CHAPTER 1
INTRODUCTION

1.1 Background

The Great Barrier Reef is spanning 2.300km and encompassing over 2.900 reefs. It is not just the largest coral reef system, it's a teeming underwater metropolis. This diverse ecosystem shelters a staggering array of marine life, from 1.500 fish species and 6 out of the 7 sea turtle species in the world. (Australian hydrographic Office, 2019, p. 76). Under International Convention, the World Heritage Convention and International Convention for the Prevention of Pollution MARPOL (Marine Pollution) prevention measures work together to safeguard the Great Barrier Reef and Torres Strait. Australia, a signatory to the World Heritage Convention, has a global responsibility for their conservation, while MARPOL (Marine Pollution) prohibits harmful discharges in these vital waters.

The Great Barrier Reef, recognized as one of the world's of Particularly Sensitive Sea Area (PSSA) in 1990 by the International Maritime Organization RESOLUTION MEPC.268(68) Annex 14, has grown in it is protected status. The area was extended to Torres Strait in 2005 and South-West Coral Sea in 2015. These PSSAs allow stricter regulations, like designated shipping routes, to safeguard this vital ecosystem. PSSAs is given special protection because international shipping activities can damage the ecological, socio-economic, cultural heritage and scientific attributes of the Great Barrier Reef and Torres Strait.

Shipping traffic in the Great Barrier Reef has grown significantly since the year of 2000, according to a 2014 report by the Australian Parliament. The report included a graph that predicted a rise in vessel calls to Great Barrier Reef ports to around 7.500 by 2020, with roughly 4.200 of those being coal ships. This represented a jump from the 4.000 total calls recorded in 2012. Currently, the number of ship movements through the Great Barrier Reef has surpassed 11.000 annually. Shipping activity is associated with several risks, particularly in the event of an accident. These risks include threats to water quality, biodiversity, and ecosystem health. Potential consequences encompass physical or chemical damage from collisions and groundings, as well as the introduction of invasive

species. Associated protective measures are designed to prevent and reduce the risks of shipping activity. The measures include e.g. designated shipping areas and recommendatory ship routing systems, a comprehensive network of visual and electronic aids to navigation, compulsory pilotage for vessels with an overall length of 70 meters or longer and any ship carrying specific cargo, regardless of size. This cargo includes oil, chemicals, and liquefied gas. The measures also include REEFVTS (Vessel Traffic Service), no anchorage areas, and emergency response assets. They improve the safety of ships and safeguard the Great Barrier reef and Torres Strait's marine ecosystem.

Navigating through the Great Barrier Reef and Torres Strait have a significant challenge. These areas are large, requiring lengthy voyages. Additionally, the waters present their own complexities: confined areas with shallow depths pose a constant risk of grounding, while strong and variable tidal streams necessitate constant adjustments of ongoing manoeuvring required to safely navigate the challenges. The monsoonal climate brings periods of low visibility due to rain squalls, and the ever-present threat of tropical storms and cyclones demands unwavering vigilance. Furthermore, navigating these vital waterways requires careful manoeuvring through narrow channels (fairways) vessel meet and overtake situations demand heightened awareness from the navigator to prevent collisions and it's not just interactions between ship to ship but also with channel bank.

Shallow depths characterise the waters surrounding the Great Barrier Reef and Torres Strait, which are dotted with numerous islands, tiny islets, reefs, and shoals. Only vessels with a shallow draught can navigate the northern portion of the strait. Because of the region's complicated topography, navigating through this strait carries significant risks of grounding. Under keel clearance decreases in this shallow water area and cause increasing of vessel's squat. When the vessel entering the coastal zone, the ship's draft will increase. This phenomenon is known as vessel squat and can have serious implications for the ship's safety and navigation. Furthermore, the area's tidal streams and currents are unusually powerful, frequent flash squalls and storms frequently limit vision, increasing the navigational risks. (Australian hydrographic Office, 2019, p. 58)

Picture 1. 1 Great Barrier Reef on ECDIS
(Source: Snapshot taken by researcher during cadet internship, 2023)

The operation of ships in conditions of restricted visibility from bad weather presents additional challenges. These challenges include maintaining a vigilant lookout, accurately determining position using landmarks, and effectively identifying other vessels. These challenges can lead to incidents such as grounding, collisions, and other maritime accidents. Additionally, dense fog disrupts the transmission of radio waves and acoustic signals, hindering the proper functioning of essential navigational equipment of radar. This disruption poses a serious threat to the safe navigation of vessels. (Hu, 2013, p. 1). Restricted visibility significantly impacts the visual range of personnel on watch, consequently hindering the ability of navigators to make clear judgments and assessments of the surrounding environment. Furthermore, the specific physical characteristics of sea fog degrade the performance of ship radar in acquiring targets. This can readily result in ambiguous radar returns, and even the complete omission of small targets, posing additional navigational hazards for vessels. (Hu, 2013, p. 2)

The “Shen Neng 1” was en route from Gladstone, Queensland to China with a load of 65,000 tonnes of coal when it ran aground roughly 0.53 nm off Great Keppel Island, Australia, on April 12, 2010. At the time of the event, the

vessel was apparently travelling at top speed. The ship's port side was severely damaged as a result of the accident, and a three-kilometre-long oil slick was later discovered. The grounding also had an impact on the ship's engine and rudder. Notably, the incident occurred 5.8 nautical miles outside the permitted maritime route. (Australian Maritime Safety Authority, 2020)

On March 15th, 2018, a container ship, APL Southampton, was on route between the ports of Xiamen and Ningbo in China, when colliding with a fishing vessel, Zhe Ling Yu, at night during foggy conditions with heavy fishing traffic. The crash sank the fishing vessel, tragically resulting in one fatality, one missing crew member, and eight injuries. There were no injuries on APL SOUTHAMPTON, which suffered minor damage to her bulbous bow. The inquiry discovered that the container ship was traveling at high speeds on autopilot and encountered intermittent fog with restricting visibility to less than 1nm at times, (despite the low visibility and heavy traffic). The ship's crew also failed to properly respond to automated collision warnings and did not attempt to contact the fishing vessel. (Britania P&I Club,2019)

Based on the background above, the author analyses the challenges and risks associated with navigating in a special area of the Great Barrier Reef and Torres Strait during restricted visibility conditions. The research conducted when the author was on board on MV Flora Delmas. The research will examine existing navigation procedures, technologies and regulations that can be adapted or augmented to improve safety and efficiency on navigating strategies during sailing in restricted visibility conditions.

1.2 Problem Statements

Based on the background, several problems related to this topic of research can be found, which are:

1. Identifying obstacles encountered during manoeuvring in special area with restricted visibility conditions.
2. How can ship navigation through the Great Barrier Reef and Torres Strait be optimized for safety during restricted visibility, considering factors like under-keel clearance?

3. What are the critical factors and decision-making processes that can be optimized to minimize collision risks for ships operating in restricted visibility conditions?

1.3 Limitation of the Problem

To ensure a focused and in-depth investigation, this research deliberately limits its scope to the manoeuvring challenges faced by container ships in conditions of restricted visibility when navigating within designated special areas of The Great Barrier Reef and Torres Strait.

1.4 Purpose of the Study

The purpose of this study is to investigate following factors:

1. To identify obstacles encountered during manoeuvring in special areas with restricted visibility.
2. To optimize safety navigation through the Great Barrier Reef and Torres Strait during restricted visibility, considering factors like under-keel clearance.
3. To analyse critical factors and optimize decision-making processes to minimize collision risks for ships navigating the Great Barrier Reef and Torres Strait during restricted visibility.

1.5 Significance of the Study

Results of this study would be useful to the following:

1. Department of Education:
    a. Could be used to support the Department of Education in developing an effective nautical programme that is applicable to students.
    b. Findings of the study could be used as input for cadets and officers on ships that has trade in special areas helping to understand the particular characteristics of manoeuvring in special areas during restricted visibility conditions.

c. Findings of the study could be used as input for future researchers in fields related to the implementation of the rules and guidance for manoeuvring in special areas during restricted visibility conditions.

2. The Company

   This study is designed to be a reference material for companies, helping to prevent human error and ship accidents caused by a lack of understanding regarding rule implementation.

3. Readers

   This study is expected to provide valuable input for mariners, helping them overcome challenges that may arise during manoeuvring in special areas.