Research Article

Systematic Literature Review of Marine Lives: The "Thwack" of Inexperience Divers towards Coral Reefs

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Abstract

Diving tourism, commonly referred to as scuba diving tourism, has emerged as a recreational activity that enables people to explore underwater surroundings and more carefully see the grandeur of aquatic life. Nevertheless, while diving tourism has played a substantial part in expanding people's awareness of the importance of marine environmental preservation, there are unethical dive practises, such as harming or destroying coral reefs, taking marine creatures as souvenirs, and improper trash disposal, that may have a detrimental effect on the marine ecosystem. Therefore, this study aims to investigate the factors causing coral reef destruction as a result of activities, particularly among inexperienced divers that involves in Discover Scuba Diving (DSD). Systematic Literature Review (SLR) method and The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) approach were used to analyse the previous studies based on the keyword search. Findings shows that, poor planning, lack of education/knowledge/information, inexperience divers are being ignorant, irresponsible behaviour, impact of diving equipment (e.g., fins, tanks), camera used, buoyancy control, incorrect weight and cognitive (e.g., stress, anxiety) are among the factors the deteriorate the environment of coral reefs. Implications are also discussed in this study.

Keywords:

Diving tourism, Inexperience diver, Coral reef deterioration, Discover scuba diving, Marine lives

1 Introduction

Diving tourism, often known as scuba diving tourism, has a long and intriguing origin. It evolved as a leisure activity that allows people to explore underwater environments and observe the splendour of aquatic lives more closely (Bideci & Cater, 2019; Gregory & Dimmock, 2019). The design and development of Self-Contained Underwater Breathing Apparatus (SCUBA) by Jacques-Yves Cousteau and Emile Gagnan in the 1940s reinvented for diving activities (Crylen, 2018; Gambin et al., 2021). It enables diving to become easier and less treacherous for leisure divers. Gregory (2022) mentioned that diving grew increasingly popular among outdoor enthusiasts and environment enthusiasts as the diving gear upgraded and became more readily accessible.

The formation of dive training organisations such as the Professional Association of Diving Instructors (PADI) in 1966 was essential in standardising diving practises while encouraging professionalism (Gore et al., 2019; PSDiver Magazine, 2018). Diving tourism has thrived in the past few decades, with its emphasis on ecological practises, involvement in the community, and educational programmes (Prasetyo et al., 2019; Tuyen et al., 2023). According to Althewaynee et al. (2022), Chowdhury et al. (2018) and Shobana et al. (2023), augmented reality and underwater drones, among other technological advances, have increased the popularity and attraction of diving world. Currently, diving tourism draws millions of divers throughout the world, allowing them to see the beauties of the undersea world while also contributing to marine conservation campaigns (Chen, 2020; Uddin et al., 2021; Zafra, 2021). It is evolving in tandem with technological breakthroughs and a rising worldwide understanding for the majesty and vulnerability of the seas.

Nonetheless, even though diving tourism has contributed to a major part in increasing the public's understanding of the preservation of the marine environment, there are immoral dive practises, such as damaging or harming coral reefs, taking marine creatures as souvenirs, and inappropriate trash disposal, which might have a negative impact on the marine ecosystem (Corley, 2023; Shoaira et al., 2019). Consoli et al. (2019) and Lucrezi et al. (2021) stated that this might give impact towards a detrimental influence on the ecological condition and biodiversity of underwater habitats in the long run. Adding to that, a new activity introduced known as Discover Scuba Diving (DSD), is a programme for those with no or limited experience diving who desire to try out scuba diving (Aygun & Norman, 2021; Merino et al., 2021). Dive centres and resorts in major diving sites across the world provide DSD programmes as they offer activities towards the introduction to scuba diving for inexperience tourists. It is allowing the tourists to experience the excitement of being underwater before deciding whether to pursue further diving license.

However, the lack of experience might lead to the environmental damage, disruption of marine life, as well as inadequate safety awareness which eventually bring fatalities to the diver himself or towards the marine lives such as coral reefs (So et al., 2023). The existence of a high number of DSD applicants might put additional

strain on fragile marine habitats. Excessive diving activity in particular regions, if it is not effectively controlled, can cause structural harm for coral reefs, interference of marine life, and deterioration of the underwater ecosystem (Tuyen et al., 2023). Not only that, DSD programmes only give an introductory lesson to scuba diving, typically lasting just a couple hours or a single day. Whilst participants are given basic instructions and safety standards, they could fail to receive adequate instruction to obtain an in-depth understanding of the skills, expertise, and safety procedures required for diving activities. Therefore, this study aims to explore the factors of coral reefs deterioration from the activities especially among the inexperience divers especially from the activity of Discover Scuba Diving (DSD).

2 Method

This study employs the Systematic Literature Review (SLR) method with a systematic review procedure, as recommended by Pangarso et al. (2022) and Raja Mustapha (2023). The systematic literature review process comprises tasks such as planning, conducting, and reporting. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) approach developed by Pickering and Byrne (2014) was used in this study. It entails (i) establishing the review protocol by identifying keywords, databases, and literature selection criteria; (iii) searching literature by tracing databases for the literature and screening search results against the criteria before refining exclusion and inclusion criteria; and (iv) retrieving literature by structuring summary tables, evaluating literature quality, and entering bibliographic data. The systematic literature review PRISMA process chart is depicted in Figure 1.

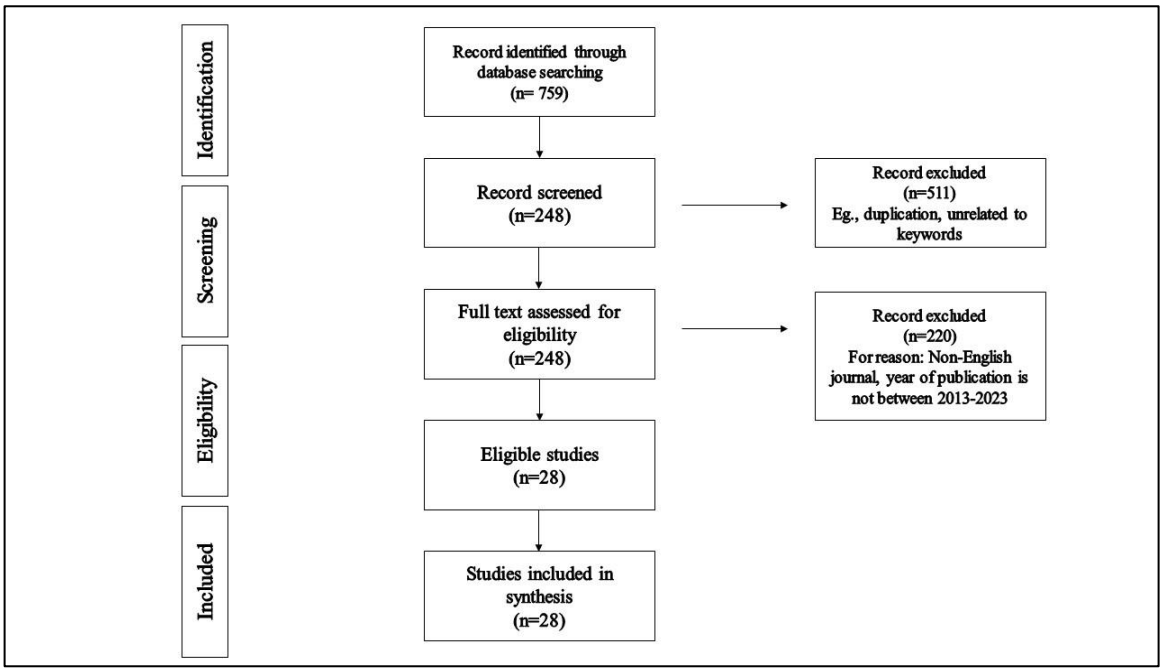

Figure 1: PRISMA Process Chart for the Inexperience Diver Systematic Literature Review

2.1 (PRISMA) Process

2.1.1 Determining Research Objectives

This study aims to provide a thorough review of impact from inexperience divers activities towards coral reefs. This study went through an extensive review from previous studies that focus on inexperience divers' impact towards marine lives in order to identify the essential information that leads to the research objectives.

2.1.2 Selection Inclusion and Exclusion Criteria

This study screened journals that focused diving tourism within their studies from 2013-2023. The keywords include "Inexperience Diver*" or "Discover Scuba Div*" or "DSD" or "Diving Touris*" or "Dive Tour*" or "Coral Reef*" or "Marine Li*" as the keywords search. The databases used for analysis were included in the Google Scholar archives from 2013 until 2023. The reason for choosing year 2013 until 2023 as the researcher would like to see the trends of journals that highlighted on the impact of inexperience divers' activities towards the marine lives especially coral reefs. Journals from Science Direct, Emeralds, Springer, and Taylor & Francis are among those selected. Only research articles published in English are counted for this study to ensure the authenticity and efficiency of the literature review. The articles in this study were chosen for their (i) titles, (ii) abstracts, and (iii) content were linked to the research keywords. It is vital to note that the research sequences were ran consecutively to enhance the study's dependability. As shown in Figure 1, the total number of journals identified in the preliminary stage was 759. Nevertheless, 511 journals were excluded for their duplication and unrelatedness to research perspective such as Data Security Division (DSD), Digital Services and Development (DSD), Direct Store Delivery (DSD) and Disabilities Services Division (DSD) which constituted different perspectives and terminologies towards research topic. Among 248 journals were assessed through full texted process reading, only 28 were eligible to be selected as shown in Appendix 1. The shortlisted journals were reviewed where the research area was examined by focusing on the impact of inexperience divers towards coral reefs from the DSD activities. Table 1 summarises the inclusion and exclusion criterion.

Table 1: Inclusion and Exclusion Criterion

Criterion	**Inclusion**	**Exclusion**
Keywords	"Inexperience Diver*" or "Discover Scuba Div*" or "DSD" or "Diving Touris*" or "Dive Tour*" or "Coral Reef*" or "Marine Li*"	Data Security Division (DSD), Digital Services and Development (DSD), Direct Store Delivery (DSD) and Disabilities Services Division (DSD)
Year/Timeline	Effective 2013-2023	A year before 2013 or, a year after 2023
Literature Type	Journal, English	Book, non-journal, non-English language

2.1.3 Bibliometric Analysis

According to the analysis, the 28 papers selected were published in a broad spectrum in terms of publication per publication. Table 2 shows the result.

Table 2: Inclusion and Exclusion Criterion

Journal	**Number of Publications Per Journal**
Australian Journal of Basic and Applied Science	1
Fortaleza	1
Environmental Management	1
Tourism Geographies	1
Journal of Coastal Conservation	1
Worldwide Hospitality and Tourism Themes	1
Journal of Ecotourism	2
Ocean and Coastal Management	3
Tourism Management Perspective	1
Journal of Maritime Archeology	1
Journal of Sustainable Tourism	1
Injury Epidemiology	1
Marine Policy	1
PLOS One	1
International Journal of Economics, Business and Management Research	1
Journal of Environmental Management	1
Journal of the Faculty of Tourism and Hotels – University of Sadat City	1
Marine Pollution Bulletin	1
Journal of Outdoor Recreation and Tourism	1
Diving and Hyperbaric Medicine	2
Journal of Malaysian Institute of Planner	1
Malaysian Journal of Sustainable Environment	1
Biology	1
International Journal of Environmental Research and Public Health	1
Total	28

Figure 2 shows the number of publications which focus on inexperience divers during from the year of 2013-2023. It is reported that the year 2013 had the highest publications compared to the recent years.

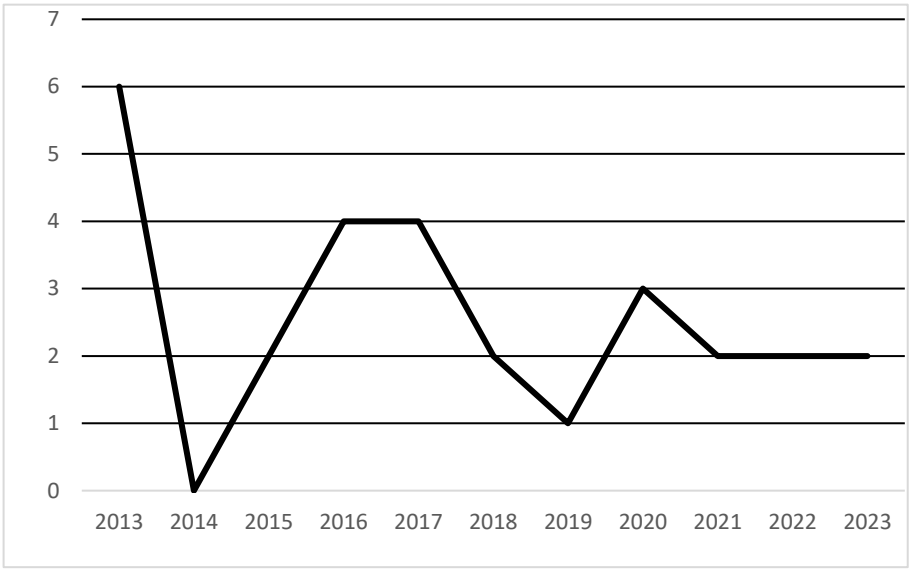

Figure 2: Journal Publications in 2013-2023

Apart from that, Figure 3 shows the countries that have been covered by the selected journals. It seems that, most of the selected journals were from Australia and Malaysia.

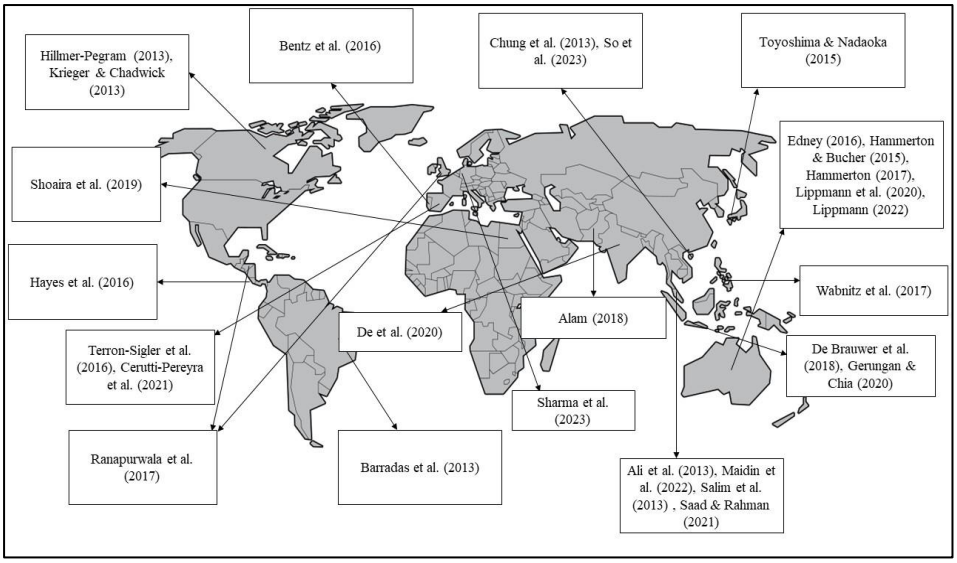

Figure 3: Countries from the Extracted Journals

The VOSviewer tool was also utilised to map the strength of keyword co-occurrence correlations. VOSviewer may also be used to display current connection patterns between several of the most cited bibliometric elements. According to the findings of the VOSviewer mapping (Figure 4), three keywords have been determined as the most frequently utilised in the overall sample of chosen publications. Analysis shows that the keywords connection between coral reef and inexperience diver are still new and associated with each other. To recap the VOSviewer study, the results completely match the previous prediction that was repeatedly analysed during the in-depth review of the articles.

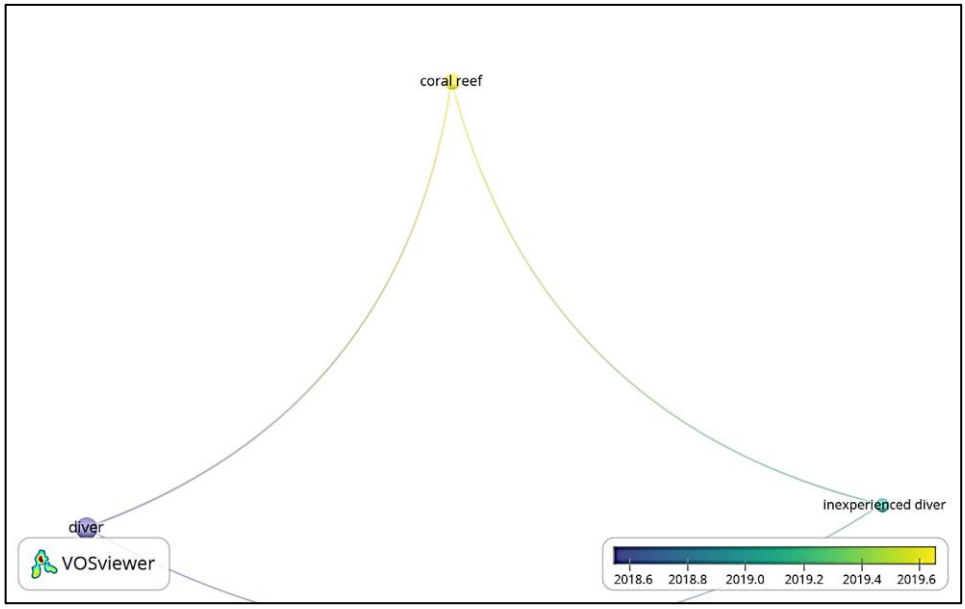

Figure 4: VOSviewer Titles and Abstract

3 Findings

3.1 Literature Overview of Diving Tourism

Regardless of the diversity of coral reef ecosystems, numerous tourism activities such as scuba diving and snorkelling have emerged (So et al., 2023; Toyoshima & Nadaoka, 2015). Scuba diving looks to be a nourishing recreational activity designed for coastal communities. The popularity of scuba diving has indirectly helped the tourism sector, which has grown to be an industry worth billions of dollars (Hammerton & Bucher, 2015; Hayes et al., 2016). The majority of coastal populations rely on coral reef ecosystems for both social and economic reasons. Island communities viewed scuba diving as a commercial opportunity, and they opt to build dive shops around dive locations in order to increase the tourism sector at the point of interest (Salim et al., 2013). Due to a high number of visitors being trained, recreational diving which explore coral reefs has expanded during the last few

decades. Moreover, this tendency has been hastened by the emergence of more dependable dive equipment and low-cost underwater cameras (Toyoshima & Nadaoke, 2015).

So et al. (2023) added that the enormous growth of the scuba diving sector may be attributed to various causes, including enhanced diving safety, increased interest in nature-based leisure activities, and rising in number of conveniences in travelling to international dive locations. Concerns regarding the environmental effect of scuba diving have grown as the business has expanded which contributed to the growth of economic benefits (De Brauwer et al., 2018; Gerungan & Chia, 2020). Furthermore, divers gain physically and psychologically from scuba diving, which provides good opportunities to explore the underwater environment. It encourages social contact among divers by additionally recommending a dive 'buddy' for safety reasons (Gerungan & Chia, 2020; Hammerton, 2017). Diving offers a promising revenue for both company owners and local communities since scuba divers are prepared to pay considerable sums of money for access to the underwater environment. Hence, scuba diving may benefit communities' income and livelihood, conservation initiatives, and divers' underwater experience (Toyoshima & Nadaoke, 2015).

Today, recreational scuba diving is a popular activity, and the recreational dive community is becoming huge, active, and mobile (Bentz et al., 2016; Shoaira et la., 2019). While it is impossible to ascertain the actual number of active divers, current estimates imply that there are between six and 28 million active divers worldwide, and the number of recreational divers continues to rise (Edney, 2016; So et al., 2023). Moreover, coral reefs are the most amazing structure ever created on planet Earth by living organisms and that has survived over time; they are actually incredibly complex ecosystems of plants and animals that occur predominantly in shallow tropical seas (De et al., 2020). Coral reefs are one of the most popular tourism attractions, and as recreational diving and tourist activities have increased, so has the harm inflicted by individual divers (Shoaira et al., 2019). Coral reefs are attractive places to visit as they portray the popular depiction of paradise. The archetypal vision of paradise reef landscape with sun, coconut, white coral sand beach, and colourful reef fish is related with renowned sites to evolve with marine lives. Tourism associated to reefs benefits at least 96 nations and territories; in 23 reef countries, tourism accounts for more than 15% of GDP (Shoaira et al., 2019). As a result of rising interest in ecology and ecosystem appreciation, self-contained underwater breathing apparatus (SCUBA) in coral reef ecosystems has become a highly significant component of the worldwide tourism sector.

Nevertheless, scuba diving may have a significant influence on the fragile ecosystems that lives on coral reefs (De Brauwer et al., 2018). Although diving tourism may provide fiscal benefits to coastal communities, divers could trigger coral degradation. These numbers and requests for dive tourism have increased over the last years, prompting environmentalists and academics to raise worry about the destruction of the marine ecosystem. Their presence may jeopardise the survival of coral reefs since some divers may touch or crush the reefs. Inexperienced diver activity

has frequently been found to harm corals, with heavily dived areas having a greater prevalence of coral disease. Inexperienced divers with inadequate technical capabilities are more likely to cause harm than more experienced divers. When they lose their buoyancy, some of them may even kick them with their fins (Salim et al., 2013). Despite this, there is a rising awareness that uncontrolled and expanded recreational usage of coral reefs frequently leads in environmental deterioration, coral skeletal fracture, and tissue erosion due to direct contact with visitors (De et al., 2020). Physically injured corals are more sensitive to illnesses, increased predatory behaviour, and less competitive in space rivalry, finally leading to coral death. Most of the time, uncontrolled dive tourism in poorly managed reefs in tropical developing countries impedes conservation. Therefore, this study assessed the factors of coral reefs destructions by inexperience divers especially from the activities of Discover Scuba Diving (DSD) which are popular among the inexperience divers.

3.2 Marine Lives Deterioration by Inexperience Divers

Human-caused degradation of ocean ecosystems has generated global interest in the construction of ocean protected zones (Viana et al., 2017; Salim et al., 2013)). According to Viana et al. (2017) and Lippmann (2022), inexperienced divers may cause coral reef degradation due to poor planning and lack of education about recommended practises and potential hazards involved with diving. Ignorance is also one of the contributions to the uncontrollable damage towards coral reefs (Krieger & Chadwick, 2013). Gerungan and Chia (2020), Hillmer-Pegram (2013) and Shoaira et al. (2019) stated that the inexperience divers had inadequate information about the underwater environment which caused them to tend to disrupt the coral reefs or other marine lives. However, he added that the majority of the dive shops on Virgin Island conserved fuel and time by transporting novice divers to nearer environmentally damaged locations rather than remote ecologically intact areas.

Nonetheless, this case is different with a case study by Alam (2018) as the splendour of the marine lives, ecosystems, and plants will captivate even unskilled divers. This occurs as a result of damage caused by hands, the diver's body, the diving equipment and paddle (Barradas et al., 2013; Chung et al., 2013; Shoaira et al., 2019). Most of the time, they cannot prevent themselves from touching and hurting the corals due to the beauty and uniqueness of the marine lives itself. This behaviour leads to negative impacts of the coral reef environments which eventually disturb their ecosystem process. Wabnitz et al. (2017) highlighted that inexperienced divers have expressed worries about overcrowding at dive locations and bad diver conduct (e.g., coral clutching or kicking, full body laying on corals, etc. leading to coral reef loss. Not only that, Cerutti-Pereyra et al. (2021) and Saad and Rahman (2021) also found inexperience divers that use of fins is one of the marine activities that may contribute to coral deterioration.

Inexperienced individuals frequently harm corals and other reef species by using fins, equipment, or bodily contact. When doing diving activities, camera users were more likely to cause reef damage. Damage was more likely to occur within the first 10

minutes of the dive as studied by Ali et al. (2013). Inexperience and faulty weighing are also common causes of poor buoyancy control (Edney, 2016; Toyoshima & Nadaoka, 2015). Mechanical damage to shipwreck fabric and protecting concretions has been reported after being damaged by equipment, notably tanks and fins. Hammerton and Bucher (2015) and Maidin et al. (2022) emphasised that it is a well-known fact that non-certified divers may do greater harm to corals, owing to a lack of coral expertise and poor buoyancy abilities, which increases the rate of coral contact and leads to unintended reef interaction. Furthermore, uncontrolled underwater buoyancy frequently results in segregation, allowing divers to crash on top of the whole coral colonies (De Brauwer et al., 2018; De et al., 2020). Diver damage may be somewhat comparable to anchor damage in some circumstances, although on a much smaller scale. Divers may crush or shatter corals, as well as stir up silt clouds with their fins, body parts, or other equipment.

Several research such as Hayes et al. (2016) and So et al. (2023) mentioned that diver impacts on marine ecosystems have found that unskilled divers have a bigger influence on coral reef ecosystems than experienced divers. If inexperienced diver behaviour (contact with coral, discrimination of local organisms, integrating of underwater sediment) is detrimental to coral reef health, it comes that inexperienced diver conduct may also negatively impact the actions and health of animals that live in coral reef ecosystems, including sea turtles, a marine life that heavily depended on coral systems (Hayes et al., 2016; Terron- Sigler et al., 2016). Numerous inexperience divers carried incorrect weights and were either underweight (positively buoyant) or overweight (negatively buoyant), which may lead to overexertion while going underwater or resurfacing, potentially leading to panics which this also reflects inexperience or a lack of training (Hammerton, 2017; Ranapurwala et al., 2017).

Another study, done by Sharma et al. (2023) and Salim et al. (2013) discovered that anxiety, which is defined as an excessive emotion, may contribute to underwater mishaps, particularly for novice divers. The aforementioned environmental elements may be connected with emotional stress. Nonetheless, the diver's personality, including his or her capacity to cope with novel conditions and psychical characteristics, may have an undetermined role in the avoidance of diving mishaps. Researchers discovered that nervous divers perform worse on new and demanding tasks. The intensity of stress factors leading to physiological changes in homeostasis includes an increase in cortisol and adrenocorticotropic hormones, which eventually leads the inexperienced divers damaging coral reefs due to their state of anxiety. Table 3 shows the summarization of causal of inexperience divers towards coral reef underwater.

Table 3: Summarization of Causal of Coral Reef Deterioration

Causal of Coral Reef Deterioration	Authors
Poor planning, lack of education/knowledge/information, being ignorance	Gerungan & Chia (2020), Hillmer-Pegram (2013), Lippmann (2022) Krieger & Chadwick (2013), Shoaira et al. (2019), Viana et al. (2017)
Irresponsible behaviour	Alam (2018)
Diving equipment (e.g., fins, tanks), camera used,	Barradas et al. (2013) Chung et al. (2013) Cerutti-Pereyra et al. (2021), Saad & Rahman (2021), Shoaira et al. (2019), Wabnitz et al. (2017)
Buoyancy control/ Incorrect weight	Ali et al. (2013), De Brauwer et al. (2018), De et al. (2020), Edney (2016), Hammerton & Bucher (2015), Hammerton (2017), Maidin et al. (2022), Hayes et al. (2016), So et al. (2023), Hayes et al. (2016), Terron-Sigler et al. (2016), Toyoshima & Nadaoka (2015), Ranapurwala et al. (2017)
Cognitive (e.g., stress, anxiety)	Sharma et al. (2023), Salim et al. (2013)

4 Study Implication, Limitations and Future Study

This study is regarded as important in terms of theoretical enrichment, knowledge advancement, and practical implications. This study adds to the body of knowledge regarding the factors affecting coral reef degradation caused by inexperienced divers, namely through Discover Scuba Diving (DSD) activities. According to the VOSviewer analysis, there are few studies that focus on the impact of coral reefs and inexperienced divers. Studies can give important insights into the status of coral reefs, conservation needs, and successful management measures. Involving unskilled divers in research operations, on the other hand, necessitates careful assessment and supervision in order to minimise harmful affect on coral reefs. Divers who are inexperienced and engaged in research operations must be well trained and supervised. This involves correct buoyancy control instruction, minimising reef contact, and adhering to research standards to protect the safety of both divers and the reef ecology.

Not only that, inexperienced divers may unintentionally harm coral reefs by accidentally contacting, hitting or leaning on them. The significance of keeping a safe distance from the reef, utilising suitable finning methods, and avoiding any direct physical contact that might injure the delicate coral structures should be emphasised in research procedures. Green Fins should be mandated at any location where water-related activities such as snorkelling and diving take place. Green Fins is a comprehensive programme designed and implemented in collaboration with the United Nations Environment Programme (UNEP) by The Reef-World Foundation. It is a

worldwide recognised effort that promotes ecologically responsible diving and snorkelling practises in order to safeguard coral reefs.

Divers who are inexperienced might not possess the skills and expertise needed to minimise harm to marine species. It is critical to teach youngsters on proper behaviour near aquatic organisms, including as keeping a respectful distance, not chasing or touching marine creatures, and not interfering with natural behaviours or habitats. Involving novice divers in research efforts may be a learning experience, promoting a greater knowledge and regard for coral reefs. It can instill a feeling of responsibility in participants and motivate them to become champions for marine conservation, raising awareness about the necessity of protecting these vulnerable habitats. Ultimately, incorporating untrained divers in coral reef conservation efforts might be a good learning experience. However, sufficient training, supervision, and adherence to ethical diving practises must be prioritised in order to minimise any detrimental consequences on the reef environment and maximise the advantages of research for conservation efforts.

This study is incomplete without its limitation, researcher only use secondary data extracted from the Google Scholar archives to gather the information regarding the research topic. Therefore, future research could expand the data gathering by using Scopus or WoS platforms to give higher impact towards the findings and results. Not only that, future study could be conducted focusing on the level of divers and their experience which affect the marine lives other than coral reefs. Their perspective can be gained through quantitative or qualitative data so that, the future result can be diversified. Other than that, the perspective of dive shops or professionals should be gathered concerning on the diving practices that include knowledge and skills of diving so that the transferring of knowledge and information is well managed and received by novice divers. This study focuses on the factors that influence the destruction of coral reef caused by inexperienced divers, future research could highlight on the awareness of inexperienced and experienced divers towards marine lives while doing the diving activities.

5 Conclusion

The aim of this research is to provide a thorough review of impact from inexperience divers activities towards coral reefs. This includes few factors such as poor planning, lack of education/knowledge/information, inexperience divers are being ignorant, irresponsible behaviour, impact of diving equipment (e.g., fins, tanks), camera used, buoyancy control, incorrect weight and cognitive (e.g., stress, anxiety) factors. This study paves a way for future researcher to look at the perspective of impact from the inexperience divers especially those who involve in Discover Scuba Diving (DSD) activities affecting the marine lives such as coral reefs. Even though diving tourism is able to generate millions of dollars, however protecting and conserving the marine environment becomes the crucial responsibility for everyone including those who involve in this industry.

Inexperienced divers have a lot of potential once they venture underwater to discover the fascinating world of coral reefs. However, in order to preserve the long-term well-being and preservation of these fragile ecosystems, it is critical to recognise the necessity of responsible diving practises and environmental stewardship. Additionally, participation in programmes such as Green Fins may give novice divers with useful information and resources. Awareness of the environment, ethical business practises, and cooperation among dive companies, and community members are all promoted through programmes like Green Fins. Inexperienced divers may actively contribute to the protection and conservation of coral reefs by engaging in such efforts and become ambassadors for good diving practises. Subsequently, an unskilled diver's visit to coral reefs has enormous potential for personal growth, understanding of the environment, and engaged in conservation actions. Inexperienced divers may guarantee that their encounters with coral reefs have a positive influence by adopting the values of ethical diving, constant learning, and teamwork, promoting a sustainable future for these wonderful underwater ecosystems.

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