Agreement on the Conservation of Albatrosses and Petrels

Ninth Meeting of the Seabird Bycatch Working Group

Florianópolis, Brazil, 6 - 8 May 2019

Gear configuration and use of floats in the South African Demersal Hake Longline fishery

Reason Nyengera and Andrea Angel

BirdLife Albatross Task Force South Africa

SUMMARY

The demersal longline fleet in South Africa uses the double line "Spanish" system. The fleet targets two hake species *Merluccius paradoxus* (deep-water hake) and *Merluccius capensis* (shallow-water hake). When targeting deep-water hake, fishermen add floats to the bottom line, making the gear more buoyant. This is done on an ad-hoc basis during a fishing trip and will depend on environmental conditions, as well as market incentives. Previous studies have not considered the different gear configurations (i.e. the use of floats) in the context of seabird bycatch.

In this paper we investigate current gear configurations for this fishery, operational methods and use of mitigation measures in the context of risk to seabirds. From 2016 to 2018, data was collected through harbour visits and at-sea observations, looking at percentage use of floats in the fishery and investigating the sink rates of hooks close to the weights, droppers and floats on the gear. Our results show that more than 40% of the gear is set with floats. The average sink rate of hooks to 10 m below the water's surface was well under the optimal 0.3 ms^{-1}. With an average setting speed of 3.9 $m.s^{-1}$, only hooks close to the weights are protected by a bird scaring line. Hooks set close to the droppers and floats will reach a depth of 10 m at 224 m and 331 m respectively. Therefore, mandatory night setting is at present the most effective mitigation measure for this fleet. Further trials on gear not using floats will determine if both gear configurations pose equal risk to seabirds. No seabirds were caught during hauling on our trips which can in part be attributed to the installation of offal management devices on all vessels, and must be commended.

1. INTRODUCTION

The demersal hake longline (DLL) fishery began operating in South Africa in the early 1980s. However, due to concerns about the status of stocks, longlining for hake was terminated in 1990 and only reintroduced as an experimental fishery in 1994 (Badenhorst 1988; Japp 1993). Annual commercial fishing rights were allocated under the Marine Living Resources Act of 1998 in 1999 and 2000, but it was with the introduction of medium (4 years) and long (15 years) term fishing rights, in 2001 and 2005 respectively that established the sector (Petersen et al. 2008).

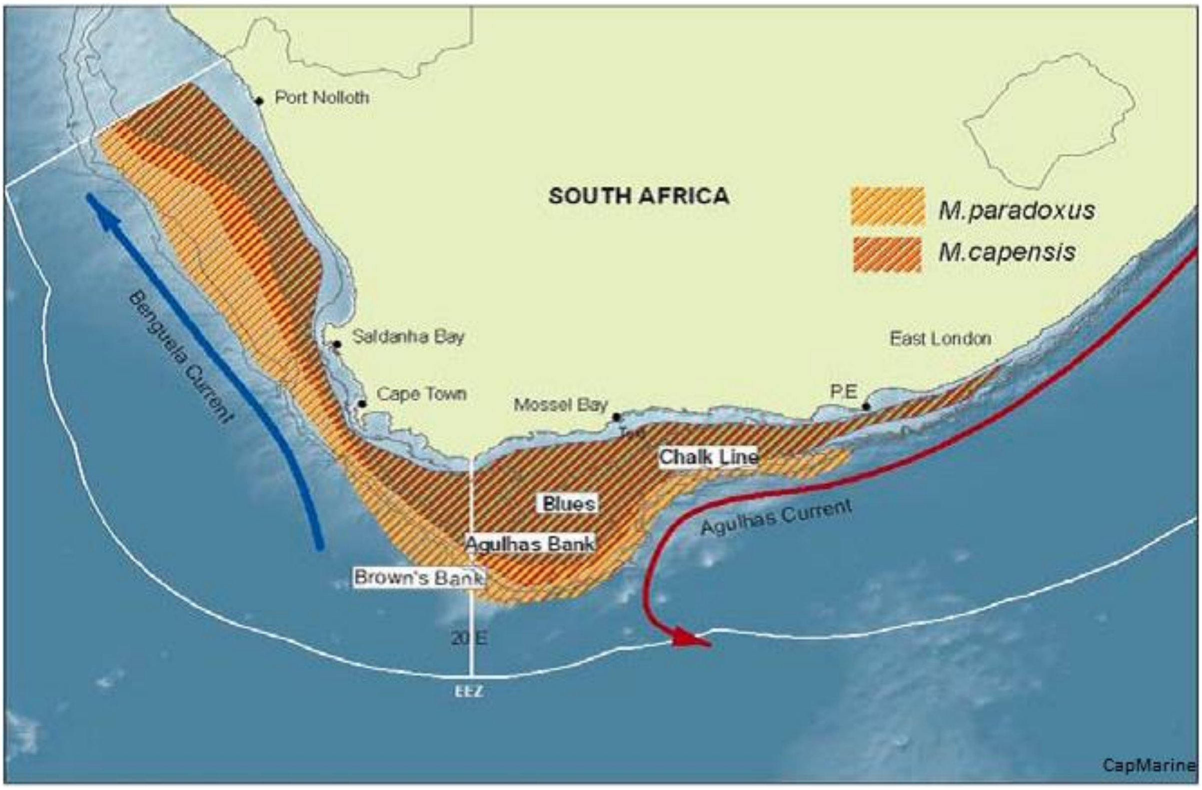

Figure 1. *Areas for catching M. capensis and M. paradoxus (Ngcongo, 2015).*

Hake longline fishing takes place throughout the year along the west and south east coasts. The fishery operates out of harbours from Port Nolloth to Port Elizabeth, though most of the vessels are based in Cape Town (Figure 1). Vessels operate in offshore and inshore waters defined by the 110 m depth contour or a distance of 20 nm from the shore. The fishery is restricted to 20 000 hooks per set (Permit Conditions, DAFF 2018). In 2018 there were 134 rights holders and 40 registered vessels, of which 25 were active (Clyde Bodenham pers. Comm[1]). The vessels operating in this fishery are small and range from 15m to 30m in length, catching primarily for export to the wetfish market. The fleet targets two hake species, *Merluccius paradoxus* (deep-water hake) and *Merluccius capensis* (shallow-water hake) (Greenstone et al., 2015).

---

[1] Chair of demersal hake longline association SAHLLA

The South African hake longline fishery uses the double line “Spanish” system consisting of a buoyant top and a weighted bottom line, to which hooks are attached. The top and bottom line are held together by vertical dropper lines. There are approximately 14,000 hooks per set and the line can be up to 30 km long, anchored at both ends (Japp 1993). The risk to seabirds posed by the fishery was assessed by Barnes et al (1997) and later more comprehensively by Petersen et al. (2008).

Seabird bycatch was estimated during the mid-90s at an annual rate of 0.44 birds/1000 hooks, with 8,000 ± 6,400 birds being killed during the setting operation (Barnes et al. 1997). A six-year study by Petersen et al. (2008) estimated the observed annual bycatch at 0.0075/1,000 hooks, representing 6.8% of total effort. More recently Ngcongo (2015) reported a reduced observed bycatch rate of 0.0017/1,000 hooks (Table 1).

Table 1. Reported estimates of seabird bycatch in the South African demersal longline fishery

Year of estimate	No. of observed hooks (sets)	Observed bycatch rate /1,000 hooks
1995 (Barnes et al. 1997)	95,500 (12 sets)	0.44 ±0.35
2000 – 2006 (Petersen et al. 2008)	14,000,000 (2412 sets)	0.0075 per year
2013 – 2014 (Ngcongo, 2015)	593,000 [1]	0.0017[2]

[1]50% of total (1,185,180) hooks deployed. [2]Bycatch rate based on total number of deployed hooks (1,185,180), a bycatch rate of 0.034 is obtained if the observed (50%) numbers of hooks are used in the calculation.

White-chinned petrels are reportedly one of the most commonly caught species in this fishery (Barnes et al., 1997; Petersen et al., 2008; Favero et al. 2013). While a smaller number of Great Shearwaters (*Puffinus gravis*) and Cape Petrels (*Daption capense*) were reportedly killed during hauling (Barnes et al. 1997). Petersen et al. (2008) attributed a larger sample size as the most likely reason for the reduced bycatch rate obtained during their study compared to Barnes et al. (1997). In Ngcongo’s (2015) study the bycatch rate was estimated using the total number of hooks deployed during observed trips, and not on the 50% of hooks actually sampled, so this may be an underestimation.

Gear configuration in the South African demersal longline fleet is dependent on the target species: a more buoyant gear is used when targeting cape hakes and heavier gear when fishing for Kingklip (Japp 1993). Due to a collapse of Kingklip stocks, the species is now considered bycatch and subject to strict catch limits (DAFF 2017). Petersen et al. (2008) mentions the use of floats when targeting hakes but does not distinguish between gear types and makes no distinction when measuring the sinking rates of hooks. There is potential that the lofting time of the more buoyant gear my present an elevated risk to seabirds, and might explain the variation in bycatch rates calculated in this fishery to date. In this paper we investigate current gear configurations for this fishery, operational methods and use of mitigation measures in the context of risk to seabirds.

2. METHODS

Gear configurations in this fleet were investigated through harbour visits carried out between 2016 and 2018. These included repeated engagements with skippers and crew, developing a rapport aimed at establishing trust, promoting the use of bird scaring lines, and getting access to vessels for sea trips. A harbour visit data sheet was developed to standardize information captured by vessel, gear configuration, fishing practices and operations, as well as the use of mitigation measures.

At-sea data was collected across 8 trips on 5 different vessels from 2017 to 2018. These were selected based on a number of criteria, including: target species, port of departure, location and timing of fishing activities, willingness to participate in trials, and capacity to host observers.

At-sea trials to measure line sinking rates were done on-board 3 vessels (July to December 2018) fishing on the continental shelf along the west and south coasts. Data was collected using CEFAS (CTL) G5 time depth recorders (TDRs) attached to the hook line. The G5 TDR measures depth, temperature, and wet/dry conditions. TDR loggers were attached to the fishing gear using water proof tape on the fishing line (Figure 2). The internal clocks of the TDRs were synchronized with the observer's watch before deployment to determine exact water entry times. These were verified using the wet-dry sensor which provided an independent reference for time of immersion.

***Figure 2**. Attachment of a CEFAS G5 Time Depth Recorders to the hook line*

The data were downloaded after each set and the loggers were redeployed. The raw TDR data was standardized following a similar method to Goad et al. (2010). For comparative purposes with previous line sinking rates collected by Petersen et al. (2008) we recorded rates attained by hooks at 2 m, 5 m, 10 m, and after 26 s. The results are assessed against the optimal sinking rate of 0.3 ms^{-1} (or 26 s) for hooks to reach a depth of 10 m (Melvin et al. (2004). The assumptions are that vessels set at speeds of 7 to 8 knots (or 13.0 to 14.8 km/h) and deploy a 100 m bird scaring line, both of which are the case in this fishery.

3. RESULTS & DISCUSSION

3.1 Gear configuration

The fishery uses a demersal bottom double longline technique that consists of a top and bottom line running parallel to each other and anchored at each end. The buoyant top line is made of braided 14 mm polypropylene rope while the bottom or hook line is made of a thinner 6mm rope. The top line is attached to the bottom line by 8 mm dropper lines, set at 92 m intervals.

The bottom line is made up of “pods” separated by dropper lines. Each pod is made up of 4 hook lines, which have approximately 30 hooks, set a fathom (1.8 m ± 0.3) apart, and attached to 1 mm monofilament snoods, 0.5 m in length. Every two hook lines a concrete weight 8 kg ± 0.3 is set, spaced on average every 98 m (92-120 m). Floats can be added onto every second dropper line depending on the target species and fishing depth. The ends of the top and bottom lines are connected to an anchor line at both ends with a bright radio buoy at the surface (Figure 3).

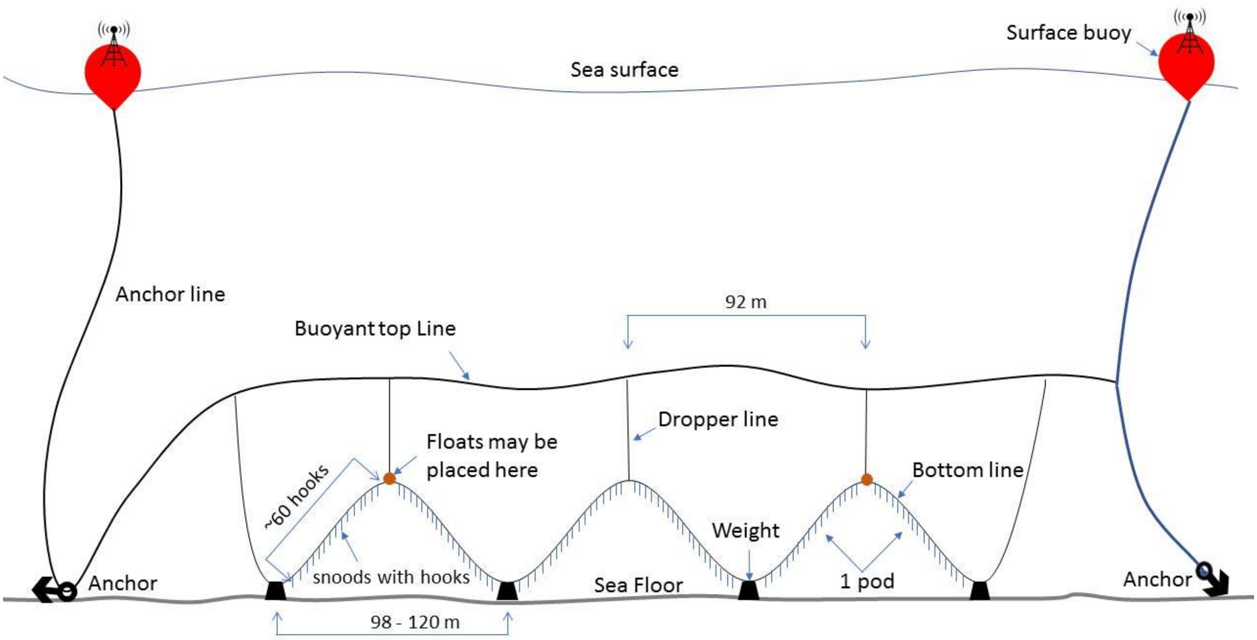

Figure 3*: Schematic diagram of the double line demersal longline gear in South Africa*

Figure 4 shows a “pot” containing 4 fishing lines containing approximately 90 to 120 hooks. Each pot has 4 attachment points where droppers, floats and weights are attached during setting. Larger vessels carry more pots and weights.

Figure 4. A standard pot commonly deployed in the demersal hake longline fleet.

At-sea trips covered a total of 1,019,015 hooks deployed, of which 835,592 (82%) hooks were observed during hauling. Between 6,500 and 16,800 (average 14,995) hooks are set per day on two fishing lines (average 6 km each) (Table 2). All setting operations started before dawn, mostly at 2 am and lasting between 45 and 120 minutes Hauling starts around 11 am and lasts for around 8 to 10 hours. Fish are processed as they are hauled and put on ice. All vessels set from the stern with the exception of one vessel that sets from the port side.

Table 2. *Summary of at-sea data collected*

	Line with Floats	**No floats**	**Total**
Total number of sets	38	29	67
Average setting speed	7.6 ± 0.5	7.7 ± 0.4	7.6 ± 0.4
Average weight (kg)	7.9 ± 0.2	8 ± 0.3	8 ± 0.3
Average distance between weights (m)	101 ± 4	95 ± 8	98 ± 6
Average distance between hooks (m)	1.5 ± 0.2	1.5 ± 0.3	1.5 ± 0.3
Average number of hooks deployed per set	14,270± 1 841	16,310± 970	14,995 ± 1858
Total hooks deployed	596,855	414,960	1,019 015
Average distance between droppers (m)	101 ± 4	95 ± 8	98 ± 6
Average distance between floats (m)	202 ± 8	N/A	N/A
Average fishing depth (m)	465 ± 62	274 ± 86	397 ± 117

The current gear configuration does not differ from what was described by Petersen et al. (2008), with the exception that the mass of the weights has increased from 6 kg to 8 kg. The spacing of the weights remains the same at approximately 108m or 60 fathoms apart. Nevertheless, both past and current weighting regimes fall short of permit condition requirements, which stipulate that weights of 8.5 kg should be spaced no more than 40 m apart. This is not considered practical by the fishermen on board vessels with limited space and the belief that a less buoyant line could interfere with catch, favouring bycatch of Kingklip and sharks.

3.2 Use of floats

From the 8 trips observed, floats were used 60% of the time and deployed when fishing at average depths of 465m ± 62. They were not used when fishing at average depths of 274 m ± 8. Harbour surveys conducted with fishermen confirmed that floats are used when targeting *M. paradoxus* in waters deeper than 400 m and usually further offshore beyond 20 nm. Floats are not used when targeting *M. capensis*. *M. capensis* is caught in shallow waters between 100 m to 400 m, while *M. paradoxus* is generally found offshore from 250 m to 800 m (Burmeister 2001). The abundance of *M. capensis* decreases towards deeper water while the opposite occurs for *M. paradoxus* (Burmeister 2001). A few vessels fish exclusively using floats while most target both species depending on weather and other factors such as market prices and availability. While we were not able to access logbooks while conducting harbor visits, fishermen claimed to use floats on 40% of their fishing operations.

3.3 Line sinking rates

TDRs were deployed during 3 trips on 16 sets set at depths of 440 m to 580 m, when fishing on the continental along the west and south coasts. Lines were set at between 2 am and 4 am for approximately 45 – 120 minutes and hauled from 10 am for approximately 8 to 10 hours. Setting speeds were between 7.5 and 8.0 knots. A total of 35 time-depth data points were collected under various regimes: float: n=15, weight: n=10, dropper: n=10. Table 4 summarises the results showing averages only. Due to the low sample size no further analysis was conducted.

Table 4 *Average sink rates attained at 2 m, 5 m, 10 m and 15 m depths. Depth (m) at 26 s, and time (s) to 10 m below the water's surface.*

TDR position	Sample size	Average sink rate $m.s^{-1}$				Depth (m) at 26 s	Time (s) to 10 m
		2 m	5 m	10 m	15 m		
Float	15	0.07	0.09	0.12	0.12	1.84	85
Dropper	10	0.07	0.15	0.17	0.17	4.17	60
Weight	10	0.67	0.50	0.41	0.36	10.12	25

There were no marked differences in line sink rates between vessels or fishing areas. The effect of the weather condition and sea conditions need further analysis. The was, however, notable differences between the sink rates of hooks close to the weights compared to ones close to the floats and droppers (Table 4 and Figure 3). The average sink rates to 10 m below the water surface (the minimum depth out of reach of most seabirds) were well under the optimal of 0.3 ms^{-1} and only hooks close to the weights are above that threshold (Table 4). Hooks close to the weights sink 3 to 9 times faster than those close to the floats and droppers (Table 4). The differences in sink rates between droppers and floats are not that marked, although floats sink consistently slower compared to the droppers for all depths considered (Table 4 and Figure 3). The slope of the sink rate increases with depth as the hooks sink below the propeller wash and away from the stern of the vessel (Figure 3).

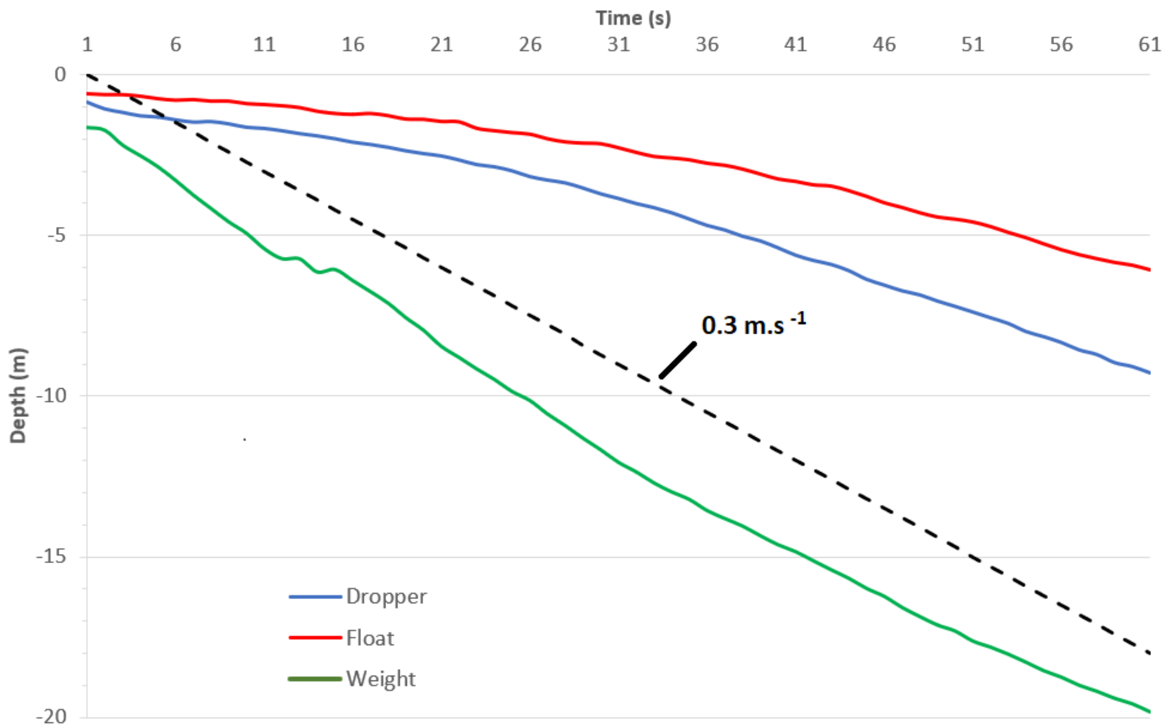

Figure 3: *Average line sink rates of TDRs attached at the weights (average 7.8 kg), droppers and floats. The dashed line represents the minimum sinking rate required for hooks to reach 10 m depth when setting at speeds of 7 to 8 knots (Melvin et al. 1994).*

Our results are consistent with those of Petersen et al. (2008), however further trials are needed to determine if hooks set close to droppers on lines without floats will sink at a faster rate, which was not assessed by Petersen et al. (2008). The potential risk to seabirds when using floated gear given the average setting speed of is 3.9 m.s^{-1}, means that only hooks close to the weights are potentially protected by the bird scaring line. The hooks close to the floats will reach a depth of 10m at 331 m, while those at the droppers will reach 10m depth at 224 m behind the vessel.

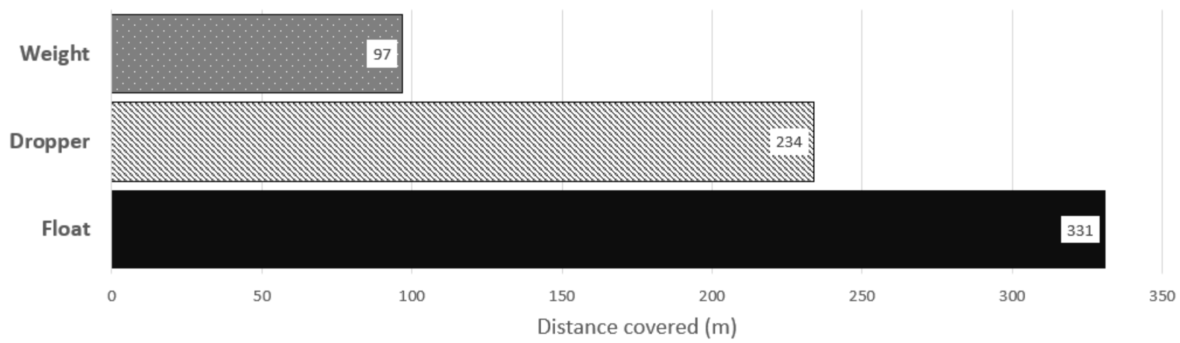

Figure 6: *Distance covered (behind the vessel) when the hooks adjacent to weights, droppers and floats reach 10m*

3.4 Use of mitigation measures

During at-sea observations, over 95% of sets ended before nautical dawn, and 4 out of the 5 vessels boarded had their deck lights facing inwards. Harbour visits confirmed that 90% of all the vessels visited (50% of registered fleet) have bird scaring line (BSL) attachment points 6 m above the water's surface, including 30% which have installed tori poles, and all vessels have at least one bird scaring line on board. During at-sea observations, compliance with the use of BSLs was 77%. Most of the skippers interviewed were not happy with the BSLs and consider them to be too long for their vessels and prone to entanglements. All visited vessels have installed offal management devices in the form of a pipe that diverts the offal discharge to the opposite side of hauling, with the exception of whole heads which are mostly thrown over-board on the same side as hauling. In previous studies the use of mitigation measures was very poor. Petersen et al. (2008) observed that while adherence to night setting was common practice compliance, the use of BSLs was only 9%, none of the vessels in the fleet had offal management devices and were discharging offal on the same side as hauling. The latter resulting in over 60% of birds being caught alive while hauling.

Seabird bycatch during our observations occurred once with two birds being killed during setting, when setting ended after first light. With BSLs affording no protection from baited hooks exposed close to the water's surface, night setting is at present the most effective mitigation measure for this fleet. Further trials on gear not using floats will determine if both gear configurations pose equal risk to seabirds. No birds were caught during hauling on our trips and can be attributed at least in part to the installation of offal management devices on all vessels. The use of lines with integrated weights has been shown to effectively reduce seabird bycatch in demersal fisheries, in particular that of White-chinned petrels with the ability to dive beyond 10 m (Robertson et al. 2006, Dietrich et al. 2008). This may be an effective mitigation option for this fleet.

4. REFERENCES

Badenhorst, A., 1988. Aspects of the South African longline fishery for kingklip Genypterus capensis and the Cape hakes *Merluccius capensis* and *M. paradoxus*. South African Journal of Marine Science, 6(1), pp.33-42.

Barnes K.N., Ryan P., Boix-Hinzen C., 1997. The impact of the Hake Merluccius spp. longline fishery off south Africa on Procellariiform seabirds. Biological Conservation, 82: 227-234.

Burmeister L.M, 2001. Depth-stratified density estimates and distribution of the Cape hake *Merluccius capensis* and *M. paradoxus* off Namibia deduced from survey data, 1990–1999, South African Journal of Marine Science, 23:1, 347-356, DOI: 10.2989/025776101784528863

Department of Agriculture, Forestry and Fisheries (DAFF) 2017. Hake Longline Permit Conditions (South coast Inshore pp. 16 and Offshore pp. 16; West coast pp. 13. Published annually by DAFF Cape Town.

Dietrich, K.S., Melvin, E.F. and Conquest, L., 2008. Integrated weight longlines with paired streamer lines–Best practice to prevent seabird bycatch in demersal longline fisheries. Biological conservation, 141(7), pp.1793-1805.

Favero, M., Blanco, G., Copello, S., Pon, J.P.S., Patterlini, C., Mariano-Jelicich, R., García, G. and Berón, M.P., 2013. Seabird bycatch in the Argentinean demersal longline fishery, 2001− 2010. Endangered Species Research, 19(3), pp.187-199.

Goad, D.; Temple, S.;Williamson, J,. 2010. MIT2009/01 development of mitigation strategies: inshore fisheries. Research Report held by the Department of Conservation, Wellington.

Greenstone J., V. Ngcongo, C. Bodenham, 2015. The South African Hake Longline

Japp D.W., 1993. Longlining in South Africa. In: Fish, fishers and fisheries. Beckley, L.E. and R.P. van der Elst (eds). Oceanographic Research Institute, Special Publication No.2. Proceedings of the second South African Marine Linefish Symposium, Durban, 23-24 October 1992.

Ngcongo, V.S., 2015. South African Hake Longline Association Fishery conservation Project – observer program report. Unpublished report Capricorn Marine (Pty) Ltd

Petersen, S.L., Nel, D.C., Ryan, P.G. & Underhill, L.G., 2008. Understanding and mitigating vulnerable bycatch in southern African trawl and longline fisheries. WWF South Africa Report Series – 2008/Marine/002.

Robertson, G., McNeill, M., Smith, N., Wienecke, B., Candy, S. and Olivier, F., 2006. Fast sinking (integrated weight) longlines reduce mortality of white-chinned petrels (*Procellaria aequinoctialis*) and sooty shearwaters (*Puffinus griseus*) in demersal longline fisheries. Biological Conservation, 132(4), pp.458-471.