0,00	0,44	0,75	0,23	0,02	0,32	0,46	0,16	0,01
Munidopsis	0,15	0,15	0,10	0,00	0,42	0,72	0,23	0,02	0,31	0,44	0,16	0,01
chunii	0,18	0,18	0,10	0,00	0,63	1,08	0,28	0,03	0,42	0,60	0,18	0,01
Pandalidae	0,15	0,16	0,04	0,00	-	-	-	-	0,06	0,08	0,02	0,00
Plesionika	0,15	0,15	0,04	0,00	-	-	-	-	0,06	0,07	0,02	0,00
martia	0,18	0,18	0,04	0,00	-	-	-	-	0,08	0,10	0,02	0,00
Pasiphaeidae	0,23	0,16	0,01	0,00	0,06	0,15	0,02	0,00	0,13	0,15	0,01	0,00
Pasiphaea	0,22	0,15	0,01	0,00	0,05	0,14	0,02	0,00	0,12	0,15	0,01	0,00
Penaeidae	6,97	7,56	1,95	2,02	7,49	8,30	1,73	3,17	7,27	7,94	1,85	2,75
Funchalia	5,58	5,94	1,22	1,31	3,49	4,31	1,08	0,89	4,36	5,10	1,15	1,16

woodwardi	6,53	7,02	1,33	1,42	4,70	5,86	1,20	0,91	5,55	6,49	1,27	1,20
Penaeidae	1,19	1,37	0,77	0,09	3,65	3,59	0,64	0,70	2,63	2,51	0,71	0,35
Polychelidae	0,54	0,47	0,07	0,01	6,22	6,33	0,85	1,86	3,83	3,47	0,44	0,56
Stereomastis	0,52	0,46	0,07	0,01	5,92	6,03	0,84	1,86	3,68	3,33	0,44	0,56
Potunidae	0,69	0,47	0,07	0,01	-	-	-	-	0,29	0,23	0,04	0,00
Solenoceridae	0,15	0,31	0,07	0,00	0,06	0,15	0,09	0,00	0,10	0,23	0,08	0,00
Solenocera	0,15	0,30	0,07	0,00	0,05	0,14	0,09	0,00	0,09	0,22	0,08	0,00
Natantia	3,80	4,11	1,13	0,66	4,12	4,17	0,48	0,87	3,99	4,14	0,82	0,82
Euphausiacea	0,89	0,98	0,06	0,03	1,74	2,27	0,29	0,16	1,39	1,64	0,17	0,09
Euphausiidae	1,00	1,10	0,06	0,03	2,00	2,56	0,29	0,24	1,58	1,85	0,17	0,12
Euphausia	0,97	1,07	0,06	0,04	1,90	2,44	0,29	0,24	1,52	1,77	0,17	0,12
Isopoda	0,82	0,70	0,06	0,02	0,82	0,67	0,07	0,02	0,82	0,68	0,06	0,02
Mysida	1,51	1,55	0,25	0,08	1,45	2,14	0,16	0,12	1,47	1,85	0,20	0,11
Mysidae	1,68	1,73	0,26	0,10	1,66	2,41	0,16	0,18	1,67	2,08	0,21	0,15
Mysiidae	1,64	1,67	0,26	0,10	1,59	2,30	0,16	0,18	1,61	2,00	0,21	0,15
Stomatopoda	**17,88**	**20,25**	**18,90**	**22,28**	8,40	8,68	6,85	4,62	**12,32**	**14,32**	**13,22**	**12,76**
Squillidae	**19,98**	**22,68**	**19,49**	**26,86**	9,66	9,80	6,99	6,77	**14,00**	**16,10**	**13,56**	**16,84**
Pterygosquilla	**19,29**	**21,77**	**19,28**	**27,26**	9,20	9,34	6,72	6,76	**13,39**	**15,37**	**13,23**	**16,85**
capensis	**23,17**	**26,43**	**21,37**	**30,23**	**13,63**	**14,10**	8,13	8,05	**18,08**	**20,76**	**15,29**	**18,83**

Squillidae	0,15	0,15	0,65	0,00	-	-	0,22	-	0,06	0,07	0,44	0,00
Tanaidacea	-	-	0,01	-	-	-	-	-	-	-	0,01	-
Maxillopoda	0,07	0,14	0,02	0,00	-	-	-	-	0,03	0,07	0,01	0,00
Chordata	**56,56**	**53,42**	**72,05**	**71,14**	**58,06**	**57,64**	**82,21**	**80,52**	**57,43**	**55,57**	**76,84**	**75,99**
Actinopterygii	**58,14**	**55,06**	**71,97**	**73,61**	**58,39**	**58,26**	**82,36**	**81,80**	**58,29**	**56,70**	**76,86**	**77,79**
Anguilliformes	0,89	0,70	1,78	0,06	4,20	4,54	4,42	1,37	2,83	2,67	3,02	0,55
Congridae	0,46	0,47	0,72	0,02	4,11	4,22	4,00	1,42	2,57	2,39	2,27	0,44
Gnathophis	0,45	0,46	0,73	0,02	3,91	4,02	3,97	1,44	2,47	2,29	2,29	0,45
capensis	0,54	0,55	0,81	0,02	1,57	1,08	1,31	0,08	1,09	0,80	1,04	0,05
Ophichthidae	-	-	0,17	-	-	-	-	-	-	-	0,09	-
Ophichthus	-	-	0,18	-	-	-	-	-	-	-	0,09	-
Aulopiformes	-	-	-	-	0,58	0,40	0,26	0,01	0,34	0,21	0,12	0,00
Chlorophthalmidae	-	-	-	-	0,67	0,45	0,27	0,02	0,39	0,23	0,13	0,00
Chlorophthalmus	-	-	-	-	0,63	0,43	0,27	0,02	0,37	0,22	0,13	0,00
punctatus	-	-	-	-	0,94	0,65	0,33	0,02	0,50	0,30	0,15	0,01
Beloniformes	0,27	0,28	0,42	0,01	-	-	-	-	0,11	0,14	0,22	0,00
Scomberesocidae	0,31	0,31	0,44	0,01	-	-	-	-	0,13	0,15	0,23	0,00
Scomberesox	0,30	0,30	0,45	0,01	-	-	-	-	0,12	0,15	0,23	0,00
saurus	0,36	0,37	0,50	0,01	-	-	-	-	0,17	0,20	0,27	0,00

Callionymiformes	**31,51**	**31,36**	**19,24**	**47,60**	**29,55**	**31,11**	**12,93**	**46,16**	**30,36**	**31,23**	**16,26**	**50,83**
Callionymidae	**35,22**	**35,12**	**19,84**	**58,01**	**33,96**	**35,14**	**13,19**	**68,79**	**34,49**	**35,13**	**16,69**	**68,23**
Paracallionymus	**34,25**	**33,94**	**20,28**	**60,12**	**32,36**	**33,48**	**13,11**	**69,18**	**33,15**	**33,70**	**16,83**	**69,35**
costatus	**39,53**	**39,74**	**21,34**	**62,12**	**45,89**	**47,72**	**15,03**	**76,26**	**42,92**	**43,41**	**18,44**	**72,41**
Clupeiformes	0,48	0,42	1,68	0,03	0,24	0,27	0,08	0,00	0,34	0,34	0,93	0,02
Dussumieriidae	0,08	0,16	1,12	0,01	-	-	-	-	0,03	0,08	0,59	0,00
Etrumeus	0,07	0,15	1,14	0,01	-	-	-	-	0,03	0,07	0,59	0,00
whiteheadi	0,09	0,18	1,27	0,01	-	-	-	-	0,04	0,10	0,69	0,00
Clupeidiformes	0,46	0,31	0,61	0,01	-	-	-	-	0,19	0,15	0,32	0,00
Sardinops	0,45	0,30	0,63	0,01	-	-	-	-	0,19	0,15	0,33	0,00
sagax	0,54	0,37	0,69	0,01	-	-	-	-	0,25	0,20	0,38	0,00
Engraulidae	-	-	-	-	0,28	0,30	0,08	0,00	0,16	0,15	0,04	0,00
Engraulis	-	-	-	-	0,26	0,29	0,08	0,00	0,15	0,15	0,04	0,00
encrasicolus	-	-	-	-	0,39	0,43	0,10	0,01	0,21	0,20	0,05	0,00
Cypriniformes	-	-	-	-	-	-	3,15	-	-	-	1,49	-
Cyprinidae	-	-	-	-	-	-	3,22	-	-	-	1,53	-
Gonorhynchus	-	-	-	-	-	-	3,20	-	-	-	1,54	-
gonorhynchus	-	-	-	-	-	-	3,87	-	-	-	1,78	-
Gadiformes	**12,60**	**11,39**	**30,48**	**14,68**	1,98	2,14	**17,66**	1,47	6,37	6,64	**24,43**	7,14

Macrouridae	**11,26**	**10,08**	**17,85**	8,80	0,78	0,75	2,09	0,09	5,18	5,32	**10,37**	3,14
Coelorinchus	9,31	8,22	**13,40**	6,06	0,74	0,72	2,07	0,09	4,30	4,36	7,95	2,20
braueri	1,79	1,48	2,36	0,16	0,23	0,22	0,53	0,00	0,96	0,90	1,52	0,06
karrerae	-	-	0,11	-	-	-	-	-	-	-	0,06	-
simorhynchus	6,62	5,18	9,38	2,13	0,23	0,43	1,37	0,02	3,22	2,99	5,70	0,73
Lucigadus	-	-	0,10	-	-	-	-	-	-	-	0,05	-
ori	-	-	0,11	-	-	-	-	-	-	-	0,06	-
Malacocephalus	0,22	0,15	1,19	0,01	-	-	-	-	0,09	0,07	0,62	0,00
laevis	0,27	0,18	1,32	0,01	-	-	-	-	0,13	0,10	0,71	0,00
Nezumia	-	-	0,12	-	-	-	-	-	-	-	0,06	-
Merluccidae	2,53	2,36	**13,20**	1,11	1,33	1,36	**15,81**	0,97	1,83	1,85	**14,44**	1,14
Merluccius	2,46	2,28	**13,50**	1,18	1,27	1,29	**15,71**	1,00	1,76	1,77	**14,56**	1,19
capensis	0,18	0,18	1,89	0,01	0,31	0,22	0,07	0,00	0,25	0,20	1,05	0,01
paradoxus	2,15	2,03	**12,53**	0,77	0,78	1,30	**18,84**	0,67	1,42	1,70	**15,43**	0,78
Moridae	0,31	0,31	0,37	0,01	0,17	0,30	0,13	0,00	0,23	0,31	0,25	0,01
Physiculus	0,07	0,15	0,22	0,00	0,16	0,29	0,13	0,00	0,12	0,22	0,17	0,00
capensis	0,09	0,18	0,16	0,00	0,23	0,43	0,15	0,00	0,17	0,30	0,16	0,00
Tripterophycis	0,22	0,15	0,16	0,00	-	-	-	-	0,09	0,07	0,08	0,00
gilchristi	0,27	0,18	0,18	0,00	-	-	-	-	0,13	0,10	0,10	0,00

Lophiiformes	-	-	-	-	0,53	0,40	0,78	0,02	0,31	0,21	0,37	0,00
Chaunacidae	-	-	-	-	0,39	0,30	0,06	0,01	0,23	0,15	0,03	0,00
Chaunax	-	-	-	-	0,37	0,29	0,06	0,01	0,22	0,15	0,03	0,00
Lophiidae	-	-	-	-	0,22	0,15	0,74	0,01	0,13	0,08	0,35	0,00
Lophius	-	-	-	-	0,21	0,14	0,73	0,01	0,12	0,07	0,35	0,00
vomerinus	-	-	-	-	0,31	0,22	0,89	0,01	0,17	0,10	0,41	0,00
Myctophiformes	0,89	0,98	0,18	0,03	0,29	0,40	0,13	0,01	0,54	0,68	0,16	0,02
Myctophidae	1,00	1,10	0,19	0,04	0,33	0,45	0,14	0,01	0,61	0,77	0,17	0,02
Lampanyctodes	0,15	0,15	0,03	0,00	-	-	-	-	0,06	0,07	0,01	0,00
Hectoris	0,18	0,18	0,03	0,00	-	-	-	-	0,08	0,10	0,02	0,00
Myctophidae	0,60	0,76	0,09	0,02	0,32	0,43	0,14	0,01	0,43	0,59	0,11	0,01
Symbolophorus	0,22	0,15	0,08	0,00	-	-	-	-	0,09	0,07	0,04	0,00
boops	0,27	0,18	0,09	0,00	-	-	-	-	0,13	0,10	0,05	0,00
Ophidiiformes	0,14	0,14	1,85	0,01	0,39	0,27	5,89	0,06	0,28	0,21	3,76	0,03
Ophidiidae	0,15	0,16	1,91	0,01	0,44	0,30	6,01	0,08	0,32	0,23	3,86	0,04
Genypterus	0,15	0,15	1,95	0,01	0,42	0,29	5,97	0,08	0,31	0,22	3,89	0,04
capensis	0,18	0,18	2,17	0,01	0,63	0,43	7,23	0,09	0,42	0,30	4,49	0,04
Perciformes	5,75	4,92	2,74	1,25	2,37	2,27	**11,70**	1,11	3,77	3,56	6,97	1,33
Champsodontidae	-	-	-	-	0,94	1,06	0,24	0,05	0,55	0,54	0,11	0,01

Champsodon	-	-	-	-	0,90	1,01	0,24	0,05	0,53	0,52	0,12	0,01
capensis	-	-	-	-	1,33	1,52	0,29	0,06	0,71	0,70	0,13	0,02
Callanthiidae	0,61	0,63	0,21	0,02	0,06	0,15	0,24	0,00	0,29	0,39	0,23	0,01
Callanthias	0,60	0,61	0,22	0,02	0,05	0,14	0,24	0,00	0,28	0,37	0,23	0,01
legras	0,72	0,74	0,24	0,02	0,08	0,22	0,29	0,00	0,38	0,50	0,26	0,01
Carangidae	-	-	0,02	-	0,33	0,30	**11,30**	0,15	0,19	0,15	5,37	0,03
Alepes	-	-	0,02	-	-	-	-	-	-	-	0,01	-
djedaba	-	-	0,02	-	-	-	-	-	-	-	0,01	-
Trachurus	-	-	-	-	0,32	0,29	**11,23**	0,15	0,19	0,15	5,40	0,03
capensis	-	-	-	-	0,47	0,43	**13,58**	0,16	0,25	0,20	6,24	0,04
Epigonidae	0,15	0,16	0,43	0,00	-	-	-	-	0,06	0,08	0,23	0,00
Epigonus	0,15	0,15	0,44	0,00	-	-	-	-	0,06	0,07	0,23	0,00
Gobiidae	5,44	4,41	1,66	0,94	0,83	0,75	0,10	0,03	2,77	2,54	0,92	0,36
Sufflogobius	5,29	4,26	1,69	0,97	0,79	0,72	0,10	0,03	2,66	2,44	0,93	0,36
bibarbatus	6,35	5,18	1,88	1,09	1,17	1,08	0,12	0,04	3,59	3,29	1,07	0,42
Sparidae	-	-	-	-	0,55	0,30	0,06	0,01	0,32	0,15	0,03	0,00
Pterogymnus	-	-	-	-	0,53	0,29	0,06	0,01	0,31	0,15	0,03	0,00
laniarius	-	-	-	-	0,78	0,43	0,07	0,01	0,42	0,20	0,03	0,00
Trichiuridae	0,23	0,31	0,51	0,01	-	-	-	-	0,10	0,15	0,27	0,00

Lepidopus	0,22	0,30	0,52	0,01	-	-	-	-	0,09	0,15	0,27	0,00
caudatus	0,27	0,37	0,58	0,01	-	-	-	-	0,13	0,20	0,31	0,00
Pleuronectiformes	2,40	1,83	2,34	0,26	**17,04**	**15,09**	**21,28**	**20,20**	**10,99**	8,63	**11,28**	6,71
Bothidae	-	-	-	-	0,06	0,15	0,16	0,00	0,03	0,08	0,08	0,00
Arnoglossus	-	-	-	-	0,05	0,14	0,16	0,00	0,03	0,07	0,08	0,00
capensis	-	-	-	-	0,08	0,22	0,19	0,00	0,04	0,10	0,09	0,00
Cynoglossidae	2,68	2,05	2,42	0,31	**12,99**	**10,71**	**11,99**	**11,10**	8,66	6,47	6,95	3,83
Cynoglossus	2,61	1,98	2,47	0,33	**12,37**	**10,20**	**11,91**	**11,26**	8,32	6,21	7,01	3,92
capensis	-	-	-	-	-	-	0,92	-	-	-	0,42	-
zanzibarensis	3,13	2,40	2,74	0,36	**18,32**	**15,40**	**13,49**	**12,85**	**11,23**	8,38	7,68	4,31
Soleidae	-	-	-	-	6,38	6,03	9,57	3,99	3,70	3,08	4,54	0,96
Austroglossus	-	-	-	-	6,08	5,75	9,51	4,07	3,56	2,96	4,58	0,99
pectoralis	-	-	-	-	0,16	0,22	0,01	0,00	0,08	0,10	0,01	0,00
Scorpaeniformes	2,95	2,67	**11,41**	1,15	1,11	1,34	4,07	0,24	1,87	1,99	7,95	0,68
Sebastidae	3,29	2,99	**11,76**	1,35	0,94	1,21	3,97	0,25	1,93	2,08	8,07	0,79
Helicolenus	3,20	2,89	**12,03**	1,43	0,90	1,15	3,95	0,25	1,86	2,00	8,14	0,82
dactylopterus	3,85	3,51	**13,33**	1,55	1,33	1,74	4,77	0,28	2,51	2,69	9,40	0,87
Triglidae	-	-	-	-	0,33	0,30	0,18	0,01	0,19	0,15	0,09	0,00
Chelidonichthys	-	-	-	-	0,32	0,29	0,18	0,01	0,19	0,15	0,09	0,00

queketti	-	-	-	-	0,23	0,22	0,21	0,00	0,13	0,10	0,10	0,00
Stomiiformes	0,14	0,14	0,02	0,00	-	-	-	-	0,06	0,07	0,01	0,00
Sternoptychidae	0,15	0,16	0,02	0,00	-	-	-	-	0,06	0,08	0,01	0,00
Maurolicus	0,15	0,15	0,02	0,00	-	-	-	-	0,06	0,07	0,01	0,00
walvisensis	0,18	0,18	0,02	0,00	-	-	-	-	0,08	0,10	0,01	0,00
Teleost	1,04	1,07	0,20	0,04	0,74	0,72	0,17	0,03	0,87	0,89	0,19	0,04
Elasmobranchii	-	-	-	-	0,72	0,53	0,48	0,01	0,42	0,27	0,23	0,00
Carcharhiniformes	-	-	-	-	0,43	0,27	0,21	0,01	0,25	0,14	0,10	0,00
Scyliorhinidae	-	-	-	-	0,50	0,30	0,21	0,01	0,29	0,15	0,10	0,00
Holohalaelurus	-	-	-	-	0,48	0,29	0,21	0,01	0,28	0,15	0,10	0,00
regani	-	-	-	-	0,70	0,43	0,25	0,01	0,38	0,20	0,12	0,00
Rajiformes	-	-	-	-	0,29	0,27	0,27	0,01	0,17	0,14	0,13	0,00
Rajidae	-	-	-	-	0,33	0,30	0,28	0,01	0,19	0,15	0,13	0,00
Cruriraja	-	-	-	-	0,16	0,14	0,01	0,00	0,09	0,07	0,01	0,00
hulleyi	-	-	-	-	0,23	0,22	0,02	0,00	0,13	0,10	0,01	0,00
Raja	-	-	-	-	0,16	0,14	0,26	0,00	0,09	0,07	0,13	0,00
straeleni	-	-	-	-	0,23	0,22	0,32	0,00	0,13	0,10	0,15	0,00
Myxinini	0,07	0,14	0,36	0,00	-	-	-	-	0,03	0,07	0,19	0,00
Myxiniformes	0,07	0,14	0,36	0,00	-	-	-	-	0,03	0,07	0,19	0,00

Myxinidae	0,08	0,16	0,37	0,00	-	-	-	-	0,03	0,08	0,20	0,00
Myxine	0,07	0,15	0,38	0,00	-	-	-	-	0,03	0,07	0,20	0,00
capensis	0,09	0,18	0,42	0,00	-	-	-	-	0,04	0,10	0,23	0,00
Echinodermata	0,07	0,13	0,29	0,00	-	-	-	-	0,03	0,07	0,15	0,00
Holothuroidea	0,07	0,14	0,29	0,00	-	-	-	-	0,03	0,07	0,15	0,00
Mollusca	3,54	3,36	3,35	0,24	4,51	3,63	5,33	0,36	4,11	3,49	4,28	0,30
Cephalopoda	3,31	3,33	3,19	0,22	4,35	3,57	5,36	0,35	3,92	3,45	4,22	0,28
Myopsida	-	-	-	-	0,05	0,13	0,08	0,00	0,03	0,07	0,04	0,00
Loliginidae	-	-	-	-	0,06	0,15	0,08	0,00	0,03	0,08	0,04	0,00
Loligo	-	-	-	-	0,05	0,14	0,08	0,00	0,03	0,07	0,04	0,00
reynaudii	-	-	-	-	0,08	0,22	0,10	0,00	0,04	0,10	0,04	0,00
Octopoda	0,48	0,56	0,80	0,02	0,14	0,13	0,13	0,00	0,28	0,34	0,48	0,01
Bathypolypodidae	-	-	0,65	-	-	-	-	-	-	-	0,34	-
Bathypolypus	-	-	0,66	-	-	-	-	-	-	-	0,34	-
valdiviae	-	-	0,73	-	-	-	-	-	-	-	0,40	-
Oegopsida	0,14	0,14	0,31	0,00	0,10	0,27	4,00	0,04	0,11	0,21	2,05	0,02
Ommastrephidae	0,15	0,16	0,32	0,00	0,11	0,30	4,09	0,05	0,13	0,23	2,11	0,02
Todarodes	0,15	0,15	0,33	0,00	0,11	0,29	4,06	0,05	0,12	0,22	2,12	0,02
angolensis	-	-	0,25	-	-	-	-	-	-	-	0,14	-

eblanae	0,18	0,18	0,11	0,00	0,16	0,43	4,91	0,06	0,17	0,30	2,32	0,02
Sepiida	2,74	2,67	2,10	0,39	3,91	2,80	1,10	0,49	3,43	2,74	1,63	0,48
Sepiidae	2,53	2,36	1,19	0,26	4,33	3,02	1,12	0,68	3,57	2,70	1,15	0,48
Sepia	2,31	2,13	1,21	0,24	4,12	2,87	1,11	0,68	3,37	2,51	1,16	0,47
australis	1,16	1,11	0,38	0,04	4,15	2,82	0,86	0,37	2,76	1,90	0,60	0,17
dubia	-	-	0,05	-	-	-	-	-	-	-	0,03	-
hieronis	0,36	0,37	0,68	0,01	-	-	-	-	0,17	0,20	0,37	0,00
Sepiidae	0,15	0,15	0,01	0,00	-	-	-	-	0,06	0,07	0,00	0,00
Sepiolidae	0,54	0,63	0,98	0,03	0,17	0,15	0,01	0,00	0,32	0,39	0,52	0,01
Austrorossia	0,37	0,46	0,39	0,01	-	-	-	-	0,15	0,22	0,20	0,00
enigmatica	0,45	0,55	0,43	0,01	-	-	-	-	0,21	0,30	0,23	0,00
Rossia	0,15	0,15	0,61	0,00	-	-	-	-	0,06	0,07	0,32	0,00
Stoloteuthis	-	-	-	-	0,16	0,14	0,01	0,00	0,09	0,07	0,00	0,00
Teuthoidea	-	-	-	-	0,19	0,27	0,06	0,00	0,11	0,14	0,03	0,00
Gastropoda	0,34	0,14	0,17	0,00	-	-	-	-	0,14	0,07	0,09	0,00
Cephalaspidae	-	-	0,15	-	-	-	-	-	-	-	0,08	-
Philinidae	-	-	0,16	-	-	-	-	-	-	-	0,08	-
Philine	-	-	0,16	-	-	-	-	-	-	-	0,08	-
aperta	-	-	0,18	-	-	-	-	-	-	-	0,10	-

Appendix 4: Percentage number (*%N*), Percentage frequency (*%FO*), percentage weight (*%W*) and percentage IRI (*%IRI*) data for prey items found in the stomachs of *Genypterus capensis* at different depths on both coasts overall. Values in bold denote frequently occurring (*%FO*)/important taxa (*%IRI*) (>10%). The minimum displayable value "-"denotes to null values.

	200 m				**400 m**				**600 m**			
	%N	***%F***	***%W***	***%IRI***	***%N***	***%F***	***%W***	***%IRI***	***%N***	***%F***	***%W***	***%IRI***
Annelida	0,14	0,12	0,00	0,00	-	-	-	-	-	-	-	-
Polychaeta	0,14	0,12	0,00	0,00	-	-	-	-	-	-	-	-
Arthropoda	**40,28**	**43,87**	**35,47**	**34,94**	**34,19**	**36,19**	**10,15**	**15,23**	**42,50**	**41,59**	5,61	**20,71**
Hexanauplia	0,14	0,24	0,04	0,00	-	-	-	-	-	-	-	-
Malacostraca	**39,90**	**43,41**	**35,36**	**34,47**	**31,35**	**32,84**	9,38	**12,49**	**38,94**	**37,74**	4,86	**16,43**
Decapoda	**23,24**	**22,74**	5,54	**20,30**	**17,09**	**17,44**	4,04	9,78	**26,94**	**27,18**	4,30	**18,48**
Calappidae	0,43	0,27	0,04	0,00	1,04	0,83	0,27	0,03	1,12	1,20	0,15	0,06
Mursia	0,41	0,26	0,04	0,00	1,02	0,80	0,27	0,03	1,03	1,11	0,16	0,07
cristiata	-	-	-	-	-	-	-	-	-	-	-	-
Callianassidae	0,16	0,14	0,01	0,00	-	-	-	-	-	-	-	-
Galatheidae	-	-	-	-	-	-	-	-	-	-	0,19	-
Geryonidae	-	-	-	-	-	-	-	-	1,12	1,20	0,35	0,06
Chaceon	-	-	-	-	-	-	-	-	1,03	1,11	0,36	0,08
chuni	-	-	-	-	-	-	-	-	2,70	3,13	0,81	0,39

Goneplacidae	-	-	0,11	-	-	-	-	-	-	-	-	-
Goneplax	-	-	0,10	-	-	-	-	-	-	-	-	-
rhomboides	-	-	-	-	-	-	-	-	-	-	-	-
Mathildellidae	-	-	-	-	-	-	0,13	-	-	-	-	-
Neopilumnoplax	-	-	-	-	-	-	0,14	-	-	-	-	-
heterochir	-	-	-	-	-	-	-	-	-	-	-	-
Munididae	-	-	-	-	-	-	0,05	-	-	-	0,93	-
Munida	-	-	-	-	-	-	0,05	-	-	-	0,98	-
sanctipauli	-	-	-	-	-	-	0,08	-	-	-	-	-
Munidopsidae	-	-	-	-	0,19	0,21	0,11	0,00	4,49	6,02	0,62	1,12
Munidopsis	-	-	-	-	0,19	0,20	0,11	0,00	4,10	5,56	0,65	1,31
chunii	-	-	-	-	0,30	0,31	0,18	0,00	-	-	-	-
Pandalidae	-	-	-	-	-	-	-	-	1,12	1,20	0,10	0,05
Plesionika	-	-	-	-	-	-	-	-	1,03	1,11	0,10	0,06
martia	-	-	-	-	-	-	-	-	2,70	3,13	0,28	0,33
Pasiphaeidae	0,21	0,27	0,04	0,00	-	-	-	-	-	-	-	-
Pasiphaea	0,20	0,26	0,04	0,00	-	-	-	-	-	-	-	-
Penaeidae	6,83	7,66	2,48	2,54	8,53	8,68	1,93	2,29	4,49	6,02	0,41	1,07
Funchalia	3,83	4,83	1,86	1,06	5,64	5,84	0,97	1,04	2,56	3,33	0,13	0,45

woodwardi	5,31	6,38	2,10	0,89	7,35	7,48	1,18	1,25	5,41	6,25	0,26	1,25
Penaeidae	2,71	2,48	0,61	0,32	2,68	2,62	0,97	0,26	1,54	2,22	0,30	0,20
Polychelidae	5,97	5,75	1,08	1,44	0,28	0,41	0,07	0,00	2,25	1,20	0,04	0,10
Stereomastis	5,72	5,48	1,07	1,44	0,28	0,40	0,07	0,00	2,05	1,11	0,04	0,12
Potunidae	-	-	-	-	0,47	0,41	0,07	0,01	2,25	1,20	0,04	0,10
Solenoceridae	0,16	0,41	0,21	0,01	-	-	-	-	-	-	-	-
Solenocera	0,15	0,39	0,21	0,01	-	-	-	-	-	-	-	-
Natantia	3,78	4,05	0,56	0,68	3,33	3,42	0,84	0,38	9,74	8,89	1,30	4,87
Euphausiacea	0,85	1,34	0,18	0,04	1,02	1,11	0,06	0,03	8,68	6,80	0,37	1,34
Euphausiidae	0,96	1,50	0,18	0,06	1,14	1,24	0,06	0,04	**10,67**	8,43	0,39	3,38
Euphausia	0,92	1,44	0,18	0,06	1,11	1,21	0,06	0,04	9,74	7,78	0,40	3,92
Isopoda	-	-	0,01	-	1,86	1,11	0,08	0,06	3,20	3,88	0,14	0,28
Mysida	1,64	2,32	0,39	0,15	1,18	1,30	0,13	0,05	1,37	0,97	0,02	0,03
Mysidae	1,87	2,60	0,40	0,21	1,33	1,45	0,13	0,05	1,69	1,20	0,02	0,07
Mysiidae	1,79	2,48	0,40	0,21	1,30	1,41	0,13	0,05	1,54	1,11	0,02	0,09
Stomatopoda	**14,60**	**17,48**	**29,32**	**23,82**	**10,49**	**12,24**	5,11	5,07	-	-	-	-
Squillidae	**16,59**	**19,56**	**30,25**	**32,62**	**11,75**	**13,64**	5,22	5,85	-	-	-	-
Pterygosquilla	**15,88**	**18,67**	**29,21**	**32,58**	**11,29**	**13,08**	4,95	5,71	-	-	-	-
capensis	**38,99**	**43,09**	**55,78**	**76,50**	**16,79**	**19,31**	7,92	9,37	-	-	-	-

Squillidae	-	-	0,83	-	0,19	0,20	0,29	0,00	-	-	-	-
Tanaidacea	-	-	-	-	-	-	-	-	-	-	0,04	-
Maxillopoda	-	-	-	-	0,08	0,18	0,02	0,00	-	-	-	-
Chordata	**54,93**	**52,64**	**62,14**	**64,81**	**62,27**	**59,97**	**86,33**	**84,54**	**55,00**	**54,87**	**83,79**	**78,81**
Actinopterygii	**55,23**	**52,84**	**61,89**	**65,31**	**63,79**	**62,20**	**86,39**	**87,26**	**58,41**	**58,49**	**84,46**	**83,07**
Anguilliformes	3,62	3,79	5,18	1,03	1,86	1,30	1,99	0,13	0,46	0,97	1,14	0,03
Congridae	3,31	3,42	3,94	0,88	1,71	1,24	1,84	0,11	-	-	-	-
Gnathophis	3,17	3,26	3,91	0,89	1,67	1,21	1,85	0,11	-	-	-	-
capensis	-	-	-	-	0,90	0,93	1,48	0,04	-	-	-	-
Ophichthidae	-	-	-	-	-	-	-	-	-	-	0,48	-
Ophichthus	-	-	-	-	-	-	-	-	-	-	0,50	-
Aulopiformes	-	-	-	-	1,02	0,56	0,29	0,02	-	-	-	-
Chlorophthalmidae	-	-	-	-	1,14	0,62	0,29	0,02	-	-	-	-
Chlorophthalmus	-	-	-	-	1,11	0,60	0,29	0,02	-	-	-	-
punctatus	-	-	-	-	-	-	-	-	-	-	-	-
Beloniformes	-	-	-	-	0,34	0,37	0,51	0,01	-	-	-	-
Scomberesocidae	-	-	-	-	0,38	0,41	0,52	0,01	-	-	-	-
Scomberesox	-	-	-	-	0,37	0,40	0,53	0,01	-	-	-	-
saurus	-	-	-	-	0,60	0,62	0,90	0,02	-	-	-	-

Callionymiformes	**25,96**	**26,41**	**13,95**	**32,70**	**41,29**	**42,12**	**24,26**	**73,28**	**14,16**	**12,62**	2,50	4,57
Callionymidae	**29,49**	**29,55**	**14,39**	**46,16**	**46,26**	**46,90**	**24,75**	**84,14**	**17,42**	**15,66**	2,57	**11,35**
Paracallionymus	**28,24**	**28,20**	**14,29**	**46,42**	**45,14**	**45,67**	**24,88**	**85,94**	**15,90**	**14,44**	2,70	**13,33**
costatus	**22,02**	**22,87**	9,62	**13,56**	**50,37**	**51,09**	**32,27**	**82,91**	**31,08**	**25,00**	4,86	**31,63**
Clupeiformes	0,23	0,24	0,10	0,00	0,59	0,56	2,04	0,04	-	-	-	-
Dussumieriidae	-	-	-	-	0,09	0,21	1,34	0,01	-	-	-	-
Etrumeus	-	-	-	-	0,09	0,20	1,35	0,01	-	-	-	-
whiteheadi	-	-	-	-	0,15	0,31	2,31	0,02	-	-	-	-
Clupeidiformes	-	-	-	-	0,57	0,41	0,74	0,01	-	-	-	-
Sardinops	-	-	-	-	0,56	0,40	0,74	0,01	-	-	-	-
sagax	-	-	-	-	0,90	0,62	1,27	0,03	-	-	-	-
Engraulidae	0,27	0,27	0,11	0,00	-	-	-	-	-	-	-	-
Engraulis	0,26	0,26	0,10	0,00	-	-	-	-	-	-	-	-
encrasicolus	-	-	-	-	-	-	-	-	-	-	-	-
Cypriniformes	-	-	-	-	-	-	1,64	-	-	-	4,08	-
Cyprinidae	-	-	-	-	-	-	1,68	-	-	-	4,20	-
Gonorhynchus	-	-	-	-	-	-	1,68	-	-	-	4,41	-
gonorhynchus	-	-	-	-	-	-	-	-	-	-	-	-
Gadiformes	1,17	0,86	3,96	0,14	**10,74**	**10,02**	**25,06**	9,52	**33,33**	**34,95**	**63,27**	**73,45**

Macrouridae	0,43	0,27	1,40	0,02	9,48	8,68	**12,00**	4,71	**29,78**	**30,12**	**24,05**	**58,80**
Coelorinchus	0,41	0,26	1,39	0,02	7,96	7,24	**10,59**	3,61	**23,08**	**23,33**	**14,95**	**44,02**
braueri	-	-	-	-	0,75	0,31	0,10	0,01	**20,27**	**21,88**	**15,74**	**27,73**
karrerae	-	-	-	-	-	-	-	-	-	-	0,77	-
simorhynchus	-	-	-	-	9,45	7,17	**15,33**	3,49	**14,86**	**15,63**	6,66	**11,84**
Lucigadus	-	-	-	-	-	-	-	-	-	-	0,28	-
ori	-	-	-	-	-	-	-	-	-	-	0,73	-
Malacocephalus	-	-	-	-	-	-	-	-	1,54	1,11	3,41	0,27
laevis	-	-	-	-	-	-	-	-	4,05	3,13	9,04	1,44
Nezumia	-	-	-	-	-	-	-	-	-	-	0,35	-
Merluccidae	0,85	0,55	2,53	0,07	2,27	2,27	**13,38**	0,90	9,55	**10,84**	**40,45**	**19,67**
Merluccius	0,82	0,52	2,52	0,07	2,22	2,21	**13,45**	0,93	8,72	10,00	**42,44**	**25,38**
capensis	0,53	0,53	6,19	0,07	-	-	-	-	-	-	-	-
paradoxus	-	-	-	-	2,25	2,18	**14,94**	0,74	**12,16**	**12,50**	**29,70**	**18,42**
Moridae	0,05	0,14	0,15	0,00	0,28	0,21	0,19	0,00	1,69	2,41	0,61	0,20
Physiculus	0,05	0,13	0,15	0,00	-	-	-	-	1,54	2,22	0,64	0,24
capensis	-	-	-	-	-	-	-	-	1,35	3,13	1,07	0,27
Tripterophycis	-	-	-	-	0,28	0,20	0,19	0,00	-	-	-	-
gilchristi	-	-	-	-	0,45	0,31	0,33	0,00	-	-	-	-

Lophiiformes	0,19	0,12	0,91	0,00	-	-	-	-	3,20	1,94	0,14	0,14
Chaunacidae	-	-	-	-	-	-	-	-	3,93	2,41	0,15	0,36
Chaunax	-	-	-	-	-	-	-	-	3,59	2,22	0,15	0,41
Lophiidae	0,21	0,14	0,94	0,01	-	-	-	-	-	-	-	-
Lophius	0,20	0,13	0,93	0,01	-	-	-	-	-	-	-	-
vomerinus	-	-	-	-	-	-	-	-	-	-	-	-
Myctophiformes	0,05	0,12	0,09	0,00	0,85	0,93	0,13	0,02	3,65	3,88	0,37	0,34
Myctophidae	0,05	0,14	0,09	0,00	0,95	1,03	0,14	0,03	4,49	4,82	0,38	0,85
Lampanyctodes	-	-	0,03	-	0,19	0,20	0,01	0,00	-	-	-	-
hectoris	-	-	0,07	-	0,30	0,31	0,01	0,00	-	-	-	-
Myctophidae	0,05	0,13	0,06	0,00	0,46	0,60	0,03	0,01	4,10	4,44	0,40	0,99
Symbolophorus	-	-	-	-	0,28	0,20	0,10	0,00	-	-	-	-
boops	-	-	-	-	0,45	0,31	0,16	0,00	-	-	-	-
Ophidiiformes	0,47	0,37	3,14	0,04	-	-	5,93	-	-	-	-	-
Ophidiidae	0,53	0,41	3,24	0,06	-	-	6,05	-	-	-	-	-
Genypterus	0,51	0,39	3,22	0,06	-	-	6,08	-	-	-	-	-
capensis	0,53	0,53	7,09	0,08	-	-	-	-	-	-	-	-
Perciformes	5,92	5,99	4,21	1,88	0,59	0,56	**11,91**	0,18	-	-	1,07	-
Champsodontidae	0,91	0,96	0,31	0,04	-	-	-	-	-	-	-	-

Champsodon	0,87	0,91	0,30	0,04	-	-	-	-	-	-	-	-
capensis	-	-	-	-	-	-	-	-	-	-	-	-
Callanthiidae	0,48	0,68	0,61	0,03	-	-	-	-	-	-	-	-
Callanthias	0,46	0,65	0,60	0,03	-	-	-	-	-	-	-	-
legras	2,12	2,13	0,80	0,12	-	-	-	-	-	-	-	-
Carangidae	0,32	0,27	0,41	0,01	-	-	**11,44**	-	-	-	1,10	-
Alepes	-	-	0,03	-	-	-	-	-	-	-	-	-
djedaba	-	-	0,07	-	-	-	-	-	-	-	-	-
Trachurus	0,31	0,26	0,38	0,01	-	-	**11,49**	-	-	-	1,15	-
capensis	-	-	-	-	-	-	-	-	-	-	-	-
Epigonidae	-	-	-	-	0,19	0,21	0,52	0,00	-	-	-	-
Epigonus	-	-	-	-	0,19	0,20	0,52	0,00	-	-	-	-
Gobiidae	4,59	4,51	2,47	1,13	-	-	-	-	-	-	-	-
Sufflogobius	4,39	4,31	2,45	1,14	-	-	-	-	-	-	-	-
bibarbatus	**18,83**	**14,89**	6,14	6,97	-	-	-	-	-	-	-	-
Sparidae	0,37	0,14	0,05	0,00	0,28	0,21	0,02	0,00	-	-	-	-
Pterogymnus	0,36	0,13	0,05	0,00	0,28	0,20	0,02	0,00	-	-	-	-
laniarius	-	-	-	-	-	-	-	-	-	-	-	-
Trichiuridae	0,05	0,14	0,51	0,00	0,19	0,21	0,18	0,00	-	-	-	-

Lepidopus	0,05	0,13	0,51	0,00	0,19	0,20	0,18	0,00	-	-	-	-
caudatus	0,27	0,53	1,35	0,02	0,30	0,31	0,30	0,00	-	-	-	-
Pleuronectiformes	**16,38**	**13,69**	**28,73**	**19,16**	3,30	2,60	1,17	0,31	-	-	-	-
Bothidae	0,05	0,14	0,20	0,00	-	-	-	-	-	-	-	-
Arnoglossus	0,05	0,13	0,20	0,00	-	-	-	-	-	-	-	-
capensis	-	-	-	-	-	-	-	-	-	-	-	-
Cynoglossidae	**12,48**	9,85	**17,28**	**10,44**	3,32	2,48	1,17	0,28	-	-	-	-
Cynoglossus	**11,95**	9,40	**17,16**	**10,59**	3,24	2,41	1,18	0,29	-	-	-	-
capensis	-	-	-	-	-	-	-	-	-	-	-	-
zanzibarensis	7,43	5,85	7,82	1,67	1,05	0,62	0,64	0,02	-	-	-	-
Soleidae	5,92	5,20	**12,15**	3,34	0,38	0,41	0,02	0,00	-	-	-	-
Austroglossus	5,67	4,96	**12,06**	3,40	0,37	0,40	0,02	0,00	-	-	-	-
pectoralis	-	-	-	-	-	-	-	-	-	-	-	-
Scorpaeniformes	1,27	1,22	1,60	0,11	2,88	2,97	**11,72**	1,15	2,28	2,91	**11,85**	0,90
Sebastidae	1,12	1,09	1,42	0,10	3,22	3,31	**11,96**	1,27	2,81	3,61	**12,19**	1,97
Helicolenus	1,07	1,04	1,41	0,10	3,15	3,22	**12,02**	1,31	2,56	3,33	**12,79**	2,54
dactylopterus	1,59	1,06	0,60	0,04	4,95	4,67	**17,29**	2,04	5,41	6,25	**25,07**	6,70
Triglidae	0,32	0,27	0,23	0,01	-	-	-	-	-	-	-	-
Chelidonichthys	0,31	0,26	0,23	0,01	-	-	-	-	-	-	-	-

queketti	-	-	-	-	-	-	-	-	-	-	-	-
Stomiiformes	-	-	-	-	0,17	0,19	0,02	0,00	-	-	-	-
Sternoptychidae	-	-	-	-	0,19	0,21	0,02	0,00	-	-	-	-
Maurolicus	-	-	-	-	0,19	0,20	0,02	0,00	-	-	-	-
walvisensis	-	-	-	-	0,30	0,31	0,04	0,00	-	-	-	-
Teleost	0,61	0,65	0,14	0,02	0,83	0,80	0,19	0,02	3,59	3,33	0,27	0,64
Elasmobranchii	0,14	0,12	0,32	0,00	1,01	0,55	0,24	0,01	-	-	-	-
Carcharhiniformes	-	-	-	-	0,76	0,37	0,22	0,01	-	-	-	-
Scyliorhinidae	-	-	-	-	0,85	0,41	0,23	0,01	-	-	-	-
Holohalaelurus	-	-	-	-	0,83	0,40	0,23	0,01	-	-	-	-
regani	-	-	-	-	-	-	-	-	-	-	-	-
Rajiformes	0,14	0,12	0,32	0,00	0,25	0,19	0,02	0,00	-	-	-	-
Rajidae	0,16	0,14	0,33	0,00	0,28	0,21	0,02	0,00	-	-	-	-
Cruriraja	-	-	-	-	0,28	0,20	0,02	0,00	-	-	-	-
hulleyi	-	-	-	-	-	-	-	-	-	-	-	-
Raja	0,15	0,13	0,33	0,00	-	-	-	-	-	-	-	-
straeleni	-	-	-	-	-	-	-	-	-	-	-	-
Myxinini	-	-	-	-	0,08	0,18	0,44	0,00	-	-	-	-
Myxiniformes	-	-	-	-	0,08	0,19	0,44	0,00	-	-	-	-

Myxinidae	-	-	-	-	0,09	0,21	0,45	0,00	-	-	-	-
Myxine	-	-	-	-	0,09	0,20	0,45	0,00	-	-	-	-
capensis	-	-	-	-	0,15	0,31	0,77	0,01	-	-	-	-
Echinodermata	-	-	-	-	0,08	0,17	0,34	0,00	-	-	-	-
Holothuroidea	-	-	-	-	0,08	0,18	0,35	0,00	-	-	-	-
Mollusca	4,65	3,37	2,39	0,25	3,46	3,67	3,17	0,23	2,50	3,54	**10,60**	0,48
Cephalopoda	4,23	3,14	2,35	0,22	3,60	3,85	3,01	0,24	2,65	3,77	**10,68**	0,50
Myopsida	0,05	0,12	0,10	0,00	-	-	-	-	-	-	-	-
Loliginidae	0,05	0,14	0,10	0,00	-	-	-	-	-	-	-	-
Loligo	0,05	0,13	0,10	0,00	-	-	-	-	-	-	-	-
reynaudii	-	-	-	-	-	-	-	-	-	-	-	-
Octopoda	-	-	-	-	0,59	0,74	0,21	0,02	1,37	0,97	2,08	0,07
Bathypolypodidae	-	-	-	-	-	-	-	-	-	-	1,80	-
Bathypolypus	-	-	-	-	-	-	-	-	-	-	1,89	-
valdiviae	-	-	-	-	-	-	-	-	-	-	5,01	-
Oegopsida	-	-	-	-	0,17	0,19	1,41	0,01	0,91	1,94	7,59	0,36
Ommastrephidae	-	-	-	-	0,19	0,21	1,44	0,01	1,12	2,41	7,82	0,78
Todarodes	-	-	-	-	0,19	0,20	1,45	0,01	1,03	2,22	8,20	1,02
angolensis	-	-	-	-	-	-	0,46	-	-	-	-	-

eblanae	-	-	-	-	0,30	0,31	0,20	0,00	-	-	-	-
Sepiida	4,23	3,06	2,26	0,61	2,62	2,78	1,38	0,30	-	-	0,95	-
Sepiidae	4,64	3,28	2,32	0,81	2,27	2,27	0,66	0,17	-	-	-	-
Sepia	4,44	3,13	2,30	0,82	2,04	2,01	0,66	0,15	-	-	-	-
australis	1,86	1,60	0,95	0,08	0,90	0,93	0,17	0,02	-	-	-	-
dubia	-	-	-	-	-	-	0,10	-	-	-	-	-
hieronis	0,53	0,53	1,42	0,02	0,30	0,31	0,45	0,00	-	-	-	-
Sepiidae	-	-	-	-	0,19	0,20	0,01	0,00	-	-	-	-
Sepiolidae	0,16	0,14	0,01	0,00	0,66	0,83	0,75	0,03	-	-	0,98	-
Austrorossia	-	-	-	-	0,46	0,60	0,46	0,01	-	-	-	-
enigmatica	-	-	-	-	0,75	0,93	0,79	0,03	-	-	-	-
Rossia	-	-	-	-	0,19	0,20	0,29	0,00	-	-	1,03	-
Stoloteuthis	0,15	0,13	0,01	0,00	-	-	-	-	-	-	-	-
Teuthoidea	-	-	-	-	0,25	0,19	0,03	0,00	0,46	0,97	0,09	0,01
Gastropoda	0,23	0,12	0,03	0,00	-	-	0,18	-	-	-	-	-
Cephalaspidae	-	-	-	-	-	-	0,18	-	-	-	-	-
Philinidae	-	-	-	-	-	-	0,19	-	-	-	-	-
Philine	-	-	-	-	-	-	0,19	-	-	-		-
aperta	-	-	-	-	-	-	0,32	-	-	-		-

Appendix 5: Percentage number (*%N*) percentage frequency (*%FO*), percentage weight (*%W*) and percentage IRI (*%IRI*) data for prey items found in the stomachs of small, medium and large *Lophius vomerinus* on the West and South Coast. Values in bold denote frequently occurring (*%FO*)/important taxa (*%IRI*) (>10%). "-"denotes null values.

		West				**South**			
		%N	***%F***	***%W***	***%IRI***	***%N***	***%F***	***%W***	***%IRI***
0-37 cm	Carcharhiniformes	-	-	-	-	-	-	-	-
	Anguilliformes	6,12	4,67	3,95	1,38	13,19	**20,00**	11,68	**22,17**
	Callionymiformes	28,57	**31,33**	11,74	**37,06**	7,69	**11,11**	1,55	4,58
	Clupeiformes	6,12	4,67	16,22	3,06	17,58	**13,33**	35,13	**31,33**
	Cypriniformes	-	-	-	-	1,10	2,22	2,76	0,38
	Decapoda	4,08	4,67	0,78	0,67	8,79	6,67	0,32	2,71
	Gadiformes	20,92	**20,67**	36,76	**34,98**	3,30	4,44	6,15	1,87
	Myctophiformes	1,53	1,33	0,24	0,07	-	-	-	-
	Myopsida	1,02	1,33	0,13	0,05	1,10	2,22	0,41	0,15
	Oegopsida	0,51	0,67	1,07	0,03	1,10	2,22	2,72	0,38
	Ophidiiformes	-	-	-	-	2,20	2,22	1,88	0,40
	Perciformes	0,51	0,67	1,93	0,05	7,69	4,44	10,20	3,55
	Pleuronectiformes	4,59	5,33	8,30	2,02	4,40	6,67	10,44	4,41
	Scombriformes	-	-	-	-	-	-	-	-
	Scorpaeniformes	3,57	2,67	3,10	0,52	8,79	8,89	10,26	7,55
	Sepiida	20,41	**20,00**	13,43	**19,86**	23,08	**15,56**	6,51	**20,52**
	Stomatopoda	2,04	2,00	2,34	0,26	-	-	-	-
	Stomiiformes	-	-	-	-	-	-	-	-
	Carcharhiniformes	-	-	-	-	1,23	1,96	0,89	0,18
	Aulopiformes	0,76	1,08	0,22	0,02	-	-	-	-
	Anguilliformes	6,87	8,60	3,11	1,92	16,05	**23,53**	12,93	**29,49**
	Callionymiformes	9,16	9,68	0,85	2,17	-	-	-	-
	Clupeiformes	1,53	1,08	14,91	0,40	16,05	**11,76**	13,20	**14,88**
	Cypriniformes	-	-	-	-	2,47	1,96	1,96	0,38

37-45 cm	Decapoda	9,92	7,53	0,47	1,75	4,94	5,88	0,65	1,42
	Gadiformes	41,22	**41,94**	52,60	**88,11**	1,23	1,96	1,44	0,23
	Myctophiformes	0,76	1,08	0,03	0,02	-	-	-	-
	Myopsida	1,53	1,08	0,01	0,04	4,94	1,96	1,37	0,53
	Notacanthiformes	-	-	-	-	-	-	-	-
	Oegopsida	3,82	3,23	5,03	0,64	3,70	3,92	3,74	1,26
	Ophidiiformes	-	-	-	-	1,23	1,96	0,91	0,18
	Perciformes	0,76	1,08	5,95	0,16	8,64	7,84	15,29	8,12
	Pleuronectiformes	3,05	3,23	3,36	0,46	6,17	9,80	7,06	5,61
	Rajiformes	-	-	-	-	-	-	-	-
	Scombriformes	-	-	-	-	3,70	1,96	4,33	0,68
	Scorpaeniformes	4,58	5,38	8,48	1,57	22,22	**13,73**	34,48	**33,65**
	Sepiida	6,87	8,60	2,32	1,77	6,17	9,80	1,55	3,27
	Squaliformes	-	-	-	-	-	-	-	-
	Stomatopoda	6,87	4,30	1,37	0,79	1,23	1,96	0,19	0,12
	Stomiiformes	2,29	2,15	1,30	0,17	-	-	-	-
	Tetraodontiformes	-	-	-	-	-	-	-	-
> 45 cm	Carcharhiniformes	0,97	0,81	0,49	0,04	0,47	0,96	0,37	0,03
	Anguilliformes	1,45	2,42	0,30	0,13	11,68	**14,42**	2,13	7,02
	Callionymiformes	4,35	3,23	0,33	0,47	1,87	0,96	0,01	0,06
	Clupeiformes	13,04	**12,10**	10,02	8,73	11,68	9,62	4,53	5,49
	Decapoda	4,35	4,84	0,22	0,69	0,93	1,92	0,02	0,06
	Gadiformes	31,40	**33,87**	34,79	**70,21**	14,49	**16,35**	22,95	**21,55**
	Myopsida	0,97	1,61	0,03	0,05	10,28	4,81	5,05	2,60
	Notacanthiformes	0,97	0,81	2,06	0,08	-	-	-	-
	Oegopsida	7,25	7,26	15,88	5,26	2,34	3,85	1,72	0,55
	Ophidiiformes	1,45	2,42	7,08	0,65	0,93	0,96	5,43	0,22
	Perciformes	8,70	8,06	13,21	5,53	19,63	**25,00**	41,87	**54,14**
	Pleuronectiformes	0,97	1,61	1,01	0,10	8,41	2,88	1,44	1,00
	Rajiformes	0,97	0,81	0,05	0,03	-	-	-	-

	Scombriformes	-	-	-	-	1,40	1,92	3,55	0,34
	Scorpaeniformes	7,73	8,06	11,83	4,94	7,48	9,62	9,54	5,76
	Sepiida	7,73	7,26	1,65	2,13	6,07	4,81	0,19	1,06
	Squaliformes	0,97	0,81	0,42	0,03	0,93	0,96	0,13	0,04
	Stomatopoda	6,76	4,03	0,65	0,94	-	-	-	-
	Tetraodontiformes	-	-	-	-	1,40	0,96	1,05	0,08

Appendix 6: Percentage number (*%N*) percentage frequency (*%FO*), percentage weight (*%W*) and percentage IRI (*%IRI*) data for prey items found in the stomachs of *Lophius vomerinus* at different depths on the West and South Coast. "-" denotes null values.

		West				**South**			
		%N	***%F***	***%W***	***%IRI***	***%N***	***%F***	***%W***	***%IRI***
< 200 m	Carcharhiniformes	-	-	-	-	0,30	0,60	0,13	0,01
	Anguilliformes	5,58	5,14	2,75	1,87	12,72	**17,37**	4,04	**13,59**
	Aulopiformes	0,37	0,57	0,16	0,01	-	-	-	-
	Callionymiformes	14,87	**17,14**	3,54	**13,76**	3,25	3,59	0,12	0,57
	Clupeiformes	13,38	**10,86**	30,86	**20,95**	15,09	**11,98**	8,83	**13,38**
	Cypriniformes	-	-	-	-	0,89	1,20	0,47	0,08
	Decapoda	8,92	9,14	0,93	3,93	4,14	4,79	0,14	0,96
	Gadiformes	17,10	**16,57**	26,53	**31,54**	5,03	6,59	17,18	6,83
	Myctophiformes	1,49	1,71	0,14	0,12	-	-	-	-
	Myopsida	0,74	1,14	0,07	0,04	7,69	3,59	4,30	2,01
	Oegopsida	0,74	1,14	1,03	0,09	0,89	1,20	0,69	0,09
	Ophidiiformes	-	-	-	-	1,48	1,80	5,79	0,61
	Perciformes	1,86	2,29	6,76	0,86	14,79	**16,77**	38,06	**41,38**
	Pleuronectiformes	4,09	5,71	6,23	2,57	7,69	5,99	2,99	2,99
	Scombriformes	-	-	-	-	1,78	1,80	4,22	0,50
	Scorpaeniformes	6,32	5,14	10,62	3,80	10,95	**10,78**	10,96	**11,03**
	Sepiida	16,36	**17,71**	7,17	**18,18**	11,54	**10,18**	0,86	5,89
	Squaliformes	0,74	0,57	0,64	0,03	0,59	0,60	0,13	0,02
	Stomatopoda	7,43	5,14	2,55	2,24	0,30	0,60	0,03	0,01
	Tetraodontiformes	-	-	-	-	0,89	0,60	1,07	0,05
	Carcharhiniformes	-	-	-	-	2,33	3,45	2,02	0,46
	Anguilliformes	4,39	6,12	1,89	0,97	16,28	**24,14**	4,04	**15,03**
	Callionymiformes	17,07	**19,05**	3,31	9,76	-	-	-	-
	Clupeiformes	2,44	2,72	3,61	0,41	6,98	6,90	0,39	1,56
	Decapoda	2,44	2,04	0,12	0,13	-	-	-	-

201-400 m	Gadiformes	36,59	**36,73**	49,23	**79,26**	34,88	**24,14**	27,69	**46,28**
	Myopsida	1,95	2,04	0,05	0,10	2,33	3,45	5,71	0,85
	Notacanthiformes	0,98	0,68	2,95	0,07	-	-	-	-
	Oegopsida	7,80	6,12	10,85	2,87	11,63	**13,79**	8,60	8,55
	Ophidiiformes	0,98	1,36	4,75	0,20	-	-	-	-
	Perciformes	6,83	4,76	9,37	1,94	13,95	**13,79**	39,69	**22,67**
	Pleuronectiformes	1,95	2,04	1,93	0,20	2,33	3,45	1,02	0,35
	Rajiformes	0,98	0,68	0,07	0,02	-	-	-	-
	Scorpaeniformes	5,37	6,12	9,14	2,23	9,30	6,90	10,83	4,25
	Sepiida	6,83	7,48	2,33	1,72	-	-	-	-
	Stomatopoda	2,44	1,36	0,37	0,10	-	-	-	-
	Stomiiformes	0,98	0,68	0,01	0,02	-	-	-	-
401-600 m	Carcharhiniformes	3,64	2,44	1,08	0,17	-	-	-	-
	Callionymiformes	3,64	4,88	0,16	0,27	-	-	-	-
	Decapoda	1,82	2,44	0,04	0,07	-	-	-	-
	Gadiformes	61,82	**60,98**	42,25	**93,26**	33,33	**33,33**	38,47	**35,90**
	Oegopsida	5,45	4,88	23,18	2,05	33,33	**33,33**	4,25	**18,79**
	Ophidiiformes	1,82	2,44	8,39	0,37	-	-	-	-
	Perciformes	1,82	2,44	12,85	0,53	-	-	-	-
	Scorpaeniformes	1,82	2,44	8,13	0,36	33,33	**33,33**	57,28	**45,31**
	Sepiida	12,73	**12,20**	2,17	2,67	-	-	-	-
	Stomatopoda	3,64	2,44	0,37	0,14	-	-	-	-
	Stomiiformes	1,82	2,44	1,37	0,11	-	-	-	-

Appendix 7: Percentage number (*%N*) percentage frequency (*%FO*), percentage weight (*%W*) and percentage IRI (*%IRI*) data for prey items found in the stomachs of small, medium and large *Genypterus capensis* on the West and South Coast. “-“ denotes null values.

		West				**South**			
		%N	***%F***	***%W***	***%IRI***	***%N***	***%F***	***%W***	***%IRI***
< 50 cm	Anguilliformes	-	-	-	-	10,71	9,84	25,50	7,40
	Callionymiformes	41,35	**38,10**	43,62	**59,13**	41,52	**41,80**	31,06	**63,07**
	Decapoda	23,08	**26,98**	20,06	**21,26**	26,34	**26,23**	18,72	**24,57**
	Euphausiacea	1,92	3,17	0,86	0,16	3,57	4,10	1,35	0,42
	Mysida	2,88	1,59	2,23	0,15	6,70	7,38	2,47	1,41
	Perciformes	10,58	9,52	12,85	4,08	-	-	-	-
	Pleuronectiformes	-	-	-	-	6,70	5,74	8,09	1,76
	Scorpaeniformes	-	-	0,19	-	0,89	0,82	0,64	0,03
	Stomatopoda	20,19	**20,63**	20,18	**15,22**	3,57	4,10	12,17	1,34
	Carcharhiniformes	-	-	-	-	0,50	0,33	0,36	0,01
	Anguilliformes	0,84	0,64	1,73	0,05	3,51	3,66	6,76	1,12
	Aulopiformes	-	-	-	-	0,67	0,50	0,46	0,02
	Beloniformes	0,15	0,16	0,36	0,00	-	-	-	-
	Callionymiformes	31,83	**31,94**	20,97	**48,54**	28,00	**29,12**	19,91	**41,57**
	Cephalaspidae	-	-	0,17	-	-	-	-	-
	Clupeiformes	0,53	0,48	1,92	0,03	0,28	0,33	0,14	0,00
	Cypriniformes	-	-	-	-	-	-	2,66	-
	Decapoda	16,95	**17,17**	4,82	**10,76**	24,09	**23,79**	6,79	**21,89**
	Euphausiacea	0,84	0,80	0,04	0,02	1,56	2,00	0,45	0,12
	Gadiformes	12,90	**11,72**	30,13	**14,51**	1,56	1,50	6,11	0,34
	Isopoda	0,84	0,64	0,05	0,02	0,95	0,83	0,12	0,03
	Lophiiformes	-	-	-	-	0,61	0,50	1,37	0,03
	Myctophiformes	0,84	0,96	0,20	0,03	0,28	0,33	0,05	0,00
	Myopsida	-	-	-	-	0,06	0,17	0,14	0,00
	Mysida	1,45	1,61	0,23	0,08	0,84	1,16	0,18	0,04
	Myxiniformes	0,08	0,16	0,41	0,00	-	-	-	-
	Octopoda	0,53	0,64	0,91	0,03	0,17	0,17	0,23	0,00

51-100 cm	Oegopsida	0,15	0,16	0,35	0,00	-	-	1,67	-
	Ophidiiformes	-	-	-	-	0,45	0,33	0,74	0,01
	Perciformes	5,42	4,49	2,36	1,01	2,73	2,83	1,62	0,37
	Pleuronectiformes	2,67	2,09	2,68	0,32	18,68	**17,47**	34,72	**27,80**
	Rajiformes	-	-	-	-	0,33	0,33	0,48	0,01
	Scorpaeniformes	2,98	2,73	9,33	0,97	1,06	1,16	1,90	0,10
	Sepiida	2,82	2,73	2,32	0,40	4,35	3,33	1,92	0,62
	Stomatopoda	18,02	**20,71**	20,96	**23,22**	9,09	9,82	11,11	5,91
	Stomiiformes	0,15	0,16	0,02	0,00	-	-	-	-
	Tanaidacea	-	-	0,01	-	-	-	-	-
	Teuthoidea	-	-	-	-	0,22	0,33	0,10	0,00
101-150 cm	Anguilliformes	4,35	4,00	2,51	0,81	-	-	-	-
	Beloniformes	4,35	4,00	1,00	0,63	-	-	-	-
	Callionymiformes	-	-	-	-	31,48	**26,92**	2,15	**29,81**
	Cypriniformes	-	-	-	-	-	-	4,02	-
	Decapoda	19,57	**20,00**	2,15	**12,82**	18,52	**15,38**	0,34	9,55
	Gadiformes	32,61	**32,00**	39,26	**67,89**	24,07	**26,92**	34,79	**52,17**
	Isopoda	2,17	4,00	0,12	0,27	-	-	-	-
	Myctophiformes	4,35	4,00	0,12	0,53	1,85	3,85	0,26	0,27
	Oegopsida	-	-	-	-	3,70	7,69	7,49	2,83
	Ophidiiformes	4,35	4,00	17,78	2,61	-	-	13,43	-
	Perciformes	4,35	4,00	4,00	0,99	-	-	26,45	-
	Pleuronectiformes	-	-	-	-	5,56	3,85	3,18	1,11
	Scorpaeniformes	8,70	8,00	31,00	9,37	3,70	7,69	7,29	2,78
	Sepiida	6,52	8,00	0,64	1,69	5,56	3,85	0,02	0,71
	Stomatopoda	8,70	8,00	1,42	2,39	5,56	3,85	0,58	0,78

Appendix 8: Percentage number (*%N*) percentage frequency (*%FO*), percentage weight (*%W*) and percentage IRI (*%IRI*) data for prey items found in the stomachs of *Gneypterus capensis* at different depths on the West and South Coast. "-" denotes null values.

		West				**South**			
	Prey Groups	***%N***	***%F***	***%W***	***%IRI***	***%N***	***%F***	***%W***	***%IRI***
≤ 200 m	Anguilliformes	0,67	0,44	2,64	0,03	4,40	5,06	6,92	1,63
	Callionymiformes	20,81	**20,89**	9,88	**14,44**	27,33	**28,50**	16,73	**35,82**
	Clupeiformes	-	-	-	-	0,30	0,34	0,17	0,00
	Decapoda	14,09	**16,00**	3,37	6,29	25,67	**25,30**	7,02	**23,59**
	Euphausiacea	0,45	0,89	0,06	0,01	0,95	1,52	0,26	0,05
	Gadiformes	1,12	0,89	7,59	0,17	1,19	0,84	1,49	0,06
	Isopoda	-	-	-	-	-	-	0,01	-
	Lophiiformes	-	-	-	-	0,24	0,17	1,53	0,01
	Myctophiformes	0,22	0,44	0,21	0,00	-	-	-	-
	Myopsida	-	-	-	-	0,06	0,17	0,17	0,00
	Mysida	1,79	1,78	0,49	0,09	1,60	2,53	0,32	0,14
	Ophidiiformes	0,45	0,44	6,44	0,07	0,48	0,34	0,89	0,01
	Perciformes	17,90	**14,67**	7,58	8,42	2,73	2,70	1,91	0,36
	Pleuronectiformes	6,26	4,89	7,10	1,47	19,07	**17,03**	43,51	**30,41**
	Rajiformes	-	-	-	-	0,18	0,17	0,55	0,00
	Scorpaeniformes	1,34	0,89	0,55	0,04	1,25	1,35	2,33	0,14
	Sepiida	2,01	1,78	2,15	0,17	4,81	3,54	2,33	0,72
	Stomatopoda	32,89	**36,00**	51,94	**68,79**	9,74	**10,46**	13,87	7,04
	Carcharhiniformes	-	-	-	-	3,02	1,79	0,65	0,17
	Anguilliformes	1,13	0,94	1,57	0,06	4,03	2,68	2,77	0,47
	Aulopiformes	-	-	-	-	4,03	2,68	0,83	0,34
	Beloniformes	0,45	0,47	0,78	0,01	-	-	-	-
	Callionymiformes	38,91	**39,34**	29,24	**66,40**	48,32	**52,68**	14,80	**86,08**
	Cephalaspidae	-	-	0,28	-	-	-	-	-
	Clupeiformes	0,79	0,70	3,11	0,07	-	-	-	-
	Cypriniformes	-	-	-	-	-	-	4,76	-
	Decapoda	17,76	**18,03**	5,25	**10,28**	15,10	**15,18**	1,74	6,62

201-400 m	Euphausiacea	0,68	0,70	0,04	0,01	2,01	2,68	0,11	0,15
	Gadiformes	13,91	**11,94**	31,62	**13,47**	1,34	2,68	12,59	0,97
	Isopoda	0,90	0,70	0,05	0,02	4,70	2,68	0,14	0,34
	Myctophiformes	1,13	1,17	0,21	0,04	-	-	-	-
	Mysida	1,58	1,64	0,20	0,07	-	-	-	-
	Myxiniformes	0,11	0,23	0,67	0,00	-	-	-	-
	Octopoda	0,79	0,94	0,32	0,03	-	-	-	-
	Oegopsida	0,23	0,23	0,57	0,00	-	-	3,00	-
	Ophidiiformes	-	-	-	-	-	-	17,19	-
	Perciformes	0,45	0,47	1,04	0,02	1,01	0,89	32,59	0,78
	Pleuronectiformes	0,79	0,47	0,56	0,02	10,74	**10,71**	2,33	3,62
	Rajiformes	-	-	-	-	1,01	0,89	0,05	0,02
	Scorpaeniformes	3,73	3,51	15,03	1,63	0,34	0,89	5,42	0,13
	Sepiida	3,51	3,51	2,11	0,49	-	-	-	-
	Stomatopoda	12,90	**14,75**	7,31	7,38	3,36	2,68	0,94	0,30
	Stomiiformes	0,23	0,23	0,04	0,00	-	-	-	-
	Teuthoidea	-	-	-	-	1,01	0,89	0,08	0,03
401-600 m	Anguilliformes	-	-	0,97	-	1,11	2,27	1,30	0,20
	Callionymiformes	17,83	**13,56**	3,53	4,50	8,89	**11,36**	1,54	4,26
	Cypriniformes	-	-	-	-	-	-	7,85	-
	Decapoda	27,13	**27,12**	6,07	**13,98**	26,67	**27,27**	2,67	**28,74**
	Euphausiacea	3,88	3,39	0,11	0,21	15,56	**11,36**	0,62	6,60
	Gadiformes	43,41	**47,46**	65,15	**79,98**	18,89	**18,18**	61,52	**52,51**
	Isopoda	3,10	3,39	0,19	0,17	3,33	4,55	0,10	0,56
	Lophiiformes	-	-	-	-	7,78	4,55	0,27	1,31
	Myctophiformes	1,55	1,69	0,07	0,04	6,67	6,82	0,64	1,79
	Mysida	-	-	-	-	3,33	2,27	0,03	0,27
	Octopoda	-	-	3,64	-	3,33	2,27	0,63	0,32
	Oegopsida	-	-	-	-	2,22	4,55	14,61	2,75
	Perciformes	-	-	-	-	-	-	2,06	-
	Scorpaeniformes	3,10	3,39	18,21	1,12	1,11	2,27	5,97	0,58
	Sepiida	-	-	1,98	-	-	-	-	-

	Tanaidacea	-	-	0,07	-	-	-	-	-
	Teuthoidea	-	-	-	-	1,11	2,27	0,16	0,10
> 600 m	Gadiformes	-	-	-	-	-	-	100,00	-

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