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An analysis of lifejacket wear, environmental factors, and casualty activity on marine accident fatality rates

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ABSTRACT

Drowning and fatalities at sea are a large concern globally. In the UK, many sea rescues are performed by the Royal National Lifeboat Institution, and this study investigates 6 years' worth of their rescue data to better understand causation of drowning and what makes an incident at sea high risk. A Poisson model is applied to numerous factors recorded as part of each rescue, including environmental conditions (visibility, sea state, etc.), lifejacket wear, and response times for rescue. Increased lifejacket wear is shown to be significantly correlated with lower fatality rates across all spectrum of activities. Survivability among those casualties wearing life jackets was 94%. A seasonal signal is clearly present, with a higher proportion of life at risk incidents occurring during winter months, and a higher than predicted number of fatalities during this time. The analysis identifies high risk groups of beach/sea users, with one of the most at risk being people fishing from shore. Incident survivability is shown to decrease at different rates per activity, as time to rescue increases. This study provides clear evidence that a co-ordinated approach to sea safety is required, and suggests that increased lifejacket wear among coastal and marine users would have a dramatic effect on reducing the number of drowning related deaths each year.

1. Introduction

The Royal National Lifeboat Institution (RNLI) is the largest maritime lifesaving organisation in the UK and it currently provides both lifeboat and lifeguard cover, with 238 lifeboat stations and in excess of 240 lifeguard units around Great Britain and Ireland. On average, RNLI lifeboats are called to attend in excess of 8,500 incidents per year around the UK. Of these, approximately 350 (4.1%) represent an incident whereby there was a verified life at risk (LAR) each year. Of all LAR incidents, 140 (40%) involve a fatality. A LAR incident is defined as an incident where either a life was lost, or would have been lost had it not been for the actions of the RNLI. There is a broad increase in water based-activity across the UK, and it is important for the RNLI to understand what that will mean for the number of incidents they are likely to be tasked to respond to. The sea is used extensively for both recreational and commercial activities, yet it is an environment that is notoriously unpredictable and quick to change. Factors such as inexperience, inappropriate equipment, mechanical failure, and horseplay mean that each year around the UK coastline, thousands of people get into difficulty at sea. Indeed, the combination of these factors has earnt commercial fishing the reputation as one of the most dangerous professions in the UK (McGuinness and Utne, 2016). Over the past 11 years in the UK fishing fleet alone, there have been on average 245 accidents, 16 vessels lost, 52 injuries and 8 fatalities each year, with the overall size of the UK fishing fleet estimated to be 6191 vessels (MMO, 2017). Both commercial and leisure users that get into trouble may be able to self-rescue (i.e. get themselves to shore, or be rescued by crew mates), or attract help from passing vessels, but many will require the assistance of the coastguard or emergency services such as the RNLI in order to get out of their predicament. Thus, in the context of this article, a service is defined as a rescue response performed by the RNLI.

Most research on maritime accidents and fatalities focus on commercial activities (Jin et al., 2002; O'Connor and O'Connor, 2006; Marvasti, 2017), as a result of the requirement from bodies such as the International Maritime Organisation (IMO, 1999) to report and investigate occupational fatalities (McGuinness and Utne, 2016). One of the most well-established lines of research is that of assessing the impact of weather conditions on the number and severity of fishing vessel

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incidents. Wind speed is regularly investigated in terms of accident and incident causation, as it is shown to be a primary factor in fishing vessel stability (Niclasen et al., 2010). Generally, as might be expected, an overall decline in weather conditions increases the likelihood of an incident per vessel (Wu et al., 2009), however, there are less journeys made in inclement weather and the overall number of incidents is shown to decrease as a result (Marvasti and Dakhlia, 2017). More recently, studies have attempted to quantify the impact of the most severe weather conditions that a particular fishing fleet may encounter, such as extratropical cyclones and large-scale sea ice coverage. The study of Rezaee et al. (2016) was one of the most comprehensive to address these factors, primarily because results were interpreted by commercial fishing vessel type (e.g. crab fishing, seal fishing, etc.). The results showed that differing fishing types were predominantly affected by different types of weather influence, as a result of differing vessel configurations and the relative locality of fishing grounds per species type. A study of passenger vessels explicitly linked the occurrence of crew injuries during incidents on cruise liners and ferries to that of passenger injuries, with obvious implications for crew training and competence (Yip et al., 2015).

Comparatively few studies have addressed boating more generally, or recreational boating specifically, although a few have attempted to quantify the impact of lifejacket use on the outcome of leisure boating incidents (Cummings et al., 2011; Wright et al., 2013; Bugeja et al., 2014; Viauroux and Gungor, 2016). However, published studies on the trends in the UK are generally either dated or entirely focused on commercial activities rather than recreational boating (Reilly, 1980; Matheson, 2001; Roberts, 2004). There is a much larger focus on understanding and preventing incidents that might be termed lifeguard incidents in the leisure sector, such as rip current rescues (Gallop et al., 2016; Pitman et al., 2016), but not incidents further offshore.

In order to reduce drowning in the UK, it is first important to fully understand the chain of causation influencing accidents and incidents in UK waters, and to appreciate the factors that influence the fatality rate of incidents. To date, no published studies have addressed the deficit of information regarding causation of UK maritime accidents, and no studies have taken a holistic approach incorporating both commercial and leisure craft, as well as small manual craft such as surfboards and bodyboards. Therefore, this study makes use of operational RNLI data spanning the period 2011–2016 in order to better understand the causes of maritime incidents in UK waters. For ease of reference, the non-standard abbreviations used throughout this article are summarized in Table 1.

2. Data and methods

Here we outline the way in which RNLI data is collected and how it has been supplemented with external data sets, and the processing steps taken for analysis.

2.1. Data

The RNLI collects data every time a lifeboat is launched, with each individual entry being termed a Return of Service (RoS). Each RoS contains information on casualty location, number of people involved, casualty activity, casualty behaviour (lifejacket use, influence of drugs/alcohol, etc.), and meteorological conditions (wind speed, wave height, visibility, sea state etc. at incident location). This study makes use of 6 years' worth of RoS data (2011–2016) supplied by the RNLI. Although more is available, the RNLI has only recorded information about lifejacket utilisation since 2011, and therefore in order to fully incorporate this parameter into the analysis, only data since 2011 will be used. The data also contains information about whether a life was saved or lost as a result of this rescue effort. Initially, the entry for life saved/lost is made by the crew, but it is subsequently verified by the RNLI HQ based on the narrative and conditions in order to ensure parity in reporting across the organisation.

Much of the meteorological information recorded is qualitative and based on the experienced coxswain's estimates of conditions. When entering the data for the RoS, they are prompted to select the appropriate conditions from a drop-down, which lists all the corresponding nautical terms. Wind speed and sea state are all recorded as per the terminology on the Beaufort scale, and this allows conversion from qualitative terms to a quantitative value for the mean wind speeds and wave heights associated with the relevant level of the Beaufort scale. The conversion applied is listed at Table 2. As a result of this qualitative approach to meteorological data, uncertainties do exist as to the reliability of the data. However, a study by Wheeler (2005), comparing qualitative recording of wind speed in ships logs to measured data, showed estimates to be consistent and reliable with 43% of all observations correct, and a further 33% only ± 1 Beaufort Scale category from the true value. Therefore, in the scope of this research, wind observations are deemed suitably robust to be included for further analysis.

One crucial parameter not recorded in RoS data is sea surface temperature (SST). In order to incorporate this into the dataset, average monthly SSTs were obtained for 10 representative stations around the UK coastline, and each RoS incident was mapped to the nearest SST station. The appropriate representative SST for the incident month was then assigned to the RoS entry, in order to provide some indication of likely SST at the incident. As a result of this averaging approach, the SST is the parameter used for further analysis with the poorest data quality overall.

2.2. Methods

In this paper, a simple stepwise log-linear (Poisson) regression model is described and applied to just the LAR incidents within the RoS data. The way RoS data is collected means that you get one entry per lifeboat incident, which may have multiple fatalities or lives saved. The data was therefore separated out into individual entries for individual people. This was achieved by splitting the RoS entry into multiple entries, based on the sum of lives saved and lost as a result of that service. The narrative for each entry was used to attribute the correct lifejacket characteristics to each individual in the incident. The result is that of 2094 RoS entries for services where a life was at risk, the dataset is expanded to reflect the 3119 individuals who were either saved or lost their lives in the 2094 services.

The dependent variable for the model will be the occurrence of a fatality (Y_i), binary coded with 1 equal to a loss of life. The model estimates the likelihood of a fatality based on the balance of independent variables, as follows;

Table 1
Royal national lifeboat institution abbreviations used throughout this article.

Abbreviation	Text in full	Brief description
RNLI	Royal National Lifeboat Institution	The name of the UK's largest maritime rescue charity
AIC	Abbreviated Incident Category	The broad categories used by the RNLI to group incidents into types based on activity (such as fishing)
LAR	Life at Risk	An incident where either a life was lost, or one would have been lost had it not been for the RNLI's intervention
RoS	Return of Service	The log pertaining to an individual incident that was attended by the RNLI
SST	Sea Surface Temperature	A measure of water temperature

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