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Piracy off West Africa 2010 to 2014: an analysis

Abstract

Piracy is one of the most frequent maritime threats. However, despite the importance of how maritime piracy is to be reduced, it is substantially less investigated than maritime safety. Piracy off Somalia is the most investigated case of piracy, but those results are not necessarily generalizable. Piracy off West Africa has been shown to be more diverse, successful and dangerous. This study investigates and analyses piracy off West Africa with the aim to understand how different operations and security measures affect the consequences of piracy. This study has identified several different intents and shows that most attacks are relatively close to shore and correspond to areas of high ship density. Attacks with the intent of theft at night-time are generally performed close to shore, and more complicated attacks against ships under way are more common during daytime and farther from shore. Five types of measures are found to have high effectiveness if the attack is detected during approach; after boarding, only two measures have high effectiveness. Of the effective measures, it can be concluded that all but one are dependent on detecting the attack. Therefore, detecting the pirates is key but must be accompanied by a set of measures because no measure alone can protect a ship given the operational conditions off West Africa. The risks associated with piracy off West Africa are estimated to be of the same magnitude as the risks posed by Somali piracy at its peak.

Key words: maritime security, West Africa, piracy, threat analysis, intent.

1 Introduction

Concerns over threats, such as maritime piracy, generated from non-state actors, particularly in relation to weak states, increased after the Cold War era (Coggins 2012). Maritime piracy is directed against important transports and affects areas of great importance (Department of Defense 2007; Council of the European Union 2014). Maritime security as a topic covers protection against threats at sea and therefore not only covers protection against piracy but also crimes such as organized crime; trafficking of human beings, arms and narcotics; and terrorism (Council of the European Union 2014; IMO 2002). However, despite the potential importance of how maritime security is to be achieved, piracy and maritime security are relative to maritime safety less investigated (Bichou 2008; Coggins 2012; Liwång et al. 2013; Yang 2011; Pristrom et al. 2013).

A frequently discussed maritime security case is piracy off Somalia (Pristrom et al. 2013), where the number of attacks was particularly high from 2008 to 2012 (Liwång et al. 2015). However, piracy off Somalia should not be used to define how piracy is understood and which anti-piracy measures to use. For example, piracy in other areas is more diverse (Liwång et al. 2015; Pristrom et al. 2016), more

successful (Coggins 2012) and more violent and dangerous (Pristrom et al. 2013; Wong and Yip 2012; Pristrom et al. 2016). These regional differences cannot be ignored (Bateman 2010), and there is thus a need to further investigate piracy and anti-piracy measures in different regions. A resulting enhanced understanding of incidents is a central aspect of achieving security (Mileski et al. 2015). One such region that needs an increasing attention is West Africa (BIMCO et al. n.d.).

Piracy is defined by Article 101 of UNCLOS and can be summarized as illegal acts from one craft directed towards another "on the high seas" or "outside the jurisdiction of any state" (UN 1982). Armed robbery is defined by the International Maritime Organization in Resolution A.1025 as a crime "within a State's internal waters, archipelago waters and territorial seas" (IMO 2010). However, in this study, this legal distinction between piracy and armed robbery is not considered, and both types of crimes are described under the term piracy.

According to a study by Pristrom et al. (2016), the way in which pirates operate (modus operandi) off Somalia is to attack ships under full speed with the intent of hijacking the ship or kidnapping for ransom. However, from a history of petty theft of crew personal effects and ships stores, West African piracy has changed into a more sophisticated, violent and diverse criminal activity towards ships that are at anchor or drifting while waiting for cargo or orders. This criminal activity has at least three different intents: armed robbery, cargo theft and kidnapping (Pristrom et al. 2016). However, authors who discuss West African piracy in more general terms, such as Liwång et al. (2015); Pristrom et al. (2013); Pristrom et al. (2016), do not give any quantitative data to further the understanding of the intents and modus operandi. Therefore, the aim of this study is to more closely analyse piracy off West Africa during the years 2010 to 2014 to identify the operational conditions that shape the piracy as well as effective measures. This is a step towards increasing maritime security in the region and diversifying the understanding of today's piracy.

2 Theory, methodology and data

2.1 Theory and methodology

Maritime security, particularly ship security, is based on risk management (IMO 2002; BIMCO 2013; UKMTO 2011; BIMCO et al. n.d.). Changes in safety risks are often a result of changes made by the ship operator or in the on-board environment. However, in the context of security risks, the situation can change dramatically, although there are no changes in ship operations. Therefore, maritime security must consider interdependencies between the situation on board and the political, economic and social situations in the areas transited and visited (Liwång et al. 2015).

The development of ship security analysis has drawn from the experience of ship safety analysis (Yang et al. 2013). However, system definition and threat identification are considered more

challenging for security than for safety (Bichou 2008; Liwång et al. 2015) and must be conducted with the particular ship and operation in mind (IMO 2013). Therefore, the analysis in this paper is performed with a risk perspective; i.e., identifying the probabilities of an attack and the consequences an attack can lead to in relation to ship types and ship operations. In this study, the analysis of the attack is divided into three phases:

1. Phase 1: attack planning and preparations
2. Phase 2: approach
3. Phase 3: boarding and post-boarding

For each phase, this study investigates and identifies the intent and capability needed and what affects the likelihood of exploiting the ship's vulnerability according to the following definitions, developed from military threat analysis and force protection as described by NATO (2007):

- Intent: The pirate's willingness to target a ship. Analysis of intent considers threat ideology, objectives, strategy, likely intentions and previous history.
- Capability: The ability needed to achieve the intent. Analysis of threat capability considers threat structure, leadership, professionalism, tactics, weaponry, targeting, and logistics.
- Likelihood of exploiting the ship's vulnerability: Analysis of likelihood includes threat history under similar circumstances, the threat's overall plan, currently implemented security controls and measures, and the most probable threat course(s) of action.

In this study, the aspects and actions described in the studied incidents are analysed with both quantitative and qualitative approaches. The data are discussed and analysed in relation to the attack phases, and wherever possible, the incident rationale proposed by other sources is tested using non-parametric tests: the Chi-Squared test or the Mann-Whitney test. For all tests, a significance level of 95 % is used.

2.2 Incident data

In total, the study examines 265 incidents off West Africa. The main source of incident data for this study is the incident descriptions collected by the International Maritime Bureau (IMB) for 2010 to 2014 (IMB 2011, 2012, 2013, 2014, 2015). Typically, the IMB incident description provides a short description of how the incident is perceived by the crew on the attacked ship.

In this study, to avoid the limitations with the generic coding performed by IMB (Bateman 2010), the incidents' quantitative and qualitative information is coded into 38 different categories (if the information is available in the incident report). These categories describe aspects such as the date, time of day, ship activity, position, piracy modus operandi, protective measures used, consequences, and reported effectiveness of the measures used.

It must be acknowledged that the IMB incident reports have quality problems, primarily the following:

- The descriptions do not describe all aspects of an incident, especially the aspects covering the intent of the pirates and activity performed by the pirates before they are detected by the ship.
- The statistics do not include all incidents (Bateman 2010).

That the IMB statistics do not include all incidents can lead to systematic errors that could have an impact on the analyses to be performed here. Therefore, this study also examined a selection of other sources for two of the years studied here. A total of ten newspaper articles were found describing 13 incidents off West Africa by searching news reports for the term "pirate" for 2012 and 2013 in The Times (2015), The New York Times (2015), and The Maritime Executive (2015). Nine of the ten articles are based on sources other than the IMB records. Of the 13 incidents, four are not included in the IMB incident descriptions. All but one of the articles primarily describe attacks with severe consequences (kidnappings or deaths). Two of the attacks with severe consequences are not included in the IMB incident descriptions. In total (IMB and found newspaper articles), there are 31 reports on incidents resulting in kidnappings or deaths in 2012 and 2013.

The incidents described in newspaper articles are typically more in depth in relation to how the hostages (or a specific hostage) were treated but lack the objective detailed description of the attacks included in the IMB reports. From the identified newspaper articles, the extra knowledge gained for this study is limited. The main contribution is that they indicate the size and type of underreporting in the IMB statistics.

It is likely that the incidents with severe consequences, including deaths and kidnappings, are underreported because the information provided by the ship operators is seen as sensitive or because the people responsible for the reporting are no longer on-board or alive. However, incidents with no or very low consequences are also most likely underreported because they can be seen as a part of the normal situation and nothing to bother with.

If severe incidents are defined as incidents leading to death or kidnapping, the investigation of news reports for 2012 and 2013 indicate that at least 2 of 31, i.e., >7 %, are not reported to IMB. It is likely that incidents with low consequences are not covered in any sources.

To investigate the attacks more closely and to capture regional differences, West Africa is in this study divided into three areas:

- Area 1, South of Gulf of Guinea: Nations from South Africa to Congo (28 attacks).
- Area 2, Gulf of Guinea: Nations from Gabon to The Ivory Coast (193 attacks).
- Area 3, North of Gulf of Guinea: From Liberia to Morocco (23 attacks).

2.3 Shipping data

To be able to estimate the probability of an attack, data on the shipping in general are also needed. However, the density of ships in coastal areas is often not publically available but is important when analysing piracy (Coggins 2012). Therefore, here, Nigerian port statistics for 2007 to 2015 (Nigerian Ports Authority 2015, 2016) and ten AIS data samples from Marinetraffic.com (2015a) from October to December 2015 are used to develop a base rate for the number of the ships close to shore and the percentage of tankers in the central Gulf of Guinea (off Ghana, Togo, Benin, Nigeria and Cameroon). The samples show that, on average, there are approximately 244 ships (the number varies between 115 and 403) in AIS range off Nigeria on any given day. In the studied area, on average, 27 % of the ships are tankers (the percentage varies between 15 and 36 %).

Using Nigerian port, which are the main ports in the region, statistics as a reference, it is shown that the ship traffic has increased on average just over 1 % per year over the period from 2007 to 2015 if 2010 is used as a reference (Nigerian Ports Authority 2015, 2016). The total Gross Registered Tonnage (GRT) for Nigerian ports has, however, increased substantially over the period and was 35 % higher in 2015 than it was in 2010 (Nigerian Ports Authority 2015, 2016).

Because the number of ships in Nigerian ports is only affected by a small increase over the period in question, it is here assumed that the base rate for number of ships and percentage of tankers based on samples taken during 2015, as described above, is also applicable for 2010 to 2014.

3 Analysis

3.1 Phase 1: attack planning and preparations

The planning phase in seldom described in the incident statistics. Only two of the incident reports explicitly describe planning and preparations. Both of those incidents represent an infiltration of other ships to use as a means to get to the target ship. For all other attacks, there is nothing in the incident descriptions that indicates that the ship was singled out beforehand. Therefore, it is possible that the majority of the ships are chosen as a result of their position and appearance at sea just before the attack is initiated without any other prior planning in relation to that particular ship. According to the reports, the equipment used during an attack is limited. However, almost all (>99 %) attacks utilize a small boat or canoe, and firearms are reportedly used in 11 % of the incidents.

The lack of evidence of a planning phase corresponds well to the situation off Somalia. Off Somalia, research indicates that the ship is selected at sea as a result of chance in combination with a rudimentary vulnerability analysis performed by the pirates (Liwång et al. 2013). According to Liwång et al. (2013), the Somali pirates base their decision to attack primarily on the ship's physical appearance and perceived level of readiness. This is in contrast to terrorist attacks, such as suicide

bombings, against ships where the planning and preparations are complicated and ships are selected to achieve a specific goal (Pristrom et al. 2013), e.g., the attack on USS Cole in 2000 (Langworthy et al. 2004).

Based on the findings above, it is here suggested that off West Africa the equipment needed for a large portion of the attacks is limited to acquiring a small boat or canoe and occasionally a handheld weapon such as knife, machete or small firearm. For approximately 50 % of the attacks, these are the only preparations needed.

According to Pristrom et al. (2013) and Pristrom et al. (2016), piracy off West Africa can be grouped into three different categories: armed robbery with the intent to steal ship stores and crew belongings; cargo theft (oil); and kidnapping. Based on the findings in this study, the three intents are modified to theft and robbery of crew belongings and ship stores, i.e., to also include unarmed attacks and attacks without contact between crew and pirates; taking cargo and sometimes ship by force; and kidnapping. These three represent the main types of incidents in the material studied here and represent 76 %, 13 % and 15 %, respectively, of the ships that were boarded. The data also show that the three categories are not mutually exclusive and that there are variants and combinations of these three categories.

It has been suggested that kidnappings off West Africa are or could be politically motivated (Liwång et al. 2015; Pristrom et al. 2013; Schneider 2012, 2013). In the material studied here, there are 25 cases of kidnappings, and at least eight cases resulted in a ransom payment. It is thus clear that these kidnappings are economically motivated, but from the material studied here, a political motive can be neither confirmed nor ruled out. For a more detailed analysis of maritime terrorist attacks until 2010, see Schneider (2013).

In sum, the attacks off West Africa are to a large extent driven by a non-evolved criminal intent similar to land-based theft, but approximately 20 % of the incidents (oil theft, hijacking a tanker and kidnappings) are based on a more complex intent, where the incident plays a part in an organized crime. These attacks must be assumed to require a more complex capability also during the planning phase. However, the material studied does not describe this planning. Based on the material for all the types of attacks, the likelihood of exploiting a specific ship's vulnerability must be assumed to be is left up to chance and a basic analysis by the pirates of the ship's vulnerability.

3.2 Phase 2: approach

The studied incidents include attacks on anchored and moored ships but also on steaming ships. According to Pristrom et al. (2013), steaming often off West Africa means traveling at a slow speed or waiting with the engines turned off. This information is also supported by a qualitative analysis of the material studied here.

The shipping in the three areas, Areas 1, 2 and 3, differ as a result of geographical and commercial differences. Off Nigeria, there are oil and gas fields as well as off-shore tanker terminals. Therefore, when the incidents are to be studied more in depth, Area 2 is used. Figure 1 describes the shipping pattern in the busiest part of Area 2, i.e., the shipping off Nigeria.

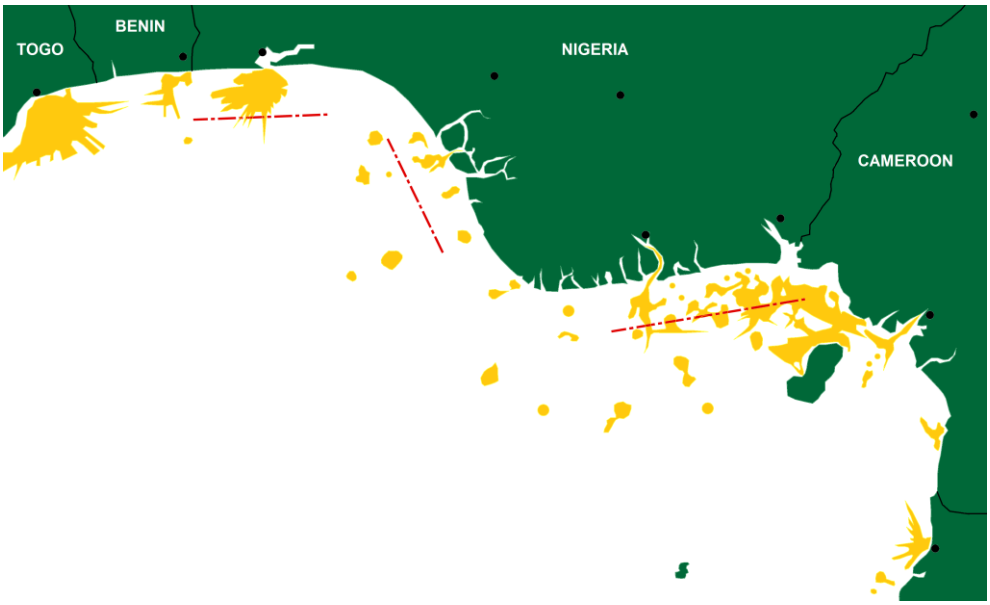

Figure 1 Areas of high ship density off Nigeria for 2014. Based on satellite AIS data from Marinetraffic.com (2015b). As a reference, the distance 30 nautical miles (nm) from shore is marked with a dash-dot line.

If the attack's position and distance from the shore is investigated, it is clear that it differs between Area 2 and Areas 1 and 3 (Figure 2). Typically, the attacks are performed closer to shore in Area 1 and 3 compared to in Area 2. This is probably a result of the off shore activity in the waters off Nigeria, as illustrated in Figure 1. This offshore activity, including ship-to-ship operations, leads to a high density of ships from the shore to approximately 60 nm out from the coast of Nigeria. See Figure 1.

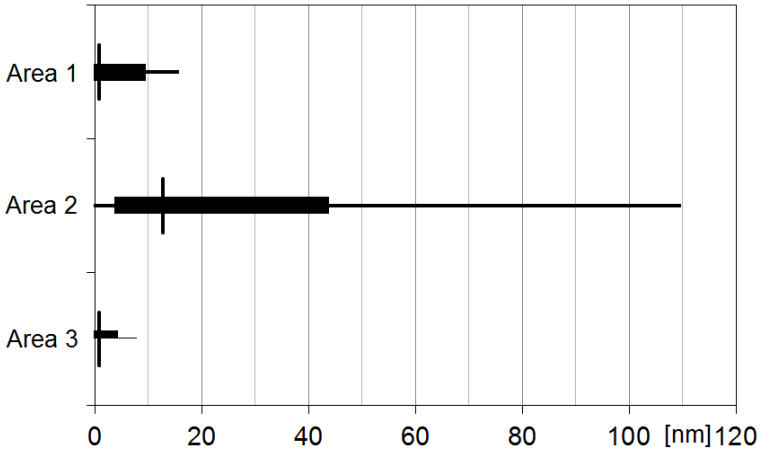

Figure 2 Attack position's distance from land in nautical miles (nm) for Areas 1 to 3. The box represents the inter-quartile distance, and the whiskers extend to the 5th and 95th percentiles. The median is marked with a vertical line.

It has been suggested that the information from the ship's Automatic Identification System (AIS) is used by pirates to select ships, see for example BIMCO et al. (n.d.). Given the indication in the material that the pirates' boats often are of a size, type and equipment level that does not include an AIS receiver publically available AIS data from the internet could still give pirates the AIS information. Publically available AIS data and AIS coverage from land is limited to the VHF transmitting range, typically 20 to 30 nm from land (see, for example, data from Marinetraffic.com (2015a)). AIS data from satellites have worldwide coverage but are not publically available and, due to their low resolution in high-ship-density areas (Carson-Jackson 2012), are not a relevant source of information on a specific ship. By comparing Figures 1 and 2, it can be seen that the areas of attack correlate better with the areas with high ship density, particularly slow-moving or anchored ships, rather than with the area defined by AIS coverage from land. Therefore, it must be assumed that the pirates in general are not limited to areas with easy to access AIS information and dependent on AIS information as long as there is a high density of slow ships to attack.

Research has shown that the ship activity (such as anchored or under way) affects the incidents (Coggins 2012; Liwång et al. 2013). Based on data from attacks, Coggins (2012) proposes that the piracy success rate is generally lower far from land. Off the coast of Somalia, most attacks were performed during the daytime, and Liwång et al. (2013) describe the effects of darkness on the attacks off Somalia. To analyse these three variables (distance to shore, ship activity, and time of day), the incidents in Area 2 are investigated more closely in respect to the effect on the coded categories. The three explaining variables used are: distance to land (median distance for incidents in Area 2 used: ≤13 nm, 95 incidents and >13 nm, 98 incidents); ship activity (anchored, 102 incidents and under way, 81 incidents); and time of day (day, 58 incidents and night, 137 incidents).

Table 1 presents the significant difference as a result of a chi-squared test between the incidents close to shore and the incidents far from land. Table 2 presents the significant difference as a result of a chi-squared test between the incidents with ships at anchor and under way. Table 3 presents the significant difference as a result of a chi-squared test between the incidents during night-time and daytime.

Tables 1 to 3 show that neither distance to shore, time of day or ship activity affect the percentage of incidents leading to a boarding which for all categories is close to 60 %.

Table 1 Significant differences between attacks close to land (≤13 nm, median distance to shore in Area 2 according to Figure 2) and ships far from land (≥13). Also data for twice the distance to shore, <26 nm and ≥26 nm, is shown to show that the sensitivity to definition of 'close' and 'far' is small.

Dependent variable	Difference, ratio [<13 nm: ≥13 nm]	[<26 nm: ≥26 nm]	
Percentage of anchored ships	5:1	4:1	
The percentage of ships that contact local government	2:1	2:1	
Effectiveness of sounding an alarm	2:1	2:1	
Percentage of ships under way	1:4	1:4	
Average number of persons kidnapped	1:2	1:4	
Frequency of evasive manoeuvres	1:4	1:4	(same effectiveness if used)
Percentage of boarded ships among the incidents where the attack was detected during approach	1:2	1:2	
Percentage of incidents were shots are fired	1:3	1:2	
Percentage of ship damaged	1:2	1:2	(relates to shots fired)
Frequency of citadel use	1:2	1:2	(same effectiveness if used)

Table 2 Significant differences between attacks against anchored ships and ships under way.

Dependent variable	Difference, ratio [anchored: under way]
Average number of persons injured	2:1
The percentage of ships that contact local government	2:1
Effectiveness of sounding an alarm	2:1
Effectiveness of evasive manoeuvres	1.3:1
Frequency evasive manoeuvres	1:8 (but more effective if anchored, see above)
Average number of persons kidnapped	1:6
Percentage of incidents were shots are fired	1:3
Percentage of ship damaged	1:3 (relates to shots fired)
Frequency of citadel use	1:2 (same effectiveness if used)

Table 3 Significant differences between attacks during night-time and daytime.

Dependent variable	Difference, ratio [night: day]
Percentage of anchored ships	3:1
Percentage of attacks performed on tankers	2:1
Average number of persons injured	2:1
Effectiveness of sounding an alarm	2:1
Effectiveness of using a citadel	1.5:1
Frequency of evasive manoeuvres	1:4 (same effectiveness if used)
Average number of persons kidnapped	1:3
Percentage of ships under way	1:2
Percentage of incidents were shots are fired	1:2
Percentage of ship damaged	1:2 (to part relates to shots fired)

From Table 1 to 3, a difference in intent can be identified between an attack performed during night-time close to land toward an anchored ship and one performed during the daytime farther from land toward a ship under way:

- Night-time, higher percentage of attacks close to land, towards anchored ships and with the intent to only steal ship stores; i.e., it does not necessarily need weapons, and the consequences can be reduced with a basic alarm or well-implemented use of citadel but can, at the same time, lead to more persons being injured if there is an interaction between the crew and the pirates.
- Daytime, higher percentage of complicated attacks with weapons and with the intent to also take hostages directed towards ships under way.

Detecting the attack during the approach and before the pirates board is a starting point but is not sufficient to avoid boarding. The percentage of boarded ships among the ships that detected the attack during approach is about 30% for almost all types of incidents. This indicates that some ships have the capacity to detect an attack but do not have the readiness needed to fully use that information to their advantage.

Off Somalia, almost all attacks are detected during approach (>90 % (IMB 2012)). Off West Africa, only 44 % of the attacks are reported to be detected during approach. This can partly be explained by the fact that ships off Somalia are attacked under way and that off West Africa, ships under way only represent 40 % of the attacks. For these 40 % (105 incidents), 59 % are detected during approach. The lowest percentage of attacks detected during approach is for berthed ships (1 of the 15 attacks, i.e., 7 %). A qualitative analysis of the attacks that are not detected during approach shows that many of the ships (particularly for berthed and anchored ships) seem to be guarded by a few people who cannot monitor the entire ship. Such a set up therefore allows for boarding and theft that is completely unnoticed or only noticed in a late stage.

It has been suggested that off West Africa, oil cargo theft is of special importance (Pristrom et al. 2013). Therefore, this study's analysis of attacks is also dependent on two ship types: tankers (including ships described as tankers, chemical tankers and product tankers) and other ships.

There are, on average, 0.03 attacks per day off Nigeria, as reported in the collected material for 2011 through 2014 within 30 nm of land, i.e., the estimated AIS range. Given a base rate of 244 ships within AIS range, this means that the probability of an attack is approximately 0.01 % on a given ship per day (24 h) spent in the area. For tankers, the probability of an attack is twice as high (0.02 %), and for non-tankers, the probability of an attack is 0.01 %.

For the cases when the attack is detected during approach, there are five types of measures that have effectiveness (reported to decrease the consequences) higher than 50 %: guards (95 %, reported 19 times), evasive manoeuvre (84 %, reported 32 times), physical protection (83 %, reported 10 times), a citadel (70 % for the cases when ship is boarded, reported 11 times), and turning on lights (60 %, reported 6 times). As seen in Table 4, there is also almost no difference between the effectiveness of armed guards (89 %, reported effective 8 times) and other types of guards (92 %, reported effective 11 times). However, the use of weapons is not always reported because it can be viewed as sensitive information or understood as a part of all guards' equipment.

Table 4 Effectiveness of guards. A measure is defined to be effective if the measure is reported to decrease the negative consequences of the incident.

	Guards, all	Guards, during approach	Guards, if boarded	Guards, weapons reported	Guards, no weapons reported
Times used	21	18	3	9	12
Times reported effective	19	18	1	8	11
Effectiveness [%]	90	100	33	89	92

During the approach phase, there are at least two clearly differing intents that have been identified in this section: the intent of stealing ship stores and the intent of kidnapping. At night-time, there is a higher percentage of attacks close to land aimed at anchored ships with the intent to steal ship stores, and at daytime, there is a higher percentage of complicated attacks with weapons directed towards ships under way and with the intent to take hostages. A third intent can be detected by comparing the probabilities of attack for different ships types, where attacks on tankers stand out with a doubled attack probability.

However, independent of the intent, the physical capability needed to perform an attack is limited to a small boat or canoe and a hand-held weapon. However, the knowhow and organization needed are greater for the more developed attack types, i.e., kidnapping and, in particular, the stealing of cargo and ships.

During the approach phase, the likelihood that the pirates will exploit a ship's vulnerability is to a large extent defined by the ship's countermeasures and the pirates' actions in relation to those measures. Most countermeasures are dependent on that the attack being detected early. If the pirates are detected, several of the standard basic anti-piracy measures (guards, evasive manoeuvre, physical protection, turning on lights and using a citadel) are shown to be effective in decreasing the outcome of the attack, but none of the countermeasures guarantees security.

3.3 Phase 3: boarding and post-boarding

The success rate (here defined as able to board) off West Africa (56 to 80 %; on average, 67 %) is high compared to piracy off Somalia for 2011 to 2014 (20 % or lower). Figure 3 presents the success rate for piracy off West Africa, Somalia and the world for the years under study.

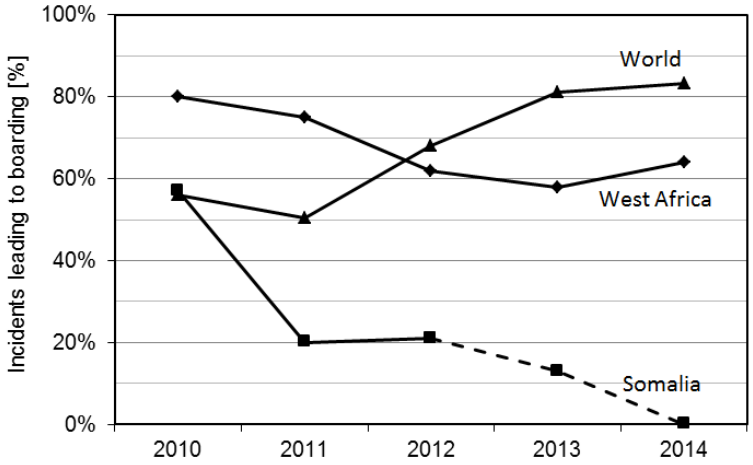

Figure 3 Percentage of incidents leading to boarding for West Africa, Somalia, and the world total, based on IMB (2011, 2012, 2013, 2014, 2015). Off Somalia, the number of incidents was 15 or lower for 2013 and 2014. Part of the explanation for the high percentages for the world for 2013 and 2014 is the high number of incidents and high success rate in Indonesia (92 % both years).

One reason that could explain why the percentage of successful boardings varies between regions is the extent to which failed attacks are underreported. It has been suggested that the particular international focus on Somali piracy by, for example, the United Nations and the encouragement to report suspicious activity in the area (UKMTO 2011) increased the reporting rate for that region (Sörenson 2011). If correct, this would explain the low success rate off Somalia. However, the success rate for piracy off Somalia from 2000 to 2009 varied between 20 and 40 %, both before and after 2008 (Coggins 2012). This although the international spotlight was put on Somali piracy in 2008 as a result of an increased number of attacks. Figure 3 also shows that for 2010, a year with a focus on Somali piracy, the success rate was particularly high. It is therefore likely that the explanation for the difference in success rates between piracy off Somalia and that off West Africa cannot be explained by underreporting alone but rather by the operational environment in general.

The material studied here shows that if the ship has already been boarded, only two measures have effectiveness above 50 %: sounding an alarm (58 %, reported 41 times) or using a citadel (64 %, reported 18 times). Disabling vital ship functions is also reported to have high effectiveness (100 %), but has only been reported twice and the material is thus too limited to draw any conclusions on the effectiveness in general. The material also shows that the two measures often used to reduce the consequences of a boarding are dependent on early detection: use of a citadel and contacting the local government. However, both of these measures require time from initiating the measure to the effect (Liwång and Ringsberg 2013; UKMTO 2011), time that ships off West Africa do not always have.

Local governments have little effect on specific attacks (reported to decrease the consequence in 16 % of the cases when the local government was contacted). In 17 % of the distress calls, the local government is reported as not having responded.

The fact that only two countermeasures are reported to have high effectiveness once the ship is boarded indicates that once the ship is boarded, the pirates already have invested substantially in the attack and are therefore less inclined to abort; i.e., the intent after boarding is to complete the attack. This also means that after being boarded, the ship's vulnerability is high and that the pirates are fairly independent of the measures used.

As a result of the conditions off West Africa (low speed and high ship density), the capability needed to perform a boarding is low, and there are few incidents where the actual boarding has been hindered.

3.4 Consequences of the attack

Central for the risk-based approach of maritime security is to identify the resulting consequences of a threat. Therefore, the frequency for consequence described in the material is summarized in Table 5. The four most frequent consequences are ship boarded, stores stolen, physical threat and shots fired. Two of these, stores stolen and physical threat, are dependent on the ship being boarded.

Of the 28 incidents where the ship was hijacked, 24 involved tankers. A qualitative investigation of the other four cases where the ship was hijacked indicates that those ships where intended to be used as mother ships, i.e. platforms for future criminal activity. This means that the probability of the ship being hijacked if it is attacked is almost seven times higher (20 % instead of 3 %) if the ship is a tanker.

Table 5 Frequency of consequences off West Africa, 2011-2014. In total 265 incidents.

Consequence	
Ship boarded	67 % of the incidents
Stores stolen	50 % of the incidents
Cargo stolen	8 % of the incidents
Ship damage	16 % of the incidents
Ship hijacked	11 % of the incidents
Ship hijacked, if tanker	20 % of the incidents
Ship hijacked, if not tanker	3 % of the incidents
Shots fired	24 % of the incidents
Stowaways	<1 % of the incidents
Physical threat (on-board)	34 % of the incidents
Injured	0.4 persons per incident (in total 100 persons)
Dead	0.04 persons per incident (in total 10 persons)
Kidnapped*	0.4 persons per incident (in total 88 persons)
Ransom	3 % of the incidents

*) off board or with ship

The consequences described in Table 5 are dependent primarily on whether the ship is boarded and whether the attack is detected during approach or not. Therefore, a selection of the consequences is described in more detailed in Table 6 for four different incident categories.

Table 6 Consequences dependent on incident category. Category #1 detected during approach, not boarded (represents 25 % of incidents detected during approach); category #2 detected during approach, boarded (represents 75 % of incidents detected during approach); category #3 all incidents, boarded (represents 67 % of all incidents); category #4 all incidents. The figures given for 'Dead', 'Injured' and 'Kidnapped' represents the average number of persons per incidents. The figures in parenthesis for the value 'Cargo stolen' and 'Ship hijacked' represent the percentage among tankers.

Cat.	Stores stolen [%]	Cargo stolen [%]	Ship damaged [%]	Ship hijacked [%]	Shots fired [%]	Physical threat [%]	Injured	Dead	Kidnapped	Ransom [%]
Not boarded										
#1	0	0(0)	17	0(0)	45	0	0.06	0.02	0.0	0
Boarded										
#2	74	4(0)	30	0(0)	29	44	0.6	0.1	0.6	4
#3	76	13(26)	15	17(38)	11	52	0.6	0.05	0.5	4
All										
#4	50	8(13)	16	11(20)	24	34	0.4	0.04	0.4	3

Safeguarding the crew is important for ship operators (Liwång et al. 2013). Therefore, the consequences that affect the crew are some of the most important aspects to investigate. Earlier studies have identified clear distinctions between the different types of attacks and the level of violence involved (Wong and Yip 2012). This is also the case in this study, and the consequences vary

primarily, as seen in Table 6, based on whether the ship is boarded but also, as shown in Tables 1 to 3, with the ship activity (the average number of persons kidnapped is substantially higher for ships under way and far from land) and time of day (average number of persons injured is twice as high during night-time).

The study shows that injuries during the approach phase are a result of the pirates' use of firearms. In comparison, injuries and deaths during the approach phase in piracy attacks off Somalia are extremely rare. The fact that they are more common off West Africa may be a result of lower speeds, shorter distances and calmer seas. However, in total, the study shows that injuries are not strongly connected to the use of firearms (the average number of persons injured does not increase if pirates use firearms). However, the average number of injured persons increases ten times if the ship is boarded. Injuries are thus primarily a result of physical encounters between pirates and crew.

Deaths are connected to the use of firearms, and the average number of dead crew per incident increases more than three times (from 0.04 to 0.13) if the pirates are reported to use firearms. This constitutes a significant difference (Mann-Whitney test). If, in addition, guards are reported to also have used firearms, the average number of dead crew is almost doubled compared to if only the pirates used firearms (from 0.13 to 0.23). This therefore supports the warnings that armed guards can escalate the violence (Pristrom et al. 2013). However, this difference is not significant, as the variation in the material is too large in relation to the low number of incidents. There are no reports on the number of killed pirates.

4 Results

The study has identified conditions that affect piracy attacks off West Africa. This study identified at least five different aims for the attacks: the ship stores, the cargo, the ship and cargo, the ship to use as a platform/mother ship for criminal activity (relates to hijacking of non-tankers), and the taking of hostages. Two of these aims are only for tankers: the cargo and the ship and cargo. Sometimes attacks include no interaction between attackers and crew and can therefore be seen as theft, but many involve force and violence.

The conditions off West Africa lead to that the capacity needed for performing an attack is low. This is a result of a high density of ships close to shore traveling at low speeds or at anchor and because some attacks are only intended to steal easy to access ship stores.

Shorter distances, slower speeds and calmer weather make weapon use from a distance (shots fired under more controlled circumstances) more deadly compared to that observed for piracy off Somalia. These circumstances also cause damage to ships from shots fired, even when the ship is not boarded, being reported in 14 of 38 attacks, i.e., 37 %.

Examining the areas of attack off West Africa, it is seen that most attacks correspond to areas of high ship density. Attacks with the intent of theft at night-time are generally performed close to shore, and attacks on ships under way that require a more complicated boarding are more common during daytime.

4.1 Effectiveness of protection measures

To guide ship operators in the selection of measures, this study investigates the effectiveness of the measures reported. In this study, an effective measure is defined as a measure reported to decrease the consequences of an attack (which does not imply that the attack is stopped or avoided completely).

Five types of measures are found to have high effectiveness if the attack is detected during approach: guards, evasive manoeuvre, physical protection, use of a citadel, and turning on lights. In addition, it is worth noting that the material shows no difference in effectiveness between armed and unarmed guards. Therefore, the potential gain that comes from having armed guards is low compared to the possible risks of escalating the violence. However, the use of weapons is not always reported. After boarding, only two measures have high effectiveness: sounding an alarm and use of a citadel. From the effective measures above, it can be concluded that all but one (physical protection) are dependent on detecting the attack as early as possible and before the ship is boarded. The use of a citadel is particularly dependent on early detection because the measures need time, from that of initiating the measure to that of the effect (Liwång and Ringsberg 2013; UKMTO 2011).

Consequently, standard measures described in the Best Management Practices for Protection Against Somalia-based Piracy (BMP4) (UKMTO 2011) and in the Interim Guidelines for Owners, Operators and Masters for Protection Against Piracy in the Gulf of Guinea Region by BIMCO et al. (n.d.) are effective. However, the measure of high speed, which can be sufficient to safeguard a ship off Somalia (Liwång and Ringsberg 2013), is not relevant off West Africa because it does not fit the ships' operational profiles. Detecting the pirates is key but must be accompanied by a set of measures. No measure can alone protect a ship given the operational conditions off West Africa.

Local governments have little effect on specific attacks. The local government is reported as not having responded to the distress call in 17 % of the cases. Given the data in this study and the relatively limited areas for piracy incidents off Nigeria (compared to, for example, piracy off Somalia), it is likely that governmental response is an area for possible improvement, particularly if combined with detecting the attack as early as possible and before the ship is boarded (i.e. more effective lookout) and strict citadel use. Detecting more attacks during approach as a result of an effective lookout would increase the time available for the crew to contact the local government and enter the citadel; it would also give the government more time to respond. This would have an important impact on the attacks that need time to complete, which is particularly important for tankers.

4.2 Descriptive models

Scholars (such as Psarros et al. (2011)), organizations working with ship security (as described by such as Yang and Qu (2016) based on a Formal Safety Assessment approach (IMO 2013)), and ship operators (as described by Liwång et al. (2013); Liwång et al. (2015)) perform security analyses. These types of analysis are needed to increase maritime security. To support such qualitative and quantitative efforts, the findings of this study are in this section presented by two descriptive models. The interactions between aspects described in Figures 4, 5 and 6 should, however, not be understood as deterministic, and the measures that are implemented effectively on board can affect the interactions and probabilities. The first, in Figures 4 and 5, describes found interactions between piracy intent, ship type, and activity and consequences.

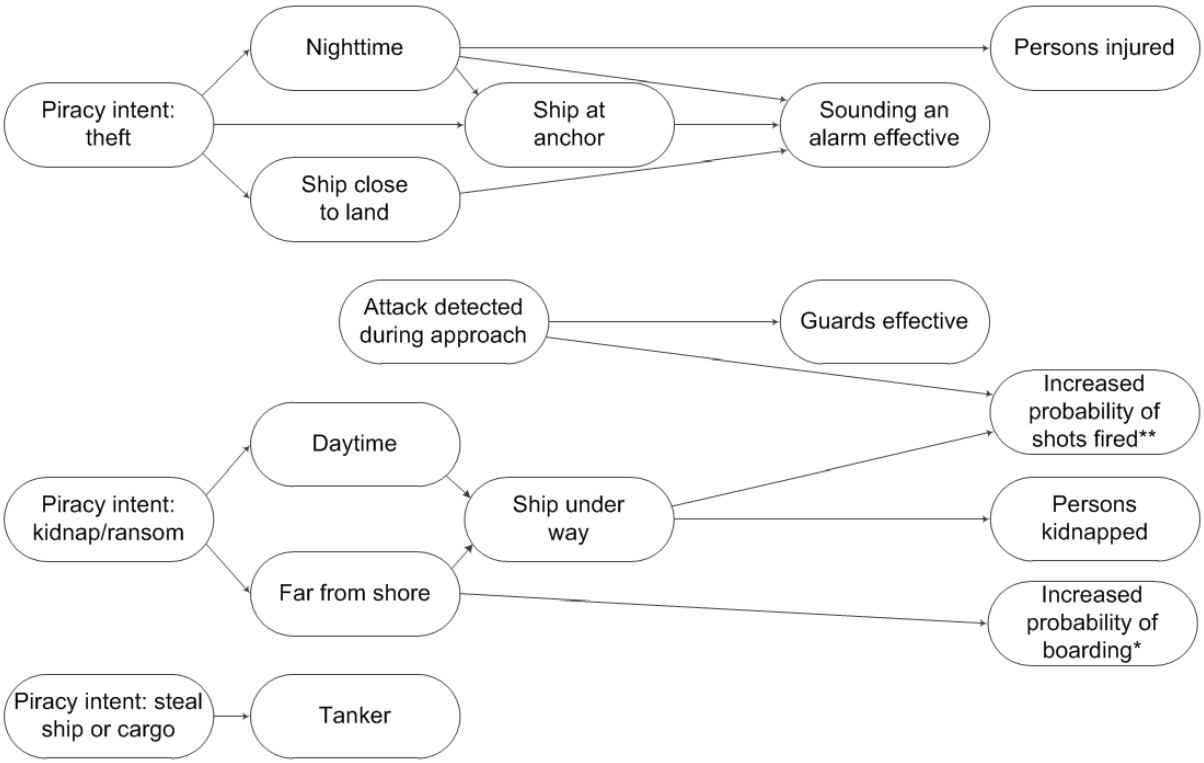

Figure 4 Found interactions in general between the pirates' intent, ship activities, protective measures, and the consequences of an attack. A detail on the effect of boarding and shots fired (marked with * and **, respectively in the figure above) is presented in Figure 5.

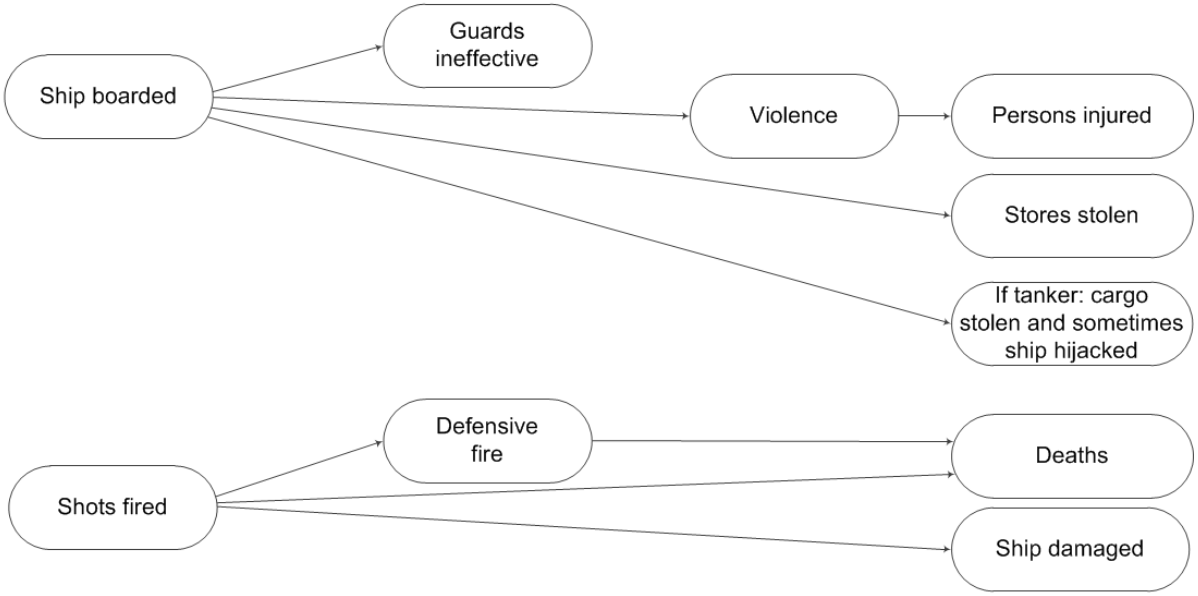

Figure 5 A detail of interactions between different consequences.

In Figure 6, the qualitative interactions of Figures 4 and 5 are complemented by a quantitative event tree. Given the base rate for shipping from Nigeria, it is estimated that the probability of boarding for a tanker is 0.0001 per day spent in the area and 0.00006 for other ships. These figures are of the same order of magnitude as the probability for hijackings off Somalia at the peak of Somali piracy, which was 1 in 4000 (0.00025) (Pristrom et al. 2013). It is not explicitly stated by Pristrom et al. (2013) whether the figures are per day or per voyage through the high-risk area; it is here assumed that the figures are per voyage (approximately 2 to 6 days dependent on ship and route).

	Ship approached	Pirates detected	Ship boarded	P_{path}	Consequences				
					Frequency			Average number	
					Stores stolen	Cargo stolen	Ship hijacked	Killed*	Kidnapped
Tankers:	No, P= 0.9998			0.9998					
	Yes, P= 0.0002	No, P=0.4	No, P=0	0				0.04	
			Yes, P:1	0.0001	0.8	0.3	0.3	0.09	0
		Yes, P=0.6	No, P=0.8	0.0001				0.04	
			Yes, P:0.2	0.00002	0.3	0	0	0.3	0.8
Other ships:	No, P= 0.9999			0.9999					
	Yes, P= 0.0001	No, P=0.5	No, P=0	0				0.07	
			Yes, P:1	0.00004	0.7	0.04	0.1	0.3	2
		Yes, P=0.5	No, P=0.6	0.00003				0.07	
			Yes, P:0.4	0.00002	1	0	0	0.3	1

*) Including injured/10

Figure 6 Event tree for piracy attacks off Nigeria 2010-2014. Probabilities given per day spent in the area.

It must be assumed, based on the figures given in Figure 6, that the maritime security risks off West Africa are as high as the risk off Somalia at the peak of Somali piracy. However, the probability for hijackings specifically off West Africa is lower than that off Somalia.

4.3 Errors and uncertainties

The data used are affected by both errors and uncertainties. As discussed in Section 2.2, the IMB incident reports do not cover all incidents in the area. By searching in other sources for 2012 and 2013, it is estimated that approximately 10 % of the incidents with severe consequences are not reported to IMB. This study has not been able to estimate the underreporting of other types of incidents, which could be substantially larger. The underreporting of incidents with severe consequences affects the estimation of the probabilities for the severe consequences and, therefore, the risk estimation.

In statistical terms, the amount of incidents studied is low, particularly incidents with severe consequences. In the studied material, six attacks led to at least one death, and 25 attacks reported at least one person kidnapped. Therefore, an attack with circumstances not representative for piracy off West Africa could affect the results substantially. However, none of the attacks studied here differ substantially from the others.

5 Discussion and conclusions

Piracy off West Africa is diverse, successful and dangerous. There is a need to better describe this diversity with the aim to investigate and identify important differences and key aspects of piracy in general and successful piracy in particular. This is important because an enhanced understanding of incidents is a central aspect of achieving security.

With the aim of understanding how to protect ships, this article describes the diversity of piracy and the conditions of piracy today off West Africa. The study is primarily based on incident descriptions published by the IMB for 2010 to 2014.

Examining the areas of attack off West Africa, it is seen that most attacks are relatively close to shore and occur in areas of high ship density. Attacks with the intent of theft at night-time are generally performed close to shore, and attacks against ships under way that require more complicated boarding are more common during the daytime and further from shore.

It has been confirmed in this study that piracy off West Africa differs substantially from piracy off Somalia, particularly regarding intent and diversity. However, it has also been shown that many of the measures used off Somalia are also effective in reducing the consequences of an attack off West Africa. Protective measures are more effective, and there are more measures with high effect if the attack is identified during approach. In particular, the following five have high effectiveness: guards,

evasive manoeuvre, physical protection, use of a citadel, and turning on lights. In addition, worth noting is that the material shows no difference in effectiveness between armed and unarmed guards. After boarding, only two measures have high effectiveness: sounding an alarm and use of a citadel. All but one of the measures with high effectiveness (physical protection) are dependent on detecting the attack. The use of a citadel is particularly dependent on early detection because the measure needs time, from that of initiating the measure to that of the effect. Consequently, detecting the pirates is key but must be accompanied by a set of measures. No measure, however, is 100 % effective, given the operational conditions off West Africa. Therefore, there are no silver bullets or quick fixes for piracy off West Africa.

The piracy off West Africa, therefore, presents substantial (and compared to Somalia at the peak of Somali piracy, larger) challenges for ship operators as well as for local governments' response. One area of possible improvement is the response rate and effectiveness of the local governments. Given the relatively short distances to shore, a rapid and reliable response by local governments could have a large impact on the events of an attack, particularly if combined with an increased rate of early detection of attacks. However, high effectiveness of such solutions depends on actions both on-board ships and by government actors.

It must also be noted that just as piracy off Somalia should not be allowed to define the general understanding of piracy, neither should piracy off West Africa. Piracy is, to a large extent, shaped by the local conditions on land and at sea. Therefore, piracy must be understood based on those conditions and not on an aggregated level by analysing all incidents in the world.

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