



Deep Waters, Remote Risks: Managing Diving Emergencies in Rural Scotland

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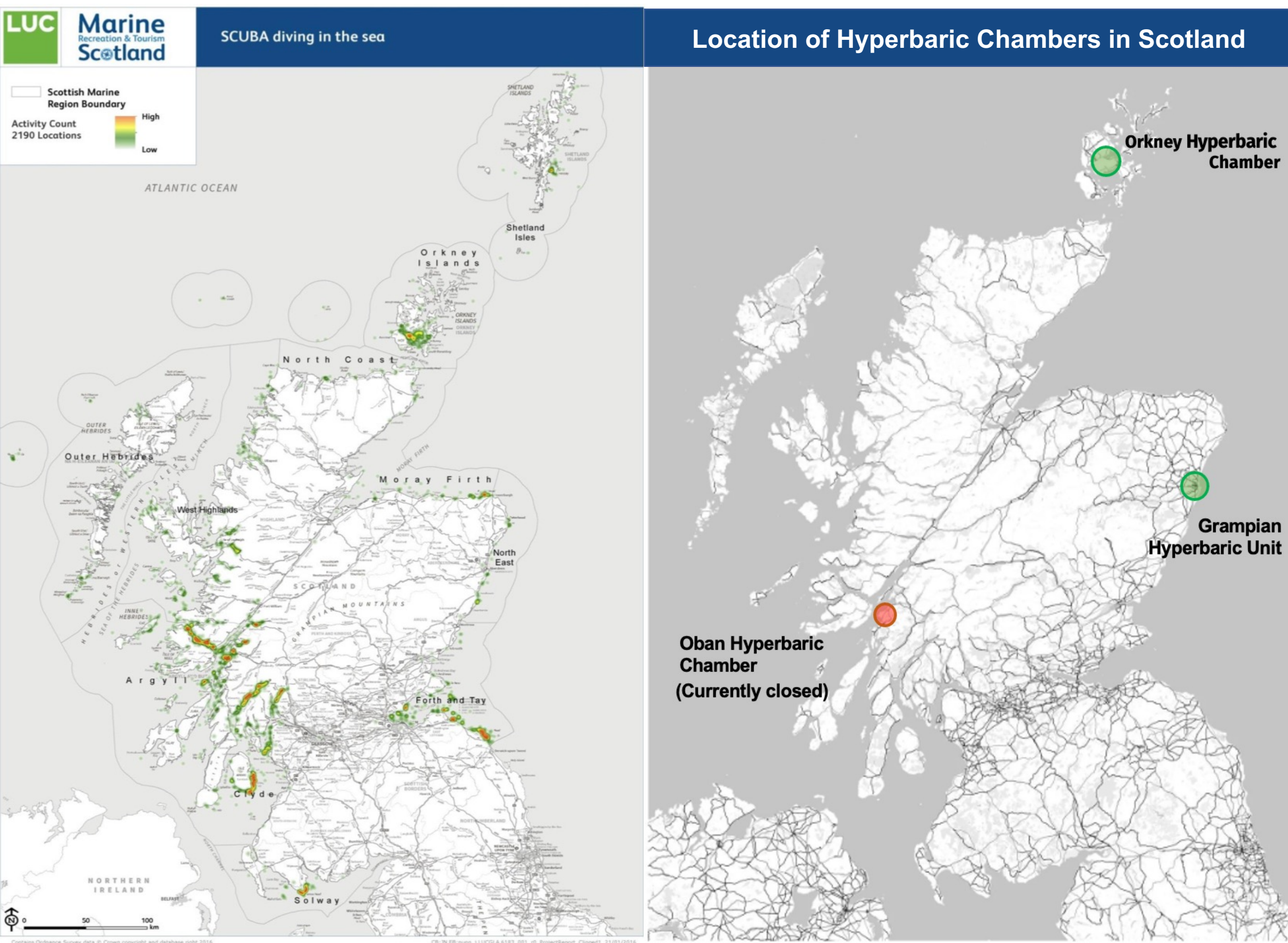
Background

Diving in Scotland is becoming increasingly popular, with a growing number of recreational divers drawn to its scenic shores (1). But what happens when the familiar saying, “Plan the dive, dive the plan,” goes wrong? Diving presents inherent risks, especially for older divers who are more susceptible to certain health complications. When things go wrong underwater, having nearby hyperbaric facilities can make all the difference between a close call and a tragedy.

Diving imposes significant strain on the body, particularly on the cardiovascular and respiratory systems. Risks include acute hypertension, circulatory disorders, and respiratory complications, especially as the density of breathing gas increases at depth (2). Divers aged over 61 face a significantly higher risk of serious injury, with 60% of cases classified as severe and 44% of these divers experiencing incomplete recovery compared to younger aged divers (2). Recompression chambers play a crucial role in treating conditions like decompression illness (DCI) and cerebral arterial gas embolism (CAGE), where rapid access to treatment is vital to prevent long-term damage. DCI is one of the most common dive-related injuries in the UK, and it is caused by the formation of nitrogen bubbles in tissues and the bloodstream. DCI often presents with fatigue, joint pain and skin itch but more notable are the injuries for divers in the older age cohort that have physiological challenges which add to pre-existing pathology.

Regarding the relationship between dive sites and available hyperbaric chambers, Scotland’s remote coastal regions present unique challenges for emergency response and treatment. Despite the numerous dive sites shown in Figure 1, access to hyperbaric chambers is limited, as highlighted in Figure 2, which outlines the chambers in Orkney Islands, Aberdeen and Oban chamber which has recently closed. This limited access poses significant risks, potentially delaying treatment for conditions like DCI.

This project aims to assess the incidence of decompression illness (DCI) treated by hyperbaric chambers in Scotland over a 10-year period and examine the accessibility of these chambers in relation to popular dive sites. Additionally, it seeks to analyse dive-related injuries across the UK during the same period to understand the relationship between injury rates and treatment accessibility and explore areas for improvement.



Methods and Materials

Study Design: A comprehensive analysis was conducted to evaluate the number of DCI incidents treated at dive chambers over a 10-year period.

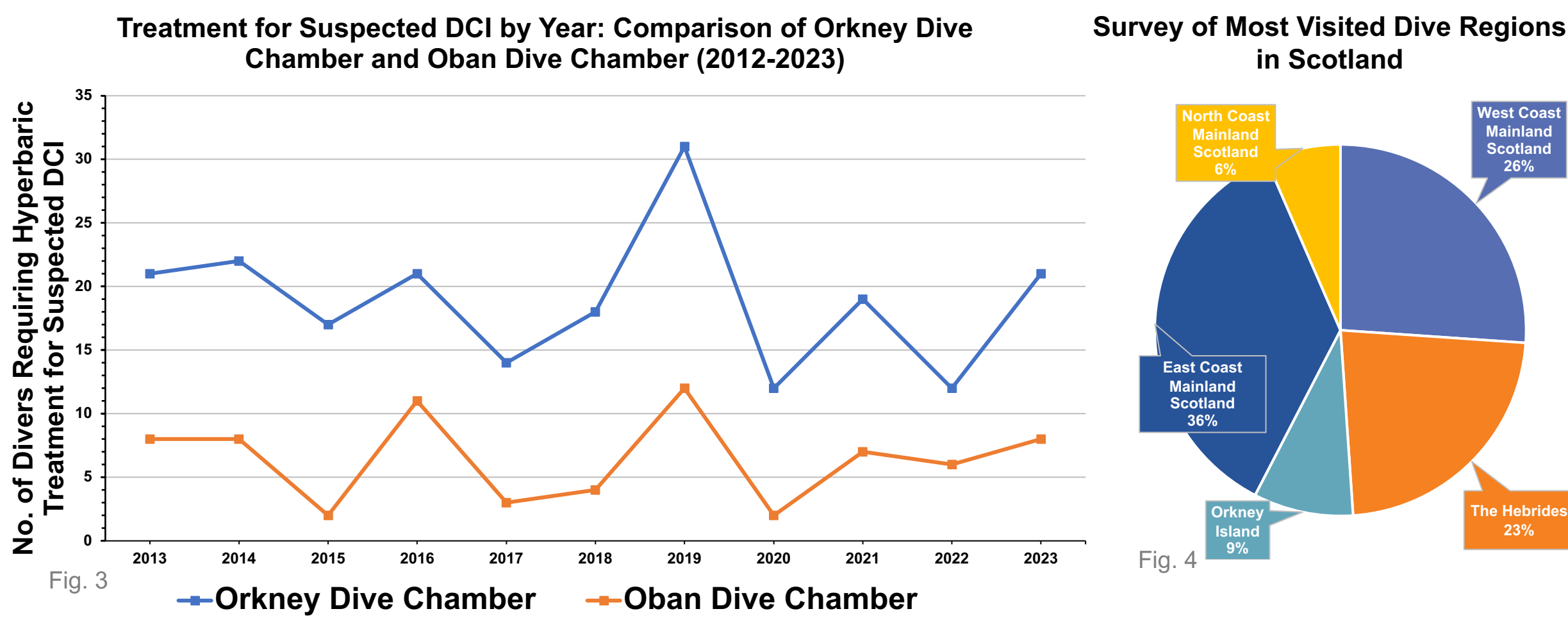
Data Collection: This study used data from dive chambers with available records (Oban and Orkney), survey results from 48 UK-based recreational divers, and incident reports from the British Sub Aqua Club (BSAC). This comprehensive approach aimed to provide a detailed analysis of DCI, non-fatal injuries (e.g. falls, minor barotrauma, near-drowning, TIA, Immersion Pulmonary Oedema, etc), fatal incidents, and availability of treatment.

Analysis: Data analysis focused on the number of DCI incidents treated at the facilities over the 10-year period. Trends in diving-related incidents from the BSAC incident reports were tested for significance using a one-tailed t-test (confidence interval: $p \leq 0.05$), and this was used to identify the changes over the number of years.

Results

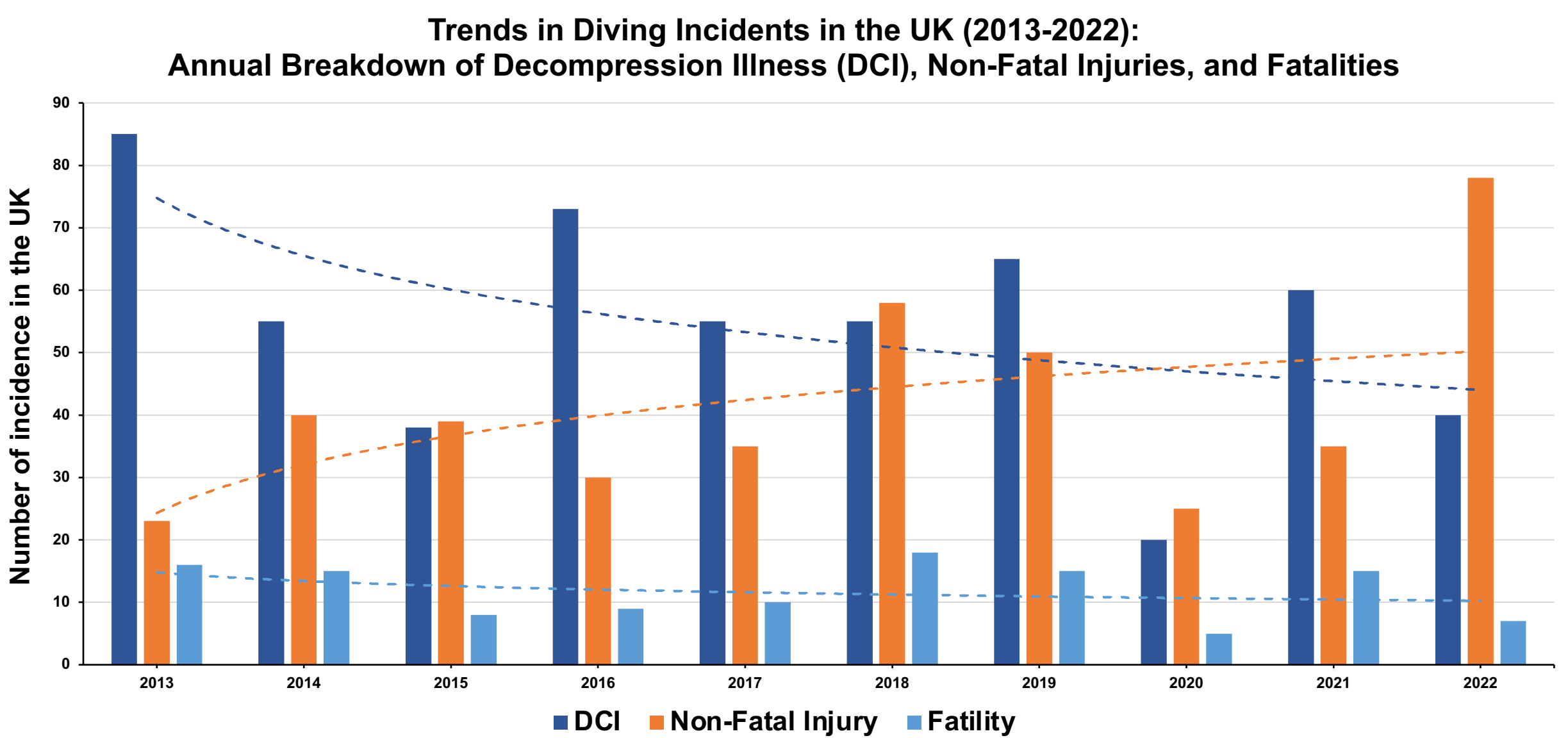
Higher Incidence of DCI Treated in Orkney Compared to Oban Hyperbaric Chamber Since 2013.

- Between 2013 and 2023, a total of 279 cases of decompression illness (DCI) were treated with hyperbaric therapy at the Oban and Orkney chambers (Figure 3).
- 75% of these incidents were treated at the Orkney chamber, which was ranked fourth most visited dive region according to a survey of UK recreational divers (Figure 4).
- DCI incidents in both Oban and Orkney saw an increase in 2019 compared to 2018. However, the correlation between the two locations over time was weak, suggesting independent trends.



Trends and Statistical Analysis of UK Diving Incidents.

- DCI incidence has decreased over the 9-year period, with a notable downward trend despite some fluctuations (Figure 5). A one-tailed t-test revealed a significant difference between the decreasing rates of DCI and number of fatalities ($p = 6 \times 10^{-6}$).
- Non-fatal injuries demonstrate an increasing trend, with significant peaks in 2022, a indicating a rise in non-fatal incidents among divers in the UK. However, the t-test indicated no significant difference between the decreased rates of DCI and the increased rate of non-fatal injuries.
- Fatalities remain consistently low throughout the decade, with a slow decline over time.



Discussion

Trends in Diver Safety and the Influence of External Factors

The reduction in rates of DCI (Figure 1) could indicate there has been improvement to safety protocols being taught to divers and dive boats which equips them to recognise and respond to symptoms earlier. However, DCI incidence is influenced by the total number of dives per year, which can fluctuate due to external factors such as the COVID-19 pandemic or the popularity dive boats during peak seasons. Therefore, while the current trend suggests a decline in DCI, this does not predict what may happen in the coming years. Furthermore, the increase in non-fatal injuries could relate to the growing proportion of older divers, who are more susceptible to additional health complications.

Challenges in Data Collection

The lack of data from the Grampian hyperbaric chamber presents a significant limitation in assessing the full scope of diving injuries in Scotland. Without this data, the true impact of DCI and diving-related injuries in Scotland remains incomplete. Lastly, Figure 5 relies on diver self-reporting, which may lead to underreporting or misinterpretation of symptoms, potentially affecting the accuracy of the data

Future Directions

Despite the temporary closure of the Oban chamber, Scotland is still a popular dive location, therefore future research should focus on identifying the prevalence of specific injuries most common to an older-age cohort of divers and thus improve safety practices within the tourism industry and diving communities across the UK.

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