Body recovery from water study

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Long read: Research into body movement patterns in water to aid recovery

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I joined the Sussex Police specialist search unit in 2007 and became a police diver and police search advisor. Part of our role was to search for, and recover, missing people in hazardous places where additional personal protective equipment and skill sets were required. We were well used in Sussex and our neighbouring counties, until the unit was disbanded in 2015.

In order to set a search strategy as a search advisor, we use information relating to the circumstances of the case to prioritise likely hypotheses as to why the person may be missing. We then refer to established and existing datasets based on past research, to enhance our understanding of likely places where that individual may migrate to on land during their missing episode (Gibb and Woolnough, 2007; Perkins, Roberts and Feeney, 2011; Eales, 2016).

During my first year in the unit, I quickly recognised that there were patterns in body movement in water. Despite this, we did not have a dataset or past research to refer to when making decisions, in terms of where in the water that person or body might be. I had seen the impact that not knowing the whereabouts of a missing person has on families and loved ones, and I wanted to do anything I could to alleviate this suffering.

I designed a questionnaire containing fields that I felt were relevant to body movement in water and in 2008, I started collecting data so that I could research this topic myself.

I called the project ‘The body recovery from water study’. The questionnaire gathers data relating to inland water incidents or those in a coastal location in contact with the land, but the findings of the study can also be used in a marine environment. It is not necessary to know the point of entry into the water to provide information or to use the research coming from the project.

I set the aims and objectives as follows.

- To collect data and share analysis of this data with the international search community, investigation teams and other interested parties regarding the movement of bodies in inland water.
- To enhance learning to make us more effective in the searching for, and recovery of, bodies in water.
- To minimise the risk to search personnel.
- To reduce search time to gain an earlier resolution in missing person cases.
- To provide sanitised information to public bodies so measures can be made to prevent drowning incidents.

These aims remain unchanged and have set the direction of my research for the past 12 years. This journey took me to the Leverhulme Research Centre for Forensic Science at the University of Dundee, where I obtained my PhD in January 2021. I am now working on postdoctoral research on this topic.

Literature review

I started this project for two reasons – because I was fascinated by it and because there was very little research that could assist us with missing person searches.

Many of the studies relating to bodies in water were in the fields of anthropology and pathology, which, although useful, were not specifically aimed at locating missing people at the earliest opportunity.

The majority of the research was also conducted on opportunistic samples or the retrospective use of records (for example, post-mortem files) and I couldn’t find a project aimed specifically at establishing the likely movement of bodies in water. I always made use of whatever I could find, so I did a broad search of all literature. This resulted in me delving into fields including sports science and textile construction in search of influences on the likely buoyancy of human bodies.

One scientist (Reh, 1967) conducted observations of submerged bodies in the 1950s in Germany, with a view to establishing the stages of body decomposition depending on the temperature of the water. Some of Reh’s work is relevant to predicting the likely buoyancy of a body in colder seasons today (Doberentz and Madea, 2010), particularly the significance of the bloat phase, which occurs

though decomposition of the body and can often cause a second phase of body movement due to increased buoyancy.

Methodology

I approached my research as I would approach a search and I split the missing episode into three areas.

1. Initial stage – where should we look in the early stages, shortly after the time of entry to the water and for the first 24 hours?
2. Subsequent stage – where should we look in the period after 24 hours, when decomposition of a body is more likely to become a factor?
3. Exit strategy – the rationale for reducing or altering search activity because the initial and subsequent search have not found the missing person.

The questionnaire that I designed was based on observations I had made as a practitioner in the field. It covered three main areas.

- The circumstances of how the person came to be in the water and those of the subsequent recovery.
- Factors relating to the environment.
- Information about the missing person – for example, their sex, age, size and clothing.

By the time I came to the data analysis stage of my PhD, I had collected just over 280 cases. These came from UK national and international practitioners. The dataset is continually growing, so my plan was to do initial exploratory statistical analyses on this sample and then later re-analyse it as new cases were added. As my data analysis was exploratory, I did this with an open mind. However, the variables that I had chosen for inclusion on the questionnaire were already based on some hypotheses that I had formed in the field. These included the following.

- There are differences in buoyancy relating to clothing and footwear amount, type and construction.
- Buoyancy increases with age of the individual.
- The buoyancy of bodies differs depending on the manner of death.

As well as having fun doing the data analysis, I was excited to see patterns emerging from the data and I was able to develop a model of prediction using some of the variables. This model gave the statistical percentage of the probability of buoyancy for a body, depending on a range of factors.

One challenge I had was that I didn't have enough data in some areas to be able to distinguish exactly what factor was the key influencer on the buoyancy. Was it clothing type, footwear, age, body mass or other factors? Or was it a combination of some or all of them? This challenge is ongoing but the collection of data is also continuing (there are currently 465 cases). With every case that is added, the results of data analyses are likely to be a more accurate representation of what we think would happen in the field.

After analysing the data, I tested two of the key findings that had emerged from this in the civil engineering laboratory at the University of Dundee. I built a man-sized model (which I named Duncan) and dressed it in various clothing and footwear configurations to assess the impact of these on buoyancy. These combinations included four clothing amount categories, from no clothing to heavy clothing, and four different types of footwear. I then used the results from this experimentation to create an empirical equation, which could be used for predictive purposes.

Results and conclusion

The indications of the data confirmed the hypotheses that I had formed while working as a practitioner.

I found that in the initial phase (the first 24 hours), the older the body was, the more buoyant it was (as a general rule), and that accidental deaths were less buoyant than suicidal ones.

There was no correlation with advanced age and body mass, indicating that the increase in buoyancy in age could be due to reduced bone density, reduced muscle mass, and clothing and footwear.

Generally, more of the accidental cases where the body was less clothed (for example, swimming accidents) were younger people and the smaller sample of accidental cases involving older people were more heavily clothed. Conversely, where some suicide cases did remove their clothing prior to entry into the water, this was not common, so deaths in water by suicide were consequently more

heavily clothed and in the colder weather. The lab work corroborated these trends.

Buoyancy increased with the amount of clothing. This was because air got trapped between the layers of clothing, which aided buoyancy until it released during the submersion process. This corroborates a finding in an experiment on cold water immersion, where air trapped within layers of clothing on live subjects was found to enhance buoyancy (Barwood and others, 2011). I found that in my experiments, buoyancy differed depending on the footwear. No footwear or wearing boots seemed to reduce buoyancy, while trainers and shoes aided it.

In the subsequent phase (the period after 24 hours), the buoyancy of the bodies increased with time in the water, as we would expect, and this was influenced by water temperature. There was also a correlation with post-mortem submersion interval (time in the water) and decomposition. The window of time at which the body could refloat was measurable and I made a basic model of prediction that showed the time at which a percentage of cases would be likely to be on the surface.

Overall, the trends emerging from this research inform our decision making when searching for missing people in water. Theoretically, the movement of a positively buoyant body that is not restricted in any way will be influenced by the environment – for example, the dynamics of the water or, if the body is on the surface and there is no water flow, it may be carried by the wind or other factors. A negatively buoyant body can also be moved by water currents or flow. However, it will experience friction with the bottom of the water course and contact with obstructions, which may slow or hinder movement.

If we do not locate our missing person in the initial phase, we want to know whether that body will refloat, and what the timeframe for this is. In the event that a body is not found during this stage, it may travel and eventually submerge, which will reduce the chances of discovery through search processes.

This research is designed to be used as an aid to decision making by people with existing knowledge and experience. It is not an exact science or a replication of what will happen in the field.

I feel a sense of responsibility to translate the findings of my research in an appropriate way and I feel strongly that we should value the knowledge and experience of the search practitioner. This

research is not designed to replace that, but to be an additional tool to use if required.

I am developing an app, which will be freely available to any person who wishes to use it for the greater good. This will be a real-time version of the results of my research, which will be updated periodically as more cases are added to the database and as I complete more experimentation. It will incorporate my research and any wider research that could be relevant to the prioritisation of search areas and selection of resources in a missing person investigation.

Recommendations

- There is a 90-minute survivability window, so early recovery could lead to resuscitation (Tipton and Golden, 2011). The point at which the incident changes from a rescue to a recovery is not defined, and it is useful to establish the circumstances with clarity and act as quickly as possible.
- In the early stages of a missing person report, consider the likely initial buoyancy of the person, the environment and what resources should be deployed. For example, in the case of an older subject in winter clothing who has fallen in a flowing river, should you consider downstream spotters on bridges and banks?
- Value the existing knowledge and experience of search personnel, as well as those with local knowledge of the geographic area and water courses.
- View research as a key part of the jigsaw puzzle and as a basis on which the rationale for decisions can be made or prioritised.
- Policing is an evidence-based profession, so it is important to emphasise the importance of research at the operational, tactical and strategic levels, as well as its application to our craft of policing in all its forms.

About the author

Lorna has been a police search advisor at Sussex Police since 2007. She spent eight of these years on a specialist search unit, where she was operational in police diving, marine operations and search and recovery in other hazardous areas.

She has a BSc (Hons) in Criminology and was awarded funding through the College bursary scheme to support her PhD for her research on the movement of bodies in inland waterways. Her work, entitled **‘The body recovery from water study’**, is an ongoing research project, which she continues in her own time alongside her police role.

- This article was peer reviewed by Dave Suffield, Public Protection Unit Missing Development Manager, Lancashire Constabulary

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