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# Change of Risk Perception and Risk Communication in Co. Cork, Ireland after Storm Ophelia (2017)

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**Abstract:** Communication with the public about the risk of natural hazards (NHs) is important to enable community resilience and encourage autonomy in handling NHs impacts. The need for communication becomes even more crucial as NHs become more frequent and intense due to climate change. Among these NHs are hurricanes that, due to warmer sea surface temperatures and decreased vertical wind shear, can undergo extratropical transition and reach northern latitudes including NW Europe and Ireland more easily. As a result, the potential impact of extratropical remnants of hurricanes is increasing in Ireland. On the 16th of October 2017, ex-Hurricane, or post-Tropical cyclone (PTC), Ophelia made landfall on the south-west coast of Ireland causing severe disruption across the southern half of Ireland, especially Co. Cork. This study assesses the risk perception of the people in Co. Cork towards NHs, especially hurricanes and their satisfaction with risk communication following Ophelia. A standardised survey methodology (n=89) was employed to analyse the risk communication chain, content, and media and to obtain suggestions for communication improvement using expert interviews. The results show that 55% of respondents are not overly concerned about being affected by NHs but that, after being affected by Ophelia, they are aware of the risks of hurricanes. The study also shows that 60% perceive hurricanes as being of higher risk in the future. Overall, 55% and 64% of the participants are satisfied with the communication on the threats from this event and how to behave during Ophelia, respectively. Improvements were suggested by the public and by experts in terms of better information and training for the public in dealing with these events. It was also suggested that a more robust electricity supply system is needed given the frequency of outages during major windstorm events including this one.

**Keywords:** *Risk perception, risk communication, Atlantic hurricanes, Ophelia, Ireland, Co. Cork*

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# 1. Introduction

Communication with the public about the risk of natural hazards (NHs) is important to enable community resilience and spark autonomy in handling impacts that might occur through NHs. Risk communication is a vital part of disaster risk management "because it shapes people's perceptions of risk and influences their actions with respect to disaster preparedness and disaster response" (Shaw *et al.*, 2013, p. 1). This is especially important as a large share of the population in Ireland "lacks an […] awareness of [disaster] risks, adaptive measures and responses" (Medway *et al.*, 2022, p. 7). However, to communicate effectively, it must be understood how people perceive a hazard to tailor the communication strategy and its content (Fischhoff *et al.*, 1993). Hence, to develop and assess risk communication procedures and programmes, risk perception studies are essential.

The need for communication on extreme storms is especially important since Ireland and the UK experience the highest number of post-tropical cyclones (PTCs), or extra-tropical remnants of hurricanes, in Europe. The fraction of PTCs affecting northern Europe with storm-force winds is already ten times greater than the fraction of mid-latitude cyclones (Sainsbury *et al.*, 2020). Tropical cyclones including hurricanes and typhoons have increased in intensity over the past 40 years and future intensity trends remain positive (IPCC, 2022). Further, the region at risk of being affected by tropical cyclones will expand northwards (Kossin *et al.*, 2017). Due to warmer sea surface temperatures (SSTs) and decreased vertical wind shear, hurricanes can undergo extratropical transition and reach northern latitudes more easily as PTCs and thus pose a higher threat of making landfall in Western Europe, especially Ireland and the United Kingdom (Baatsen *et al.*, 2015; Haarsma *et al.*, 2013; Liu *et al.*, 2017; Michaelis & Lackmann, 2019). These extra tropical remnants generate high winds, storm surges and heavy rainfall and as such present a risk to the population exposed to this NH.

On the 16th of October 2017, PTC Ophelia made landfall on the south coast of Ireland (see Figure 1) with 10 min sustained windspeeds of 115 km/h and gusts of 156 km/h at Roches Point (Met Éireann, 2018b; Moore, 2021; Stewart, 2018). Ophelia caused three fatalities and damages to buildings, power lines, water supply services, trees, roads, and communication networks across Ireland (National Directorate for Fire and Emergency Management [NDFEM], 2019). Ophelia developed in the subtropical Atlantic Ocean in the west of the northwest of the Azores (Met Éireann, 2018b; Stewart, 2018). The system became a category 3 hurricane on the 14th of October and the strongest, most eastern, North Atlantic hurricane ever recorded (Hickey, 2017; Met Éireann, 2018b; NDFEM, 2019; Rantanen *et al.*, 2020; Stewart, 2018). Despite its extraordinary characteristics, there is no research about the risk communication or the long-term impacts of Ophelia, instead, research has primarily focussed on its physical characteristics. Hence, this study's objectives are:

1. To examine people's risk perception of NHs, especially hurricanes,
2. To evaluate peoples' satisfaction with the risk communication during PTC Ophelia by analysing the risk communication chain, content, and media and
3. To survey views on improvements to NH communication.

The focus of this work is on Co. Cork, which was the most severely affected area in Ireland; 90,000 residents had no power, 58,000 had no water and 51,000 had no mobile service (Cork County Council, 2017).

In the following section, we provide the conceptual framework for this work, focusing on risk perceptions and risk communication concepts. Following this, we present the methods used for evaluating risk perception in Cork before we present our findings related to the public's risk and communication perception towards hurricanes and the used communication chain, content, and media during Ophelia. Finally, we highlight the need for further improvement in risk communication on PTCs and for further research into risk perception.

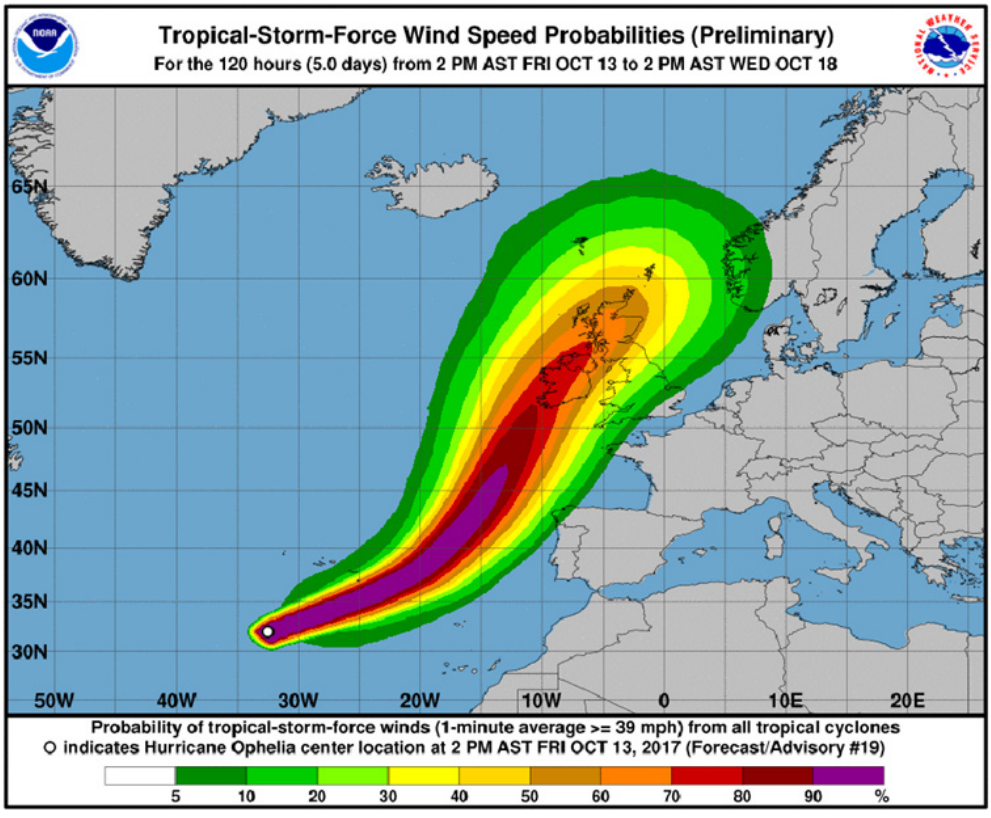


**Figure 1:** Hurricane track map of Ophelia. (Source: NOAA in Met Éireann (2018b)

## 2. Conceptual framework

### *2.1 Risk perception – two conceptual models*

Risk perception is the processing of information regarding potentially hazardous occurrences or actions and their assessment and conclusion of their probability, gravity, and acceptability (Renn, 2008). In this article, we look at the concept of cognitive heuristics and psychometric factors which influence risk perception.

In the cognitive heuristics model, there is a basic assumption that people try to avoid risks if the possible losses are high, and they face risks if achieving rewards is likely. Many people moderate their risk-taking behaviour by adopting an optimal risk strategy that does not maximize their rewards but provides a good pay-off and the avoidance of catastrophic events (Slovic, 2000). The risk perception of the general public and experts frequently differs (Siegrist *et al.*, 2018). Slovic (1987) stated that an expert understands risk using statistics, such as the re-occurenceof an event or the associated fatalities, while an ordinary person usually connects the term 'risk' with the threat of catastrophic events.. Even when a hazard occurs rarely, but causes a lot of fatalities, the general public tends to recognize the risk as high due to its potentially high impact, while experts might consider the risk rather low, due to the rarity of the event (Fischhoff *et al.*, 1993).
According to Renn (2008), people have four typical biases while assessing the risk. These are:

- Availability – Events directly in mind are more probable
- Anchoring effect – If the link between cause and effect is plausible, risk will be perceived as high, regardless of statistical evidence
- Representation – Personal experiences on singular events are more trusted than statistical information on the frequency of events
- Avoidance of cognitive dissonance – Information that challenges one's own opinion will be ignored or downplayed

The latter applies to experts also; Drummond and Fischhoff (2019) found that people with a greater scientific understanding ignore contrary information the same way as the general public, especially if their minds are already made up about the risk.

The psychometric factors model goes beyond the analysis of harm, probability, and benefits. It also contains the view of probability versus consequence as described before but includes a person's feeling of dread (Fischhoff *et al.*, 1978; Slovic, 1987). Dread is influenced by voluntariness, understanding, control, beliefs, and emotions. If someone is in a risky situation voluntarily, they understand it very well, they have positive emotions towards it or they believe they have control over it. As a result of these characteristics, they tend not to have a strong feeling of dread. On the contrary, if the risk situation is out of your control, it is not understood, you have negative emotions towards it or you are in the situation not out of your own choice, then risk is perceived as high as is the dread. In addition, the negative experience of an evacuation leads to a higher dread of the associated hazard (Tanner & Árvai, 2018).

### *2.2 Risk communication*

Risk communication involves multiple messages not only about an approaching NH, but also incorporates opinions, reactions, and feelings about the hazard in times when no hazard is forecasted. It is an interactive process of information exchange and can involve several parties (Kuhlicke & Steinführer, 2010; National Research Council [NRC], 1989). However, the value of this information is dependent on the psychology, knowledge,

skills, and capabilities of the intended audience (Otto *et al.*, 2018). To process the communication, the audience must first overcome attention and selection filters, in particular, there must be access to the message and the motivation to listen to it (Renn, 2008). The processing itself can be examined in the context of judgement & decision-making and mental models. While there are other processing models, these two have been found to benefit hurricane risk communication notably (Millet *et al.*, 2020). Judgement & decision-making models explain the decision to act based on either 'system one' or 'system two' thinking. The former refers to near automatic responses acquired due to experience. The latter refers to situations where there is no prior experience system and all information needed to decide is gathered first (Millet *et al.*, 2020). By comparison, the mental model is based on the individual they describe all experiences one has made in one's life and how these shape a person's judgement of the communication (Jones *et al.*, 2011).

## 3. Methods

This research was carried out in Co. Cork, which was severely impacted by PTC Ophelia and its location along the south coast of Ireland exposes it to severe storms. Co. Cork has 584,156 inhabitants (Central Statistics Office [CSO], 2022a) of which 222,526 live in Cork City and its suburbs (CSO, 2022b). Additionally, the city is a main economic centre and the second largest city in Ireland, after Dublin. Most importantly Cork has 1,198.5 km of coastline, which is 15.9% of the whole Irish coast (Neilson & Costello, 1999). In 2016 more than 60% of Cork's population lived within 5 km proximity of the coast and more than 30% within 1 km of the coast (CSO, 2016b). This is the highest proportion of inhabitants in all of Ireland (CSO, 2016a) and the potentially most vulnerable to the impacts that natural coastal hazards generate.

Figure 2 shows the structure of this research including how the methods assist in answering the objectives of this research. To assess the perception of the general public towards risk perception and communication we developed a standardised online questionnaire survey. In addition, risk communication chain, content, and media were evaluated with the help of expert interviews.

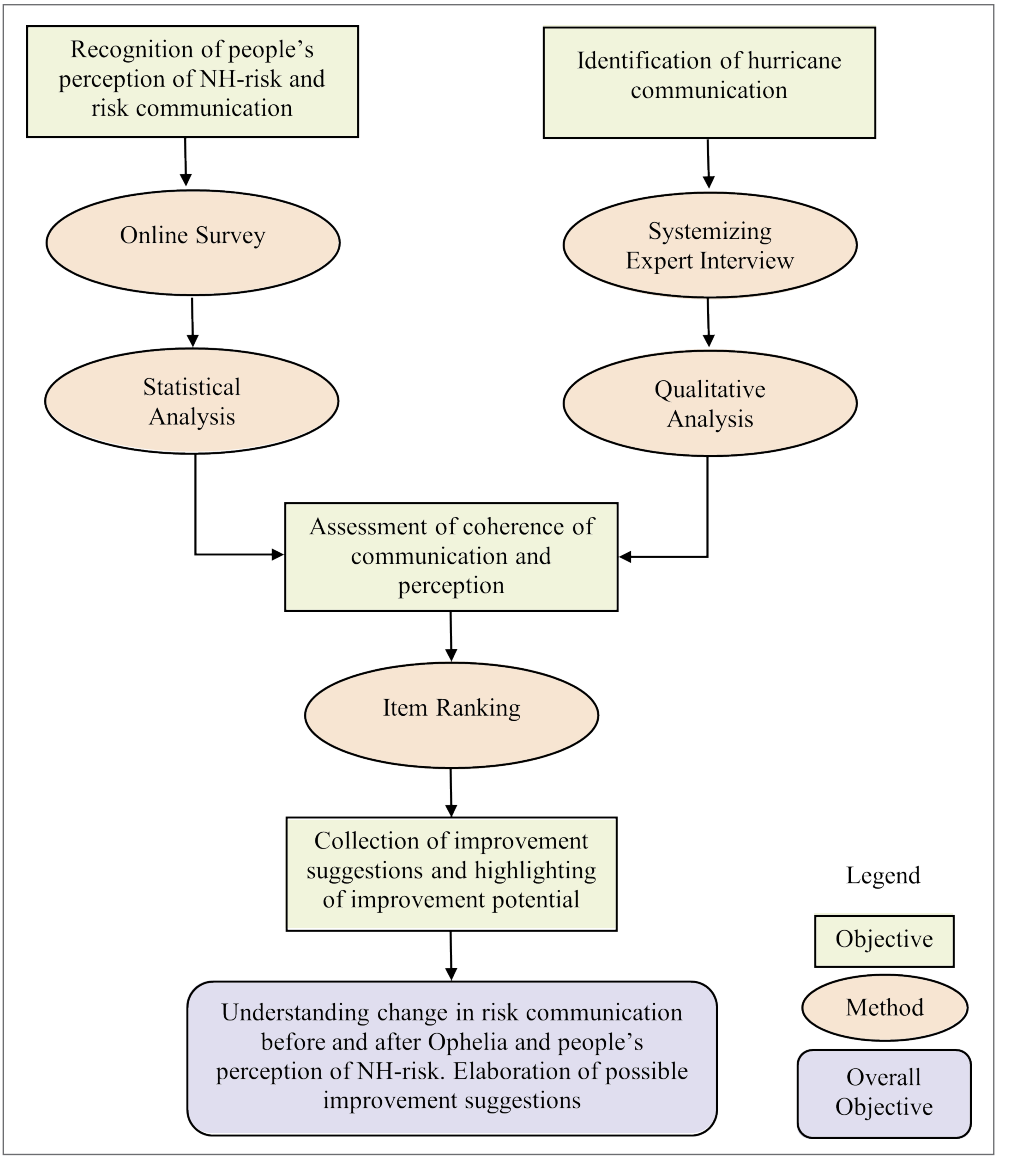


**Figure 2:** Scheme of objectives and their related methods

### *3.1 Standardised survey*

A standardised online survey (Porst, 2011) was used to assess the risk perception towards NHs and risk communication during PTC Ophelia. The survey content is organised into four sections: natural hazards and their perception, the experience of PTC Ophelia, their view on risk communication and personal information (Table 1).

**Table 1:** Content of standardised survey

| Survey Section | Questions Content |
|---|---|
| **1 – Natural Hazards and their Perception** | Asks about the participants' feelings towards NHs, if they are concerned about them or not, which is the one they fear most, as well as if they have been personally affected by any. |
| **2 – PTC Ophelia** | Questions the respondent about how affected they were by Ophelia and in which way they have been affected. Further, it is asked if the people were concerned about hurricanes hitting Ireland before Ophelia and if they are more concerned after the event. |
| **3 – Risk Communication** | Asks if the threat of the event, as well as behavioural advice, was given, how it was given before and after the event, and if the people felt informed. Additionally, it is asked what information they would have wished for. |
| **4 – Personal Information** | Contains demographic questions like sex, age, and place of living. |

The survey was created with Google Forms and published in three local Facebook groups of the area, namely "Cork News and Events", "Cobh Sell, Buy or Swap" and "Kinsale Notice Board" and through the mailing system of University College Cork. These Facebook groups were used as the most severe damage in Co. Cork was reported from these three urban areas (Cork County Council, 2017) and all groups had more than 3,000 members each at the time of the survey (May to June 2022). Initially, the survey results of people not living in Cork during the time of the study were removed, and the intra-individual response variability was calculated (Dunn *et al.*, 2018). Finally, the sample consisted of 89 participants and these were treated as a randomly obtained sample for the purposes of statistical analyses (Blasius & Baur, 2014). However, ideally the survey method would have been expanded to include more, and more diverse, participants. The responses were evaluated according to ten hypotheses with the help of statistical software (SPSS) using descriptive statistics, Pearson correlation and sum of ranking value. The Likert scale questions were only named at their extreme ends to use them as interval scales and all were given six scores to avoid respondents placing themselves in the middle of a scale (Porst, 2011). At the outset of the survey, participants were asked about their experience of NHs; although this response can be influenced by memory bias (Levine & Safer, 2002), it was included to establish a benchmark on risk perception.

### *3.2 Expert interviews*

To assess the risk communication chain, content and used media, semi-structured expert interviews were conducted. Experts inclided those working in the emergency management of Ireland since before the landfall of Ophelia. Eight interviewees from seven different emergency management institutions agreed to an interview.

Recordings were made during the interviews and summarised afterwards. The summaries were uploaded to MAXQDA where they were subject to a qualitative content analysis (Kuckartz, 2018; Mayring, 2015). For the analysis, code categories were created

deductively beforehand, based on the interview questionnaire. During the coding process, more categories were created based on the data mentioned in the interviews. After a new creation of a code category, all the documents were analysed again in case the new categories influenced the already completed coding of the interview summary.

### *3.3 Assessment of improvement potential*

The experts suggested 14 improvements for risk communication in Cork, which were extracted during the qualitative analysis. These improvements were collected and inserted into an online poll, which was sent to six of the interview partners via e-mail. The representatives of Met Éireann and ESB were excluded as they had a national emergency management focus, while the others had a local one. One representative of Cork County Council was included, who was not available for an interview but was interested in this research.

As part of a multi-criteria analysis, the experts did an ordinal ranking after Borda and Kendall (1975) where a discrete value must be placed on any option (Mendoza *et al.*, 1999). The evaluation of the rank was done by calculating the sum of the rankings assigned by the experts for each improvement suggestion. The smallest sum indicated the first rank and the highest sum was the last rank. The expert ranking here is based on the importance of the suggestions to the institutions only and there is no focus on trade-offs, financing, or realisation of the suggestions.

## 4. Survey Results

### *4.1 Sample*

The sample had a gender distribution of 65% female and 34% male participants – one person identified as diverse. The age distribution of the participants (Table 2) was relatively equal among the age groups, 16-30, 31-45, 46-60 and 61-75. There were very few in the over 75 category and none in the category younger than 16; the latter would have been just nine or younger at the time of Ophelia.

**Table 2:** Age distribution of the survey participants.

| | 16-30 years | 31-45 years | 46-60 years | 61-75 years | >75 years |
|---|---|---|---|---|---|
| **n** | 26 | 25 | 24 | 13 | 1 |
| **%** | 29 | 28 | 27 | 15 | 1 |

*Note: the age group ≤ 15 was not included in the graphic as no one picked this age category*

Of the sample, most of the respondents were staying in Co. Cork (88.8%) during Ophelia. Only a few were staying in Co. Galway (3.4%), Co. Limerick (1.1%), Co. Clare (2.2%), Co. Dublin (1.1%), Co. Kerry (1.1%) or have not been in the country at all during the event (2.2%).

### 4.2 Results

In this section we provide overall results from the survey on 1) people's risk perception of NHs in general 2) people's current and future risk perception of hurricanes and 3) their perception of risk communication. The results of the ratings are shown in Figure 3. Where a value of 1 represents total disagreement with a question and 6 indicates total agreement.

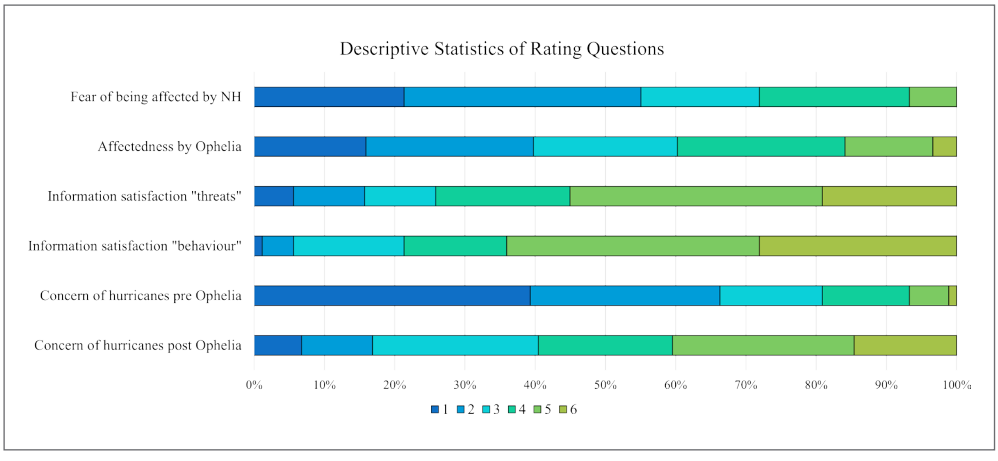


**Figure 3:** Descriptive statistics of rating questions based on survey results

#### 4.2.1 Perception of natural hazards

Survey participants are not overly concerned about being affected by NHs; 55% of the respondents rated their concern with 1 or 2 (n=89) even though 60% of the participants were affected by Ophelia. This inconsistency is also present in the responses to the questions about NHs and Ophelia. At the time of the research (May and June 2022), Ophelia's landfall had occurred five years ago yet, 69% of respondents stated that they have not been affected by NHs in the past six years, while 84% of participants indicated that they have been affected by Ophelia (see Table 3).

**Table 3:** Comparison of participants affectedness by Ophelia and natural hazards in general.

| | | Have you been affected by a natural hazard in the past six years? n = 89 | Have you been affected by Ophelia? n = 88 |
|---|---|---|---|
| **Yes, I have been affected** | Valid | 28 | 74 |
| | % | 31% | 84% |
| **No, I have not been affected** | Valid | 61 | 14 |
| | % | 69% | 16% |

Further, if people are afraid of being affected by NHs, it does not automatically mean that they have had such an experience themselves; 28% ranked fear of being affected by NHs at ≥ 4 but of these 68% declared that they had not been affected by a NH in the past six years.

### 4.2.2 Perception of hurricanes today and in the future

When it comes to the fear of being affected by a hurricane there is a significant discrepancy between the expressed fear of hurricanes before and after the experience of Ophelia. Before this event 81% were not at all or only slightly afraid (39% not concerned at all and 42% slightly afraid). After the event, 60% are now concerned about being affected by PTCs in the future and only 7% are not concerned at all (see Figure 3). .

This is also shown in the ranking results where participants were asked to rank the NHs that they feel threatened by most. The given hazards were: storms, river flooding, hurricanes, storm surges, heat waves, drought, landslides, and wildfires. Storms and hurricanes were listed separately to see if respondents are aware that PTCs can affect Ireland. After the first ranking, they were asked if they would have ranked differently before Ophelia. If this was the case, they were asked to rank the NHs again (Table 4).

**Table 4:** Ranking results of fear of NHs in Cork, after (n=89) and before (n=27) landfall of Ophelia.

| Natural Hazard | Rank after landfall | Rank before landfall | Sum after landfall | Sum before landfall |
|---|---|---|---|---|
| **Storm** | 1 | 1 | 266 | 82 |
| **River Flooding** | 2 | 2 | 293 | 83 |
| **Hurricane** | 3 | 8 | 349 | 136 |
| **Storm Surge** | 4 | 4 | 373 | 106 |
| **Heat Wave** | 5 | 3 | 382 | 101 |
| **Drought** | 6 | 5 | 401 | 119 |
| **Landslide** | 7 | 6 | 444 | 125 |
| **Wildfire** | 8 | 7 | 453 | 135 |

Before Ophelia, respondents ranked hurricanes in last place (8$^{th}$) whereas after Ophelia they were ranked 3$^{rd}$. In both rankings, it was possible to mention other NHs that were considered dangerous. In this field, 16 responses were given with the most mentioned ones being tsunamis (4) followed by diseases (3). Intriguingly, the survey showed that even though people fear hurricanes in the future, only 43.4% of these respondents (53) ranked hurricanes in their top three (54.7% in their top four). By comparison, only 25% of people who do not fear hurricanes in the future ranked the hazard in their top three.

Those that fear NHs in general and were affected by Ophelia ranked hurricanes among the NHs they fear most. Of respondents who fear NHs, 54.5% rank hurricanes in the top 3 NHs compared to 35.7% of people who were not very much afraid of NHs in general. This result is primarily a reflection of their experience of Ophelia and how badly affected they were.Moreover, the impact of Ophelia on respondents also influenced their concerns about hurricanes in the future. There was a low but significant correlation ($r = 0.296$, $p \leq 0.003$) between the levels of impact from Ophelia and of concern about future hurricanes (Cohen, 1988). A regression analysis supports the hypothesis that direct experience of PTC impacts increases the fear of future hurricane events; while the $r^2$ of 0.088 is statistically significant ($\leq 0.05$), the relationship is weak.

### 4.2.3 Perception of risk communication

Respondents felt well informed about the threats that Ophelia posed before landfall and how to behave during the NH event; more than 50% (60%) rated information on threats (behaviour) highest on the Likert scale. However, people still wished for improvements including more information about essential services and additional assistance specifically on what to do in case their house is destroyed (e.g. where to go, how to prepare and protect, etc.) and what damage can be expected locally. Further information needs focussed on how to respond if water supply is not available and if power is disrupted/restored. Several comments focussed on the nature of the NH itself and the associated weather. In the latter case, this was a concern with the warm weather associated with Ophelia.

## 5. Expert Interviews Results

In total eight representatives were interviewed from seven different institutions. Three experts wanted to remain anonymous, so are not listed below in Table 5.

**Table 5:** List of interviewed experts

| Institution | Representative | Position |
|---|---|---|
| **Civil Defence County Cork South** | John Kearney | Civil Defence Officer |
| **Cork City Fire Department** | anonymous | anonymous |
| **Civil Defence Cork City** | anonymous | anonymous |
| **Cork City Council** | David Joyce | Director of Operations |
| **Met Éireann** | Evelyn Cusack | Head of Forecasting Division |
| **ESB** | Paul Hand | Senior Press Officer |
| **HSE** | Cian O'Brien | Emergency Management Officer |
| **ESBN** | anonymous | anonymous |

### 5.1 Communication chain

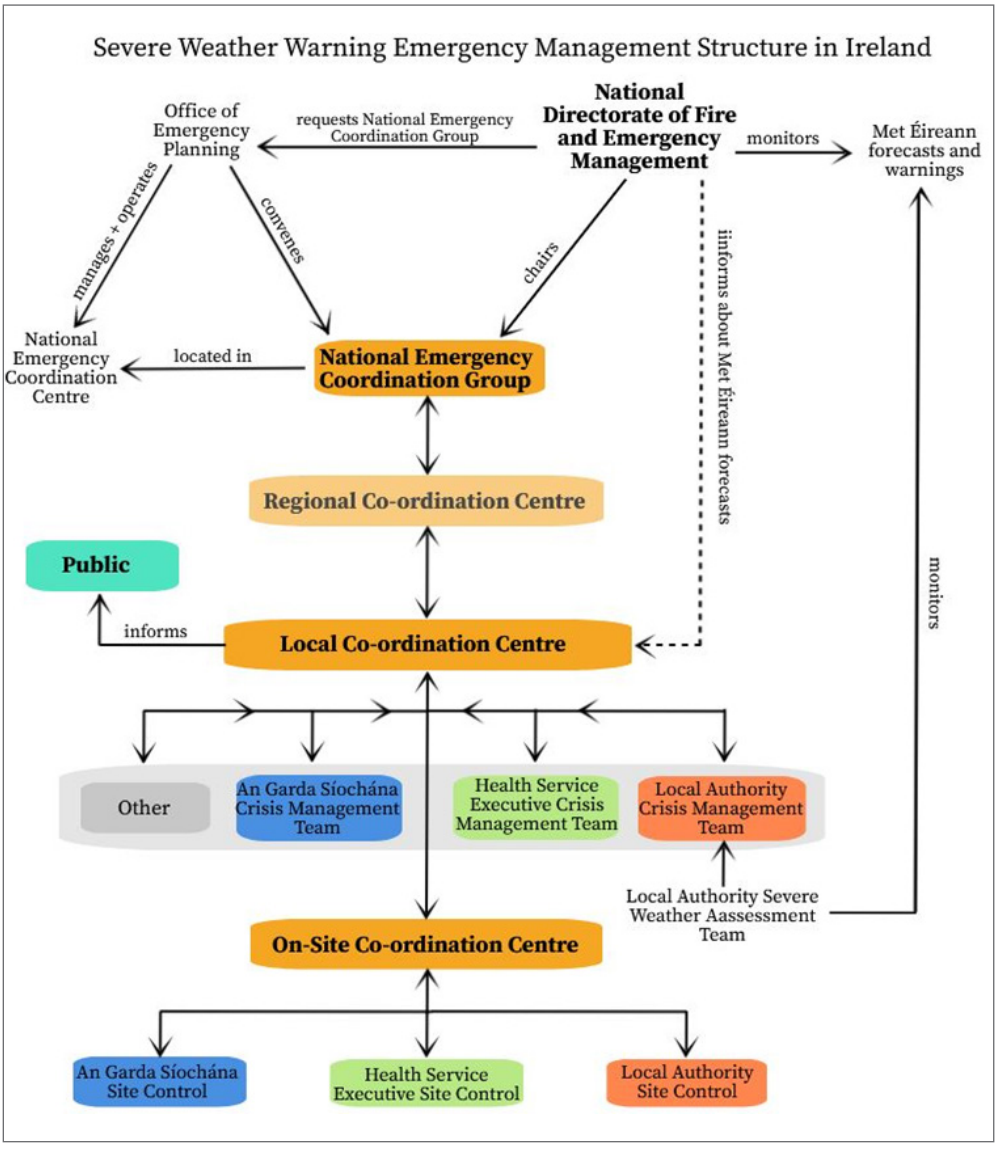


**Figure 4:** Severe weather warning emergency structure in Ireland. Based on data from Department of Housing, Planning and Local Government (2006), Department of Housing, Planning and Local Government (2020) Government of Ireland (2021) and Interview partners

The threat posed by Ophelia activated a national management approach (see Figure 4), which in cases of severe weather, is led by the National Directorate for Fire and Emergency Management (NDFEM). It monitors the warnings and forecasts issued by Met Éireann, which are categorised into yellow, orange, and red. Each warning has associated

threshold values; see Figure 5 for the meaning of the warnings for the storm related hazards of wind and rain. Depending on the severity and size of the area of the warning, the NDFEM decides to convene the National Emergency Co-ordination Group (NECG) at the Office for Emergency Planning (OEP). The OEP maintains the National Emergency Coordination Centre (NECC), which is the national emergency management room and can convene the NECG there. The NECG consists of the members of the Government Task Force (GTF) which involves senior managers of all government departments and lead agencies. In the first NECG meeting, all members of the GTF need to participate. Afterwards, only the GTF members of relevance for the specific emergency will join the meeting. The NECG is in contact with all assembled Regional/Local Co-ordination groups (RCG/LCG) and provides information on the current situation and vice versa (Government of Ireland, 2021).

| Weather Status | Status Yellow | Status Orange | Status Red |
|---|---|---|---|
| Description | Weather that does not pose a threat to the general population but is potentially dangerous on a localised scale. | Infrequent and dangerous weather conditions which may pose a threat to life and property. | Rare and very dangerous weather conditions from intense meteorological phenomena. |
| Wind | • Widespread mean speeds between 50 - 65km/h<br>• Widespread gusts between 90 - 110km/h | • Widespread mean speeds between 65 - 80km/h<br>• Widespread gusts between 110 - 130km/h | • Widespread mean speeds in excess of 80km/h<br>• Widespread gusts in excess of 130km/h |
| Coastal Wind Warnings | Gale force 8 / Strong Gale Force 9 | Storm Force 10 | Violent Storm Force 11 / Hurricane force 12 |
| Rain | • ≤ 20mm – 30mm in 6 hrs<br>• ≤ 30mm – 40mm in 12 hrs<br>• 30mm – 50mm in 24 hrs | • ≤ 30mm – 50mm in 6 hrs<br>• ≤ 40mm – 60mm in 12 hrs<br>• 50mm – 80mm in 24 hrs | • > 50mm in ≤ 6 hrs<br>• > 60mm in ≤ 12 hrs<br>• > than 80mm in ≤ 24 hrs |

**Figure 5:** Met Éireann's weather warning explanation. Source: Met Éireann (2022)

In the following section, the answers of the experts, representing the Civil Defence (of Cork County South (CDS) and Cork City (CDC)), the Cork City Fire Department (FD), Cork City Council (CCC), Met Éireann, the Electricity Supply Board (ESB), the Health Service Executive (HSE), and ESB Networks of Dunmanway, Cork (ESBN) are stated. The abbreviation "p.c." will be used to indicate that the source is a "personal communication".

The communication chain of the LCG was triggered by the weather warning of Met Éireann on the 14th of October 2017 (CCC, CDC, FD, CDS, ESB, ESBN, HSE, p.c., 2022) from which it recived weather updates every two hours (CCC, p.c., 2022). The LCG

consists of the Local Authority, which is the leading principal response agency in case of severe weather emergencies, the Health Service Executive (HSE) and the An Garda Síochána, which is the Irish police. There is two-way communication of the LCG with Cork City Council, the ESB, the Office of Public Works (OPW), the Civil Defence, the Army, and the public communications team of the LCG. The public communications team was located in the Local Coordination Centre (LCC), and monitors social media platforms, reports incidents to the local authority, replies, and gives information to users (CCC, CDC, FD, p.c., 2022). Further, the LCG communicates information on behalf of the HSE to the public. The internal communication chain of the LCG was not affected by power outages due to a generator in the building of the LCC (CCC, p.c., 2022). However, *"the communication between the crews and us was challenging"* (CDS, p.c., 2022). Hence, the CDS established local communication chains and involved farmers and their heavy machinery in the road clearing process (CDS, p.c., 2022).

ESB, ESBN and the HSE started unofficially preparing with Met Éireann's weather advisory (12.10.2017). ESB and ESBN prepared their crews (ESB, ESBN, p.c., 2022) and the HSE emergency manager of Cork and Kerry informed all parts of the health system, which include the *"entire spectrum of the health service, like the public health, the ambulance, the community services, and the hospitals"* to prepare for the implementation of their severe weather protocols and emergency management plans (HSE, p.c., 2022). The ESB usually associates a yellow warning with around 5,000 affected customers (compared to 2.5 million customers in total), an orange warning with 5,000-50,000 affected households and power restoration within 24 hours. *"However, a red warning is very serious, it is usually nationwide and causes severe disruption and power restoration can take several days, like in the case of Ophelia"* (ESB, p.c., 2022).

Following the official weather warning on the 14th of October 2017, all parts of the HSE were in responsibility to provide the information to their staff and their patients and follow the top-down communication chain of making staff coming in early before the warning and reschedule appointments with patients (HSE, p.c., 2022). ESB informed the public and the ESBN started internal communication with ESB and the ESBN control centre in Dublin (ESBN, p.c., 2022). After Ophelia made landfall, the damage was severe and ESB crews could not handle the repairs on their own. Thus, they requested more workforce from the UK, Northern Ireland, and France (ESBN, p.c., 2022).

Based on the Ophelia experience some minor changes to the communication chain have been made. For example, *"the cooperation between the NHC and the UK Met Office is mainstreamed nowadays in the case of PTCs"* (Met Éireann, p.c., 2022). Further, the HSE is included in their regular communication chain when Met Éireann issues warnings; before Ophelia the HSE was only informed sporadically (HSE, p.c., 2022). The LCG would include local communities which have established during COVID-19 before requesting the Civil Defence (CCC, p.c., 2022). ESB and ESBN had a whole restructuring of their emergency management including adjusted roles, training imporvements, and employed more staff in communication (ESB, ESBN, p.c., 2022). The HSE did not change any communication chains after Ophelia, however, severe weather management

and emergency management plans are taken more seriously. Not until after Snowstorm Emma in 2018 did certain sectors of the health system establish patient lists for those requiring life-saving medical care in order to facilitate better appointment rescheduling and mainstream compensation for employees who report early before the weather warning goes into effect. (HSE, p.c., 2022).

### *5.2 Communication content*

The intra- and inter-agency communication was at its most intense when the weather advisory about PTC Ophelia was issued and continued until the storm made landfall; the ESB, ESBN and HSE started communicating with the weather advisory on the 12th of October 2017 (ESB, ESBN, HSE, p.c., 2022). All other organisations started when the weather warning two days later was issued (CCC, CDC, CDS, FD, p.c., 2022). The internal communication was about preparatory tasks, like activating protocols, securing loose objects, cutting down trees, assembling crews, and stocking up vans and storages (CCC, CDC, FD, p.c., 2022). Met Éireann gave in-depth forecast on the development of PTC Ophelia to the emergency management institutions through meetings and calls by the duty forecaster (Met Éireann, p.c., 2022).

Precautionary measures were undertaken by all institutions: *"When the red warning came into place there was no staff allowed on the streets, except for life threatening incidents. Risk assessment was undertaken the whole period since landfall to observe if it is safe for the crews to go on duty"* (CDC, p.c., 2022). This practice was agreed to by several other institutions (CCC, FD, ESB, ESBN, p.c., 2022) Further, the crews on the street verified reported incidents and gave suggestions on which incidents should be prioritised, like critical infrastructure (FD, ESB, p.c., 2022) and vulnerable customers (ESB, ESBN, p.c., 2022).

After Ophelia, *"the intra- and inter-agency communication content improved. Crews were reporting back better"* (CCC, p.c., 2022) and redundant emergency calls could be reduced through better handling and overviewing of the status of each reported incident side (CCC, ESBN, p.c., 2022). Before a storm arrives *"staff is now asked to come in early and shelter in depots and hotels nearby to prevent private travelling during the storm so that staff is in place before roads might be blocked"* (HSE, p.c., 2022).

The communication content for the public before the NH event was given by the national agencies, the Local Authority and ESB and included:

1. Warnings
2. National and local level information
3. Advisable actions for preparation and behaviour
4. Possible impacts on services (school, public transport, health service, power lines)
5. School and transportation closure (was only decided on the 15th of October 2017, 8 p.m.)

All information that had been communicated before the event was kept for the time during the event and data on impacts, such as power disruptions and blocked roads, were added to communications as they were reported (CCC, CDC, FD, ESB, p.c., 2022). Met Éireann provided warnings to the general public (Met Éireann, p.c., 2022). A total of 16 warnings were issued within three days regarding Ophelia; of these, ten were valid for Cork (five for Cork specifically and five were valid for all of Ireland) (Met Éireann, 2018a). A nationwide red warning came into place on Sunday, the 15th of October at 8 p.m. (Met Éireann, p.c., 2022).

After Ophelia, there were changes in communication with the public. Met Éireann introduced medium range forecasting for 6-10 days in advance to give more lead time for weather related NHs. Agencies and the public can follow this forecast and see if the upcoming event is likely to affect their area (Met Éireann, p.c., 2022). Further, messages to the public were made simpler and local situations were additionally included in the national information (CDC, FD, p.c., 2022). The representative of CCC stated: *"Communication with the public is more proactive nowadays and does not happen only on request"* (CCC, p.c., 2022). The high number of 300 fallen trees in Cork due to Ophelia was unexpected and, as a result, information on the danger of fallen trees has been given out ever since (CCC, FD, p.c., 2022). Moreover, ESB started to film their restoration efforts and broadcast them to raise more understanding among the public in case of long-term power faults (ESB, p.c., 2022).

### *5.3 Communication media*

For internal communication, the agencies relied mainly on mobile phones (CCC, ESBN, HSE, p.c., 2022). This led to several challenges due to the disruption in power service which resulted in a failure of mobile service. The CDS claimed: *"When the power generators at mobile masts got empty there was no mobile service anymore. The CD [Civil Defence] in Kinsale could only use TETRA radios and lost connection to the LCG, as the LCG was not equipped with TETRA at that time"* (p.c., 2022). LCG staff at home did not know when they were needed if they were affected by mobile and landline issues (FD, p.c., 2022). The ESBN crews and the representative of the HSE were forced to drive around in their cars until they came to a spot with mobile service and their phones were charged (ESBN, HSE, p.c., 2022). However, there were no prolonged outages of mobile and or power outages in Cork City itself so mobile service stayed up for the crews there (CCC, FD, p.c., 2022).

The most important communication medium in Cork to communicate with the public is the local radio (CCC, FD, CDS, p.c., 2022). For ESB, RTÉ television and radio are the main media for public communication (ESB, p.c., 2022). The HSE relies most on social media but only provides information and is not actively interacting with the public. Figures 6 and 7 give an overview of the used media.

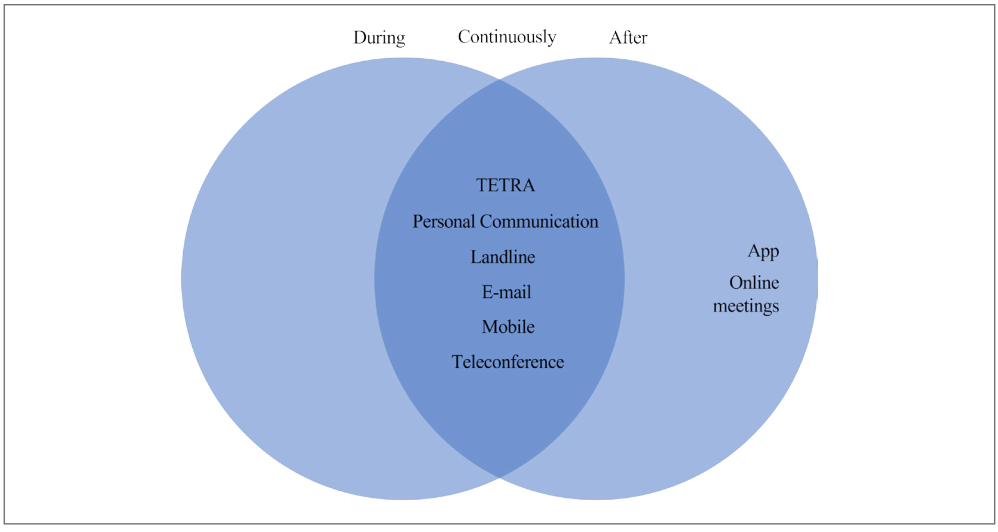


**Figure 6:** Media used for intra-/inter-agency communication. Based on information from interviewees.

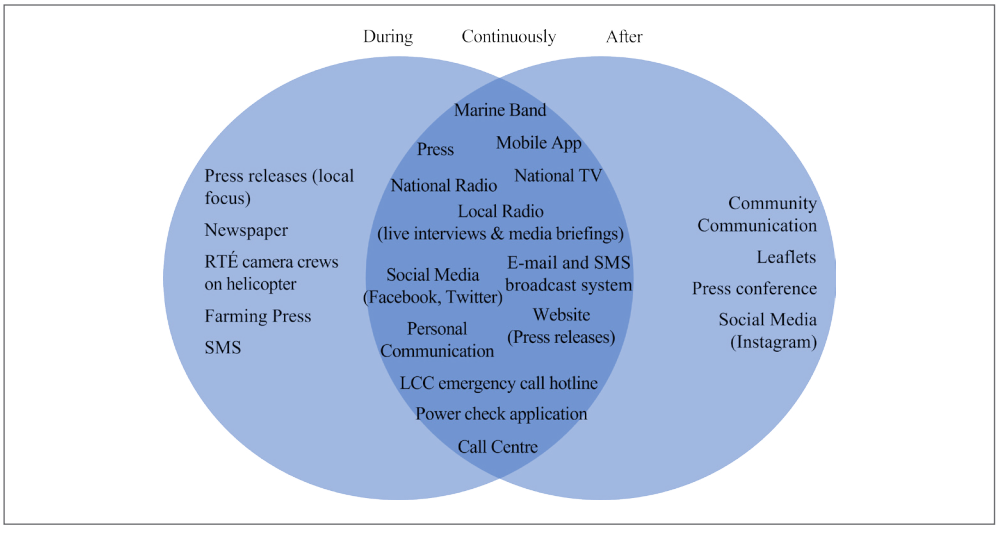


**Figure 7:** Media used to communicate to the public

### *5.4 Improvement suggestions*

From the survey, some improvements to risk communication were suggested. Respondents wished for more information on preparatory measures they can undertake: *"What to do if house destroyed and have nowhere else to go etc."*, *"What is the safe and correct thing to do if a certain situation occurred e.g., water supply lost"*, *"List of things to do to protect yourself during a hurricane"*, and *"Safety instructions, how to prepare etc."*. Moreover, one person wished for a *"more accurate damage expectation per area"*. Also,

improved power supplies for relay stations to maintain communication infrastructure in the event of disruption was desired.

The improvements for risk communication in Cork suggested by the experts were ranked by them as shown in Table 6.

**Table 6:** Improvement suggestions with their assigned rank and sum of values

| Rank | Improvement | Sum |
|---|---|---|
| 1 | Behavioural advice before NH hits + reason why orders and advice are given | 20 |
| 2 | Have education and regular training for citizens → start in school education | 23 |
| 3 | Have impact forecasting, instead of weather forecasting | 30 |
| 4 | Have a user-friendly GIS map where people can see status of incidents and report new ones | 32 |
| 5 | Have specific communication for people with disabilities, mental health issues, etc. | 37 |
| 6 | Have more trained staff working on a 24/7 rota in emergency management | 41 |
| 7 | Have at least one TETRA for every crew | 46 |
| 8 | Have clarity if each red warning equals school and business closure | 47 |
| 9 | Have regular training for emergency managers on how to interpret weather maps | 52 |
| 10 | Have regular training for emergency managers on how to use TETRA | 54 |
| 11 | Have childcare available for people who also work during red warnings | 57 |
| 12 | Have larger backup generators at mobile masts | 61 |
| 13 | Have a central building in each city/town that functions as a supply centre and shelter with a generator | 63 |
| 14 | Have special security plans for livestock | 67 |

# 6. Discussion

## *6.1 Change of risk perception*

Most survey respondents (55%) are not overly concerned about being affected by NHs, despite their experience of Ophelia. As there are usually no, or few, fatalities caused by NHs affecting Ireland (Centre for Research on the Epidemiology of Disasters [CRED], 2023) this can be understood as lay people associate high risk with events causing many fatalities, even if the probability is low (Fischhoff *et al.*, 1993). Furthermore, there is possibly a low feeling of dread, which also influences the perception of risk (Slovic, 1987; Slovic *et al.*, 2004) as there are only a few events which disrupt services in the county.
Still, the perception of the risk of hurricanes is high among respondents. Hurricanes were ranked in 3rd place as the NH they feel threatened by most, following PTC Ophelia. Only storms and floods were seen as riskier. When respondents were asked how they

would have ranked before they experienced Ophelia, hurricanes ranked in 8th place. Though, only 27 people stated they would have ranked differently before Ophelia this is a meaningful difference that can be attributed to the recent experience of this PTC. Montero and Batista (2020) also found that the most recent destructive hazards are the ones that are felt most risky; inhabitants of southeast Cuba had a higher perception of hurricanes than of earthquakes even though earthquakes are more frequent in the area. Unfortunately, only 10 people, who experienced Ophelia outside of Cork participated in the survey. Thus, we could not assess the effect of location on hurricane risk perception. A future study that compares different geographical areas in Ireland and their perception of natural hazard risk and communication could be of interest.

Respondents who experienced a greater impact from Ophelia tend to rate hurricanes higher in the list of NHs they feel threatened by most, compared to those less affected. This result is mirrored in the literature generally. Adverse personal experiences and negative feelings towards a hazard result in a high perception of risk (Fischhoff *et al.*, 1978; Slovic, 1987). Wong-Parodi and Garfin (2022) found that being adversely affected by hurricanes results in higher risk perception. The converse is also true. Not all parts of Cork were badly damaged even though residents were expecting worse and this gap between expectation and reality could be described as a false alarm. Through false alarms, people tend to take the next warnings less seriously (Breznitz, 1984). Consequently, those least affected have less fear of future events. This is shown by the weak positive correlation indicating that a higher level of impact results in a greater fear of hurricanes in the future. Hence, there must be other factors that lead to the fear of hurricanes in the future. In the case of Ophelia, it was the first red warning issued by Met Éireann that resulted in a national shutdown of several services, since the warning system was initiated in 2013. Barnes *et al.* (2007) found that more warnings (correct and false ones) also raise awareness of the hazard and people are more willing to obey the next warning.

Interestingly, although 84% of the participants (n=89) reported that they were affected by Ophelia, 69% of these respondents claimed that they were not affected by NHs within the period that included Ophelia. These responses reveal significant discrepancies between the two sets of questions as shown in Table 3. Cork is affected by NHs often, especially mid-latitude storms (Met Éireann, 2018a) and floods (CDC, FD, CCC, p.c., 2022). Since Ophelia (until the 17th of February 2021), there have been an additional 49 orange and red warnings for Cork (Met Éireann, 2018a). Thus, it is difficult to understand why 69% of the participants of this survey maintain the view that they have not been affected by a NH before. People tend to absent the risk of past events from their memory. This practice of absenting can contribute to losing sight of the risk in everyday situations (Bickerstaff & Simmons, 2009; Parkhill *et al.*, 2010). According to Monteil *et al.* (2020), individuals may not see some NHs as a possible concern in the context of ordinary dreads since they are substantially less relevant in the present. A further study could focus on the reasons why people were not considering the impact of Ophelia on them as being affected by NHs.

### 6.2 Change of risk communication

Respondents felt well informed about how to behave during Ophelia but less about the threats it posed. They still wished for information on how to personally deal with a NH and how to prepare for the impacts of the storm, in case of disruption in services, damage to property and the local impacts that can be expected. Firstly, the people expressed a wish to have more detailed instructions on how to react in the case of occurring impacts and secondly that the government should provide more explanation on why it is useful to follow the recommendations of the weather warnings and the local authorities. Intriguingly, these wishes are in line with the suggestions experts proposed to improve risk communication including both short-term information before the hazard arrives and long-term communication together with training. This is in line with best practice; risk communication that includes impact forecasting and avoids misinterpretations of windspeed and precipitation values (Millet *et al.*, 2020), and describes options for protection that include training (NOAA Office for Coastal Management, 2016) can result in better preparedness and is an important step in reducing vulnerability (Lazrus *et al.*, 2012; MacIntyre *et al.*, 2019). There are currently no evacuation centres in Ireland (CDS, p.c., 2022) and it is unlikely that they will be needed given the existing building infrastructure, even though the people suggested this as an improvement.

There was little interest in backup generators to cope with power outages among the experts as they thought expense outweighs their likely need and usage. This is a little surprising, as some institutions were relying on a functioning mobile network, which failed during Ophelia resulting in loss of communication during prolonged power outages. Furthermore, better power backups at mobile masts were desired by the respondents as well. The issue of not being able to communicate with crews still exists but might be overcome partially, as some of the agencies now start introducing TETRA radios to all their crews (CCC, p.c., 2022). TETRA radios are very reliable in functioning during extreme events and should be considered as the main communication media for intra- and inter-agency communication (CCC, p.c., 2022).

The aspects ranked as most important for communicating risk are already in the Framework for Major Emergency Management (FMEM) of Ireland. This includes the preparedness of the public through raising awareness of risks, communicating these, how to minimise risks and how to empower each person with self-protection measures (Department of Housing, Planning and Local Government, 2006). Medway *et al.* (2022) came to the same conclusion after interviewing Irish experts involved in risk management on local, regional and national level about their awareness of climate change related risks. They agreed that education and awareness raising about climate-induced risks is a key task that should be carried out in Ireland. So, there is a need to integrate these improvements into risk communication in Cork and, according to Medway *et al.* (2022), also in Ireland. This could include introducing a "Be Storm Ready" campaign to raise awareness and preparedness among the general public of Cork and the whole country, similar to the 2022 "Be Summer Ready" campaign by the Department of Defence (Department of Defence, 2022). Even though there is the "Name our Storms" campaign

by Met Éireann (Met Éireann, 2023) to raise awareness of storms, there is no advice given about self-protection measures. Further, a participatory communication approach would also support strategic goal four "Mobilise climate action in local communities" of the "Delivering Effective Climate Action 2030" report by the County and City Management Association (County and City Management Association [CCMA], 2019). Awareness-raising and participatory communication have had great success in risk management (Anderson-Berry, 2003; Houser *et al.*, 2017; Nathe, 2000). Participants of participatory approaches were more aware of extreme weather threats and more inclined to start precautionary measures (Driscoll *et al.*, 2013). Moreover, including a wide range of community stakeholders in public involvement initiatives is the most efficient way to raise public awareness of possible hazards, inspire an individual response, and foster greater community trust and collaboration (Wachinger *et al.*, 2013). It is also suggested that starting to communicate NH mitigation behaviours, like insurance, is important; Lim *et al.*, (2022) found that injunctive norms messaging notably increased people's perception of hurricane mitigation measures.

## 7. Conclusion

While it could be argued (based on the survey) that the people of Co. Cork are in general not overly concerned about being affected by NHs, they still are aware of the risks of hurricanes, especially after they experienced PTC Ophelia in 2017. Hurricanes are perceived as riskier in the future after Ophelia and this aligns with the scientific literature that indicates PTCs (extra-tropical remnants of hurricanes) will reach Europe, and particularly Ireland, more often in the future due to climate change (Baatsen *et al.*, 2015; Haarsma *et al.*, 2013; Liu *et al.*, 2017; Michaelis & Lackmann, 2019). Respondents were satisfied with the communication about the threats posed by PTC Ophelia and how to behave. Still, improvements were suggested by the public and by experts. The agreed improvements include education, training, impact description and behaviour during an event. Though, there was less agreement on the need for safe shelters and better mobile service supply, which were wished for by the public but ranked as low priority by the experts.

However, international best practice includes post-event assessments to evaluate the effectiveness of risk communication strategies and as a result apply lessons learned for dealing with future hurricane events (Department of Homeland Security, 2016). Also, the establishment of feedback mechanisms to receive input from the general public and stakeholders, allowing for continuous improvement in risk communication strategies is needed (Renn, 2010). These would significantly enhance the risk communication in Cork.

This study shows that to develop and assess risk communication programmes, risk perception studies are essential. As effective communication depends on understanding the issues that the intended audience has, it is important to use the wishes of the population as a trigger to engage them in communication. The implementation of these

improvements and the enhancement of public involvement in risk communication can lead to a more resilient population and better risk management (Department of Homeland Security, 2016). These risks should be addressed in the exchange between public and risk management institutions and should be part of risk communication that makes the people of Cork more resilient to hurricanes and their associated effects. By integrating these considerations, along with the adoption of post-event assessments, as advocated in the best practices of risk communication, these enhancements would develop and boost Cork's overall risk communication strategy.

# 8. Annexe

## Annexe 1 – Survey Questionnaire

***Risk perception and communication of natural hazards***

Dear Sir or Madam,

This poll is part of a Postgraduate Research project from the TH Köln – University of Applied Science in Cologne, Germany in cooperation with the University College Cork (UCC). I am Ines Koensgen, studying Integrated Water Resources Management in Cologne and the topic of this research are natural hazards in Ireland. A natural hazard is a natural phenomenon that might have a negative effect on people or the environment. As I have experienced some natural hazards during my former stay at UCC in Cork I want to dedicate my studies to this topic and the improvement of its handling. This survey contains questions on risk perception concerning natural hazards by the citizens of County Cork, as well as about risk communication in the County. The focus group of this survey are the citizens of Kinsale and Cobh. The survey will approximately take you 10 – 15 minutes to complete. Feel free to share this poll with your family and friends! The more people answer the survey the better the results. Thank you very much in advance for your collaboration.

### SECTION 1 – NATURAL HAZARDS

***How afraid are you of natural hazards affecting you?***

The ends of the scale show the opposite feelings, as closer you are to one end as more you feel related to that feeling, the further away you are the less you feel related to that feeling. Please mark only one tickbox.

I don't feel afraid ☐ ☐ ☐ ☐ ☐ I feel afraid

***Have you been personally affected by any natural hazards in the past 6 years?***

☐ Yes ☐ No

***If so:***

What is the natural hazard that first came to your mind that you have been affected by?

_____

Which natural hazard, that occurred to you, was the most devastating one in your opinion?

_____

***If you read the following hazards that occur in Ireland which one would you consider the one that you feel threatened by most?***

*Please rank from 1 to 8, where 1 is the hazard, you feel threatened most and 8 where you feel threatened the least. In case the hazard you fear most is missing please write it down under "other" and rank from 1 to 9, where 1 is the hazard, you feel threatened most and 9 where you feel threatened the least.*

- ☐ River Flooding
- ☐ Drought
- ☐ Heat Wave
- ☐ Storm
- ☐ Hurricane
- ☐ Coastal Flooding (storm surges)
- ☐ Wildfire
- ☐ Landslides
- ☐ Other, namely: _____

***Do you think you would have ranked the natural hazards mentioned before differently prior to Hurricane Ophelia?***

☐ Yes ☐ No

***If so:***

***How would you have ranked the natural hazards before Hurricane Ophelia?***

*Please rank again from 1 to 8. (1 is the hazard, you feel threatened most and 8 where you feel threatened the least). In case the hazard you fear most is missing please write it down under "other" and rank from 1 to 9, (1 is the hazard, you feel threatened most and 9 where you feel threatened the least).*

- ☐ River Flooding
- ☐ Drought

☐ Heat Wave

☐ Storm

☐ Hurricane

☐ Coastal Flooding (storm surges)

☐ Wildfire

☐ Landslides

☐ Other, namely: _____

## SECTION 2 – HURRICANE OPHELIA

***How affected were you by Hurricane Ophelia which hit Ireland in October 2017?***

*Please mark only one tickbox.*

Not affected ☐ ☐ ☐ ☐ ☐ Very much affected

***How were you affected?***

*Please choose from the following options by ticking the boxes. You are allowed to mark several boxes.*

☐ I was injured during the storm

☐ Family members were injured

☐ Neighbours/ Friends were injured

☐ Damage to property

☐ Loss of property

☐ Damage to cars/ other vehicles

☐ Prolonged disruption of power supply

☐ Prolonged disruption of water connection

☐ Prolonged disruption of internet connection

☐ Prolonged disruption of mobile phone service

☐ Prolonged disruption of landline phone service

☐ Other, namely: _____

☐ I was not affected

***How concerned were you about hurricanes hitting Ireland before Ophelia made landfall?***

*Please mark only one tickbox.*

Not concerned ☐ ☐ ☐ ☐ ☐ Very much concerned

***After you experienced Ophelia, how concerned are you that hurricanes will affect Ireland more often in the future?***

*Please mark only one tickbox.*

Not concerned ☐ ☐ ☐ ☐ ☐ Very much concerned

## SECTION 3 – RISK COMMUNICATION

***How informed did you feel about the threats of Hurricane Ophelia?***

*Please mark only one tickbox.*

I didn't feel informed ☐ ☐ ☐ ☐ ☐ I felt well informed

***How informed did you feel about how to behave during Hurricane Ophelia?***

*Please mark only one tickbox.*

I didn't feel informed ☐ ☐ ☐ ☐ ☐ I felt well informed

***What kind of information did you wish you had received during the event that was missing in your opinion?***

Please write below.

_____

***How did you receive information about Hurricane Ophelia before it made landfall?***

*Please choose from the following options by ticking the boxes. You are allowed to mark several boxes.*

- ☐ Television
- ☐ Radio
- ☐ Newspaper (printed)
- ☐ Newspaper (online)
- ☐ Sirens
- ☐ Neighbours/ friends/family
- ☐ Social Media
- ☐ Smartphone Applications, like Met Eireann
- ☐ E-Mail
- ☐ Other, namely: _____
- ☐ I did not receive any information

***How did you receive information about Hurricane Ophelia after it made landfall?***

*Please choose from the following options by ticking the boxes. You are allowed to mark several boxes.*

- ☐ Television
- ☐ Radio
- ☐ Newspaper (printed)
- ☐ Newspaper (online)
- ☐ Sirens
- ☐ Neighbours/ friends/family
- ☐ Social Media
- ☐ Smartphone Applications, like Met Eireann
- ☐ E-Mail
- ☐ Other, namely: _____
- ☐ I did not receive any information

## SECTION 4 – PERSONAL INFORMATION

***Which age category are you in?***

☐ ≤15 ☐ 16-30 ☐ 31-45 ☐ 46-60 ☐ 61-75 ☐ >75

***Which sex are you?***

☐ Female ☐ male ☐ diverse

***In which town/city were you staying during Hurricane Ophelia?***

*Please write below and also mention the county.*

_____

***In which town/city are you living today?***

*Please write below and also mention the county.*

_____

Below you find a voluntary field which you can use in case there is anything else, regarding risk communication of natural hazards, that appears important to you but was not part of this survey. If you want, you can address that here.

_____

_____

_____

You have reached the end of the survey. Your data will be handled anonymously, no data will be handed over to second or third parties.

I want to thank you for your time and effort in completing this poll and I hope you enjoyed your little excursion on the topic of risk communication and risk perception of natural hazards with focus on hurricane Ophelia.

For feedback, queries, comments and/or information about the results please feel free to contact me via: ines_martina.koensgen@smail.th-koeln.de

## Annexe 2 – Interview Questionnaire

Technology
Arts Sciences
TH Köln

# Questionnaire for Experts

UCC
Coláiste na hOllscoile Corcaigh
University College Cork, Ireland

**General Info:**

Date and Place of Interview: _____

Name of Interviewee: _____

Preferred Mentioning in Thesis: _____

**Risk communication chain and content**

1. Please explain the risk communication chain you are part of and the tasks with which you are charged.

   Who are you receiving information from?

   Are you generating any information?

   Which information do you transfer and to whom?

In case you give information to several people/institutions: Is the info content the same?

**Thresholds**

2. When did you start communicating about the risks of Ophelia?

   Were there any thresholds that were reached to initiate any communication action?

   Which thresholds did you have while acting during Ophelia? (Track, Wind speed, expected wave height/ storm surge)

**Media for communication**

3. Which media did you use for communication?
4. Were there differences in the media used during the different stages of the event (before, during, after)?

   During Ophelia, 150,000 customers were without broadband, mobile and phone service. How did you keep these people, who had no connection, informed about the status quo of the event? Especially in Co. Cork, 51,000 customers were without service even longer.

**Lessons learned**

5. Was there any need for change in the risk communication chain or in thresholds or in communication content after you experienced the communication before, during and after Ophelia?

   There have been deaths because people wanted to clear fallen trees by themselves. Did you inform the population about handling such scenarios?

   Would you consider giving guidelines of action on how to handle impacts that could arise during the storm, like how to handle fallen trees, flooded basements, interrupted power lines, etc.?

6. What were your lessons learned about the event and its communication? Would you communicate differently the next time?

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