Dissertation of Doctor of Engineering

A Study on Optimum Civilian Volunteer System for Maritime Search and Rescue in Korea

by

Matthew Vail Smith

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Department of Coast Guard Studies

Graduate School

Korea Maritime and Ocean University

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Matthew Vail Smith

Under the Direction of

Professor Jong-Hwui Yun

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Dissertation Committee:

Prof. Lee, Eun-Bang, Chair

Prof. Gug, Seung-Gi

Prof. Seol, Dong-Il

Prof. Kim, Dong-sun

Prof. Yun, Jong-Hwui, Advisor

Department of Coast Guard Studies

Graduate School

Korea Maritime and Ocean University

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A Study on Optimum Civilian Volunteer System for Maritime Search and Rescue in Korea

Matthew Vail Smith

Department of Coast Guard Studies
Graduate School of Korea Maritime and Ocean University

Abstract

Korea has suffered three major maritime disasters resulting in the loss of hundreds of lives. The most recent disaster happened in March 2014 near Jindo; the tragedy of the event being that the massive loss of life was entirely preventable, but the Search & Rescue (SAR) system broke down. In a nation that is almost entirely dependent upon the ocean for its survival, the question is how it can provide more SAR capacity without the extreme expense of expanding the Coast Guard. For several developed and developing nations, the answer is to use a civilian volunteer maritime SAR organization (CVSO). There are two primary models: the USCG Auxiliary model and the Royal National Lifeboat Institute (RNLI) model. The Auxiliary model is more widely used within the American hemisphere, while the RNLI model tends to be used in Europe. Korea has very friendly ties with both the USA and Europe, so neither model has an obvious advantage for adoption by Korea. The problem then becomes what kind of CVSO should Korea choose, and how can one know what is the optimal system for Korea's needs. To decide which model to use, five years of maritime incident data was given by the Korea Coast Guard and analyzed. Five possible variations, or scenarios, of the Auxiliary and RNLI models were set up and calculated. Two scenarios were clearly failures. One scenario had

an 85% success rate, while two scenarios had 100% success rates. The problem then could not be answered with mere quantifiable data, because the quantifiable data yielded two equal results. Going back to the raw data, it became clear that Korea needs improvement not only in SAR response but also in SAR prevention, especially among commercial fishing vessels. Going further back to the narrative descriptions of the USCG Auxiliary and the RNLI, it became clear that, while the RNLI is the better SAR response CVSO, the USCG Auxiliary is the model Korea should adopt, both for its greater capacity for multiple missions, and, more importantly, for its much lower startup and operational costs. However, since the RNLI model has such valuable features, namely, their lifeboat stations and purpose-made lifeboats, the paper suggests using the Auxiliary model to begin, and then phasing in the most valuable aspects of the RNLI over the course of decades as the reputation and donor base grows. Although this paper is about the particular case of Korea, the method is easily transferred to any nation seeking to start its own CVSO.

Chapter 1

INTRODUCTION

1.1 Background and purpose

In the aftermath of Titanic disaster in 1912 with more than 1,500 lives lost, the international convention, Safety of Life at Sea (or 'SOLAS 1914') was adopted to prevent maritime disasters. Maritime Search and Rescue ('SAR') related issues were included. After that, as marine casualties increased along with the rapid growth of shipping worldwide, the International Maritime Organization (IMO, formerly IMCO) was adopted by the SAR Convention 1979 and separated from the SOLAS Convention to respond more effectively to marine accidents and save persons in distress.

Korea experienced two ferry disasters, the Namyeong-ho in 1970 and the Seohae Ferry in 1993, after which the Korean government ratified the SAR Convention. This was put into effect in 1995 and the Korean government has sought to prepare for SAR incidents by appointing Korea Coast Guard ('KCG') as the lead agency in maritime SAR incidents.

South Korea is, in terms of land mass, a relatively small country: 109 out of 247 (Central Intelligence Agency 2013). However, it has the 15th largest economy by Gross Domestic Product (nominal) (World Bank 2013);

27th largest, if measured by Gross National Income per capita (World Bank 2013). Korea joined the Organization for Economic Co-operation and Development in 1996 (OECD 2013) and it is a member of the Group of 20 (G20), (G20 2014). It is clear that Korea's economic power far exceeds its geographical rank.

The natural question, then, is to wonder how Korea gained and sustains its economic power. Korea gained its international prominence through the maritime industry. According to the United States Department of Transportation, Korea has the 7th largest vessel fleet and ranks 9th in terms of Deadweight Tonnage. (Bureau of Transportation Statistics 2007) Korea ranks number 6 in Container Port Traffic (World Bank 2013). In terms of Imports and Exports as a percent of GDP, Korea ranks 52nd (World Bank 2013) and 29th (World Bank 2013), respectively. According to the Korean Ministry of Land, Infrastructure and Transport (MOLIT) in 2012, over 99.7% of international goods were transported by sea, while slightly less than 0.3% was transported by air. (Ministry of Land, Infrastrcture, and Transport n.d.)[1] Clearly the maritime industry is extremely important to the Korean economy and the well-being of all Korean citizens, not to mention the other nations that benefit from trade with or through the Korean shipping industry.

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[1]Nothing international was recorded as being transported by land (road or rail) since North Korea is the only country to which South Korea has a land connection. It should be self-evident why there is no free trade between the two countries.

Because of this high dependence upon shipping, coastal traffic becomes busier each year and the number of marine accidents continues to increase; resulting in loss of lives and damage to property and environment. Besides, in recent years, civilian leisure pattern is appreciably changing to the coastal activities such as recreational boating, fishing, vacation at the beach, sea excursions, and island tours (to name but a few). As the probability of loss of lives grows, so too does the demand for the government to build up SAR capabilities; citizens demand that the government save lives no matter when and where the incident occurs.

It is, however, impossible for the responsible organization, KCG, to keep an eye on long and rugged coastline of about 13,000 km and vast sea areas (including EEZ) without assistance from other organizations. It seems to be difficult for KCG duty vessels (or aircraft) to leave their particular Areas of Responsibilities for SAR operations at any time or to respond to SAR operation promptly because each facility conducts several missions simultaneously. For this reason, several developed countries depend on civilian volunteer search and rescue organizations ('CVSO') that are now well-established. Examples of these CVSO are the USCG Auxiliary ("the Auxiliary") in the U.S.A., RNLI (Royal National Lifeboat Institute) in the U.K., KNRM (Koninklijke Nederlandse Redding Maatschappij) in the Netherlands, MRJ (Maritime Rescue of Japan) in Japan, and the CCGA

(Canadian Coast Guard Auxiliary) in Canada. Recently several Caribbean nations have started their own civilian volunteer SAR organizations. These organizations come in two basic models (USCG Auxiliary and the RNLI). However, each organization has made adaptations to suit the laws and needs of their nation. They also maintain close cooperation with the national government agency that has maritime jurisdiction. Recognizing the importance of these relationships between the public and private sectors, it is imperative to establish a CVSO in order to have organizational and systematic relationship with KCG to improve national SAR capabilities.

As a result of the amended SAR Act 2012 authorizing KCG to request assistance from rescue volunteers or to give necessary instruction and direction to them on-site of marine casualties, MARSA Korea, similar to foreign volunteer organizations, was established in January in 2013. A few studies and research papers were also done regarding how to set up the organization, how to measure effective performance, and a medium/long term roadmap for MARSA. (Korea Coast Guard 2013) (Yun 2013) Nevertheless there is still much to be done to make a CVSO appropriate for Korea, with the ultimate goal of minimizing the loss of life at sea.

In this regard, the author will attempt to find an optimum civilian volunteer system at sea in this paper, examining the gaps of Korean SAR system, benchmarking of developed systems of foreign countries, analyzing historical data of marine incidents by vessel, and making suggestions as to how a new CVSO in Korea could augment the KCG's SAR capabilities.

1.2 Materials and Methods

Data Used

To analyze the historical data of marine incidents by ship in Chapter 4, the data was acquired from the Korea Coast Guard, and included January 2007 through October 2013. The five-year period 2008-2012 was selected because the 2013 data was incomplete, and 2007 would make this study's data set a non-standard six years. The data originally came in 14 categories. They are:

- Date/Time
- Location
- Latitude
- Longitude
- KCG Office Jurisdiction
- Type of Waters
- Type of Incident
- Cause of Incident
- Weather

- Number of vessels involved
- Type of Vessels
- Persons Rescued
- Persons Dead
- Persons Missing

Not all of these categories worked well. For example, Date/Time needed to be separated into discrete categories in order to sort and analyze the incidents better. Location was deleted because it was superfluous; latitude, longitude, and sea area already give that information. It was also not recorded in a standard way, making sorting and analyzing very difficult.

Many entries had to be deleted because the information was deeply flawed or missing (e.g. Latitude and Longitude recorded as 00°00’00”). Where possible, some of these errors were corrected by using other information provided. Fig. 1.1 has eleven examples of faulty data that had to be discarded or corrected prior to use. Notice that every longitude entry in this screen shot is flawed.

<table>
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<tr><td>13분</td><td>34|02|56</td><td></td><td></td><td></td><td>238|45|48</td><td></td><td></td><td></td><td>창원</td><td>항</td></tr>
</table>

Fig. 1.1: Examples of bad data

If the data could be corrected, I corrected it. (In one case in Fig. 1.1, the latitude and longitude simply needed to be switched.) Most of these entries were discarded.

In the cases where the number of ships involved was listed as 0 (zero), those records were deleted. It is impossible to have a ship incident with no ships involved. In most cases, the flawed data entries were simply unusable. What remained of the original 6,854 incident entries, 6,558 survived the correcting and normalizing process.

Methods

Several key issues are addressed in the different chapter to determine how to construct a CVSO well suited for Korea. In order to accomplish this task, this study:

- reviews International and Korean SAR system, and compare the two systems to each other;
- reviews the history, organization and capabilities of USCG Auxiliary, the Royal National Lifeboat Institute, and then compares the two organizations;
- analyzes the historical data of marine incidents and creates a method for calculating SAR response time and costs;
- examines the results of the SAR response calculations;
- suggests the type of CVSO Korea should choose, along with 5-, 10-, 20-, and 50-year plans; and
- suggests improvements to this project and areas for future research.

Of the above investigations, the historical data of marine incidents are analyzed looking for patterns to discern where the needs are greatest. A CVSO can then be established to address those needs.

This investigation has some assumptions. First and foremost it is assumed that there are patterns in ship incident data that can be analyzed and discerned. That is to say that it is assumed that ship incidents are not simply random events that happen detached from the lives of men. Rather ship incidents, or patterns of ship incidents, are knowable and at least somewhat predictable based on historic data, or empirical evidence, or one's experience.

In order to improve SAR response without adversely affecting the other missions that the KCG must perform daily, this paper posits the existence of a CVSO that can be used to augment KCG assets and personnel. This study discusses at great length the features of civilian SAR organizations.

The primary mathematical portion of the paper involves calculating the distances from SAR vessels to distress vessels using the Haversine Equation for calculating distances using latitude and longitude on a sphere, and using those distance calculation results to make further calculations about the costs of operations. All of this culminates in a cost-benefit analysis. The reason for doing a cost-benefit analysis is to drive home the point that a CVSO is worth the annual investment from KCG. It is fine to claim that a CVSO will help the KCG, but this section proves it in terms of operational costs saved, lives saved, and property saved.

Finally, this dissertation ends with some discussion about what to do with the results of this study. That is, how to form an organization and move it forward toward the goal of helping the KCG to save lives and property. There will also be some discussion about how to improve this study to make it more accurate and sophisticated, which could hopefully then be used to make better predictions of future needs, and also be exported for use in other countries other than Korea.

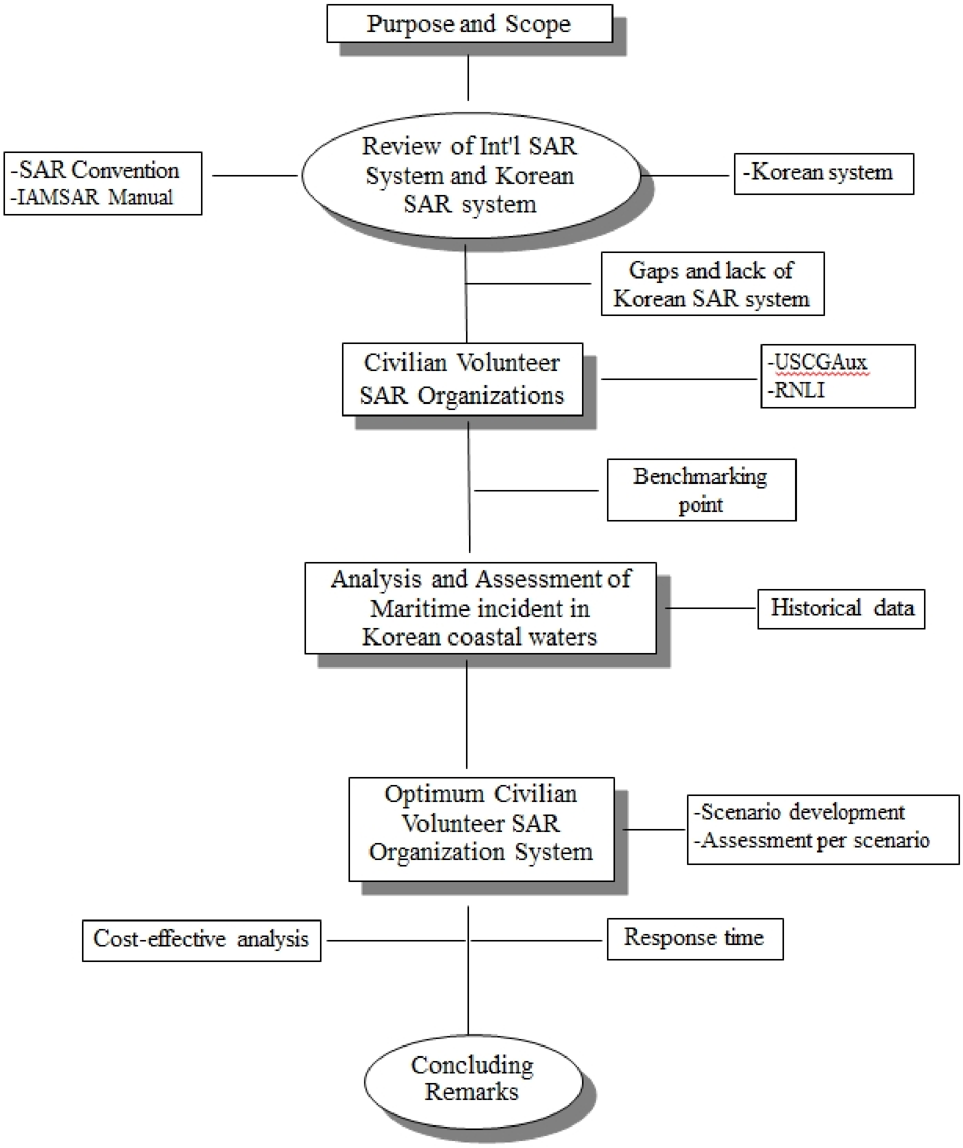

Fig. 1.2: Flow chart of the study

Chapter 2

SAR SYSTEMS

2.1 International SAR System

With the rapid increase of marine transportation and marine casualties, IMO adopted the International Convention on Maritime SAR in 1979. Its objective is to develop and promote SAR activities by establishing an international SAR plan to account for the needs of maritime traffic, to rescue persons in distress at sea, and to promote co-operation among SAR organizations around the world and among those participating in SAR operations at sea. The text of the Convention consists of terms and definitions, organization and co-ordination, cooperation between States, operating procedures and ship reporting system, and the Parties agreed to the Convention are required or recommended to:

- participate in the development of SAR services to ensure that assistance is rendered to any person in distress at sea, and take urgent steps to ensure that necessary assistance is provided;
- establish appropriate national procedures for overall development, coordination, and improvement of SAR services and also establish

RCC and RSC. In addition, to ensure the closest practicable co-ordination between maritime and aeronautical services;

- identify all facilities able to participate in SAR operations, to designate suitable facilities as SAR units, and also to provide those units with equipment appropriate to the task;
- coordinate their SAR organizations and SAR operations with those of neighboring States;
- have each RCC (or RSC) make available up-to-date information especially concerning SAR facilities and available communications relevant to SAR operations in its area, and to ensure they are capable on a 24-hour basis of promptly and reliably receiving distress alerts;
- ensure that effective arrangements are in place for the registration of communication equipment and for responding to emergencies;
- have any SAR unit receiving distress information initially take immediate action, and have RCC or RSC execute emergency phases of uncertainty, alert, and distress;
- follow the procedures in each phases, take appropriate action in accordance with the operation plan, coordinate the SAR activities on-scene to ensure the most effective results, and continue SAR operations until all reasonable hope of rescuing survivors has passed;

- established ship reporting system either individually or in cooperation with other States.

IMO and ICAO jointly published the three-volume *International Aeronautical and Maritime Search and Rescue* (IAMSAR) Manual, which provides guidelines for a common aviation and maritime approach to organizing and providing SAR services.

Each volume can be used as a standalone document or in conjunction with the other two volumes, as a means to attain a full view of the SAR system.

- *Volume I, Organization and Management*, discusses the global SAR system concept, establishment and improvement of national and regional SAR systems and co-operation with neighboring States to provide effective and economical SAR services.
- *Volume II, Mission Co-ordination*, assists personnel who plan and co- ordinate SAR operations and exercises.
- *Volume III, Mobile Facilities*, is intended to be carried aboard rescue units, aircraft and vessels to help with performance of a search, rescue or on-scene coordinator function, and with aspects of SAR that pertain to their own emergencies.

Of the three volumes, *Volume I* is concerned with the organization and management of aeronautical and maritime search and rescue organizations. The manual does not tell IMO member-nations specific rules about how to organize and manage a SAR organization, but rather it lays out guidelines for all nations and organizations to follow and supplement with their own nation-specific or organization-specific laws, regulations, policies and manuals. The idea being that all nations and organizations can follow a general framework with which everyone worldwide can be familiar, and yet the SAR system can be tailored to a nation's or organization's needs, environment, culture, resources, etc.

Any and all SAR organizations should be based on the plan outlined by *IAMSAR, Volume 1*. The first matter that needs to be emphasized is that SAR is not an *ad hoc* response to an incident. Rather, SAR must be a *system* for response to incidents. Indeed, not just a system to respond to incidents, but there must be provisions to prevent SAR incidents. *IAMSAR, Volume I* establishes a legal basis for SAR organizations, how to build SAR systems, specifics about training, communications, systems management, and how to continually improve services. The manual includes several appendices that member-nations can use to help them establish their own SAR organization. In short, a nation could use the *IAMSAR, Volume I* manual as the basis for their national Search and Rescue Plan, or for a Coast Guard-specific search and rescue plan. This is exactly what the United States of America did.

For example in US SAR system, the National Search and Rescue Committee (NSARC), made of representatives from the Departments of Interior, Commerce, Defense, and Transportation, the Federal Communications Commission, and NASA, published the "United States National Search and Rescue Supplement to the International Aeronautical and Maritime Search and Rescue Manual" (NSS) in May 2000[2]. It is over 230 pages of much greater detail than IAMSAR, specifically tailored to fit the structure of the US government at the federal, state, and local levels. This publication is further supplemented for maritime use by the "U.S. Coast Guard Addendum to the United States National Search and Rescue Supplement (NSS) to the International Maritime Search and Rescue Manual (IAMSAR)"[3] also known as COMDTINST M16130.2E. This manual is nearly 700 pages of highly detailed SAR planning and operational policy tailored very specifically for the USCG and the USCG Auxiliary. If anyone has a question about how the USCG does SAR, this manual is it, and it is consciously and explicitly based on IAMSAR.

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[2]Available free in pdf format at: *www.uscg.mil/hq/cg5/cg534/manuals/natl_sar_supp.pdf*
[3]Available free in pdf format at: *www.uscg.mil/directives/cim/16000-16999/CIM_16130_2F.pdf*

The conclusion one should reach about IAMSAR is that it must be the basis for a SAR *system*, and that it is the nation's responsibility to build a SAR organization with great attention to detail in order to serve the mariners of that nation's waters with the greatest efficiency and effectiveness.

2.2 Korean SAR system

Overview of Korea SAR Act

KCG is a part of the Department of Ocean & Fisheries and the principal civilian maritime operational arm of the Korean Government. It operates 234 vessels (cutters, boats, hovercraft, and other response vessels) and 23 airplanes. KCG conducts a variety of missions such as SAR, coastal patrol, marine spill response, maritime safety & security, interdiction of foreign illegal fishing activities, maritime protecting sovereignty, etc.

Korea became a signatory country to the International Convention on Search and Rescue 1979 after experiencing the catastrophic event of Seohae Ferry in 1993, in which 292 lives were lost. This disaster inspired the Korean government to create a national SAR system made in accordance with SAR convention. In most countries that ratified the SAR convention, the SAR systems are described in a supplement or an addendum. In Korea, the National Assembly wrote a special SAR Act in which the national SAR system is described in detail regarding objectives and definitions of terms, contingency planning to prepare for marine casualties, SAR operations, establishment of a maritime rescue association, enhancement of civilian rescue assistance and rescue technology, distress communications, measures after termination of the SAR operation, and more.

SAR Co-ordination

A Search and Rescue Region (SRR) is an area of defined dimensions associated with a Rescue Coordination Center (RCC) within which SAR services are provided. Coastal states usually define the boundaries of an SRR based on the size and shape of the Area of Responsibility (AOR), air and shipping traffic density, and SAR resources. With reference to international guidance, there are 17 SRRs along the coastal waters based on location of KCG district station as shown on Fig. 2.1. Looking at the AOR of each Korean SRR, one can see that Korean SRR are smaller than the SRR in many other countries, since each station has capabilities to conduct the given missions with its own personnel and assets.

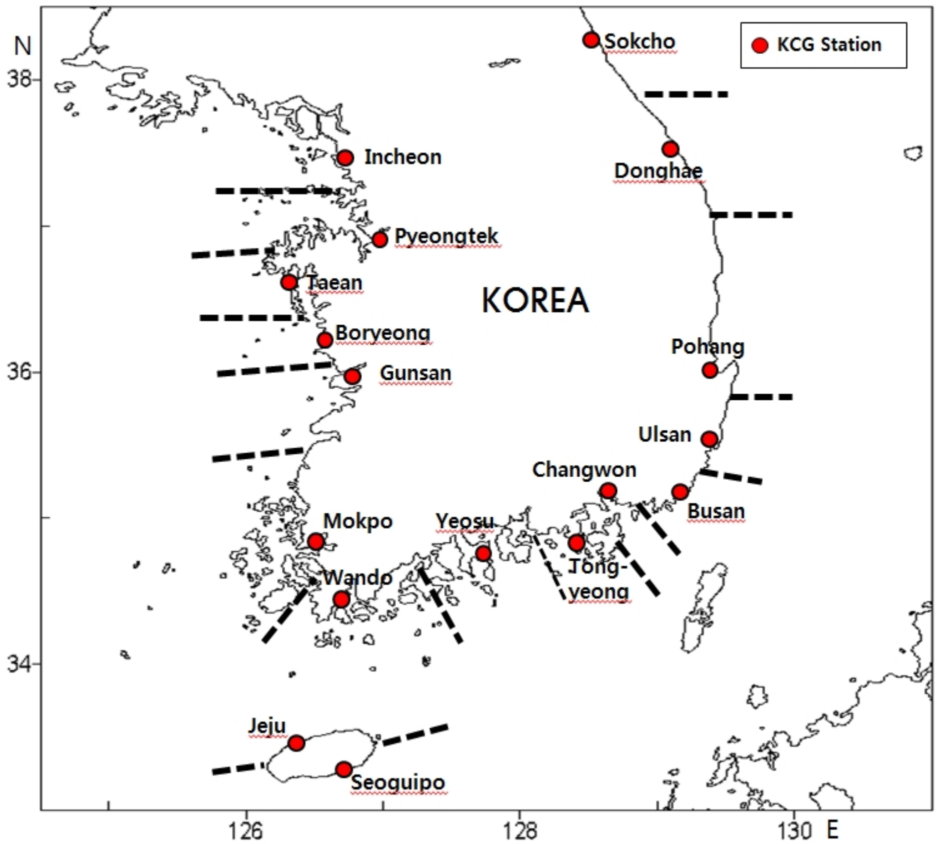

Fig. 2.1: Location of SRR and RCC (or RSC) and approximate boundaries of the AOR

An RCC is an operational facility responsible for promoting efficient organization of SAR services and for coordinating the conduct of SAR operations within an SRR. When maritime incidents occur, three kinds of RCC (national, regional and district) will be established according to location and size of accident as shown in Table 2.1.

Table 2.1: Name of Regional and District RCCs

Nation	Region	District
National RCC	West sea	Pyeongtaek, Taean, (Boryeong,) Gunsan, Mokpo, Wando
	South sea	Yeosu, Tongyeong, Changwon, Busan, Ulsan
	East sea	Sokcho, Donghae, Pohang
	Jeju	Jeju, Seoguipo
	Incheon	-

There are one national, five regional and 16 district RCCs (or RSC) nationwide. This does not necessarily mean that all of these RCCs are fully capable of SAR activities to effectively respond to any kind of marine accidents. Rather, SAR within one RCC can be supplemented by adding necessary facilities from other RCC whenever deemed necessary. (Boryeong is in parentheses because it was founded in 2014, outside the scope of the dataset used.)

According the Korean SAR Act, the Command Staff of an RCC consists of an Incident Commander, a Deputy Commander, and a Coordinator. The KCG Commissioner, and the Chiefs of Regional Headquarters and District Offices are pre-designated Incident Commanders in national, regional, and district RCCs, respectively. These Incident Commanders take overall control of incidents, and the Deputy Commander and Coordinator act as assistants, while the Chief of a District Office is an On-Scene Coordinator (OSC) as well. This hierarchy is a little different from other international systems in which the Search and Rescue Mission Coordinator (SMC) is in charge of overall control over SAR activities while one of the SAR participants on-scene will act as the OSC. The international and Korean SAR organization mission structures are found in Fig. 2.2 and Fig 2.3 respectively.

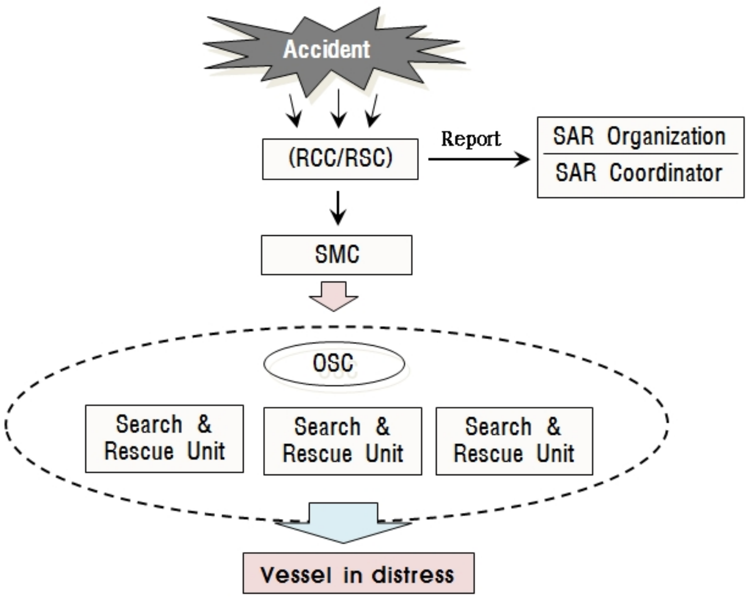

Fig. 2.2: International SAR Organization mission structure

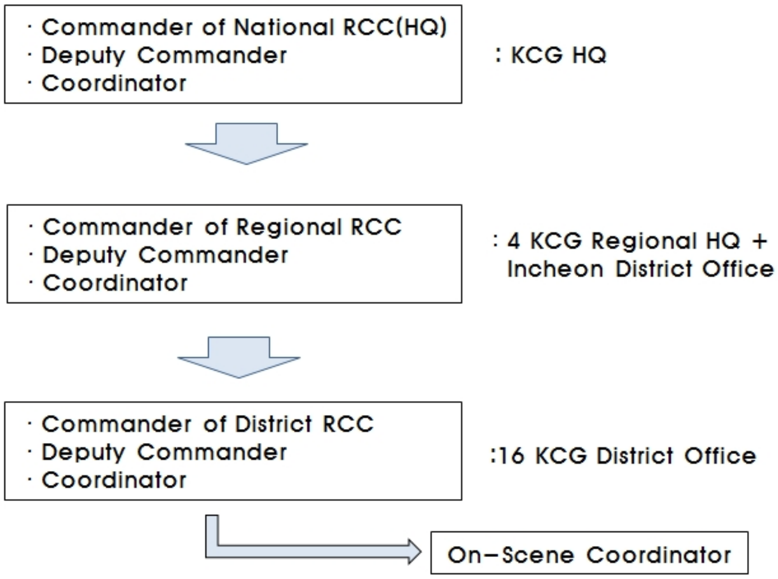

Fig. 2.3: Korean SAR Organization mission structure

There is no explanation for why Korea chose not to use the international standard for a SAR mission structure. SAR coordination in Korea's SAR system may be not adequate for effective SAR performance, because the Search and Rescue Coordinator (SC) has the overall responsibility for establishing, staffing, equipping and managing the SAR system, and yet he is not normally involved in the execution of SAR operations. Instead, SAR missions are carried out under the direction and supervision of the SMC. Accordingly the SMC should be well trained in all SAR processes and be thoroughly familiar with the application of SAR plans, along with the OSC, who is assigned to coordinate the operational activities of all participating units on-scene.

Korea Ship Reporting System

Since Korea ratified the SAR Convention 1979, the government appointed KCG as the lead agency for SAR and established the Korea Ship Reporting System (KOSREP) in 1998 to meet the objective of the reporting system, to reduce the interval between the loss of contact with a vessel, and to initiate SAR operations in cases when no distress signal has been received, to permit rapid determination of which vessel should be called upon to provide assistance, to permit delineation of a search area of limited size in case the position of a vessel in distress is unknown or uncertain, and to facilitate the provision of urgent medical assistance or advice to vessels not carrying a doctor.

KOSREP covers the area shown in Fig. 2.4, which corresponds to the seas within jurisdiction of Korea's RCCs. KOSREP has 4 types of reports: sail plan, position report, deviation report, and final report. The system does not provide automatic plot and display facility (SURPIC).

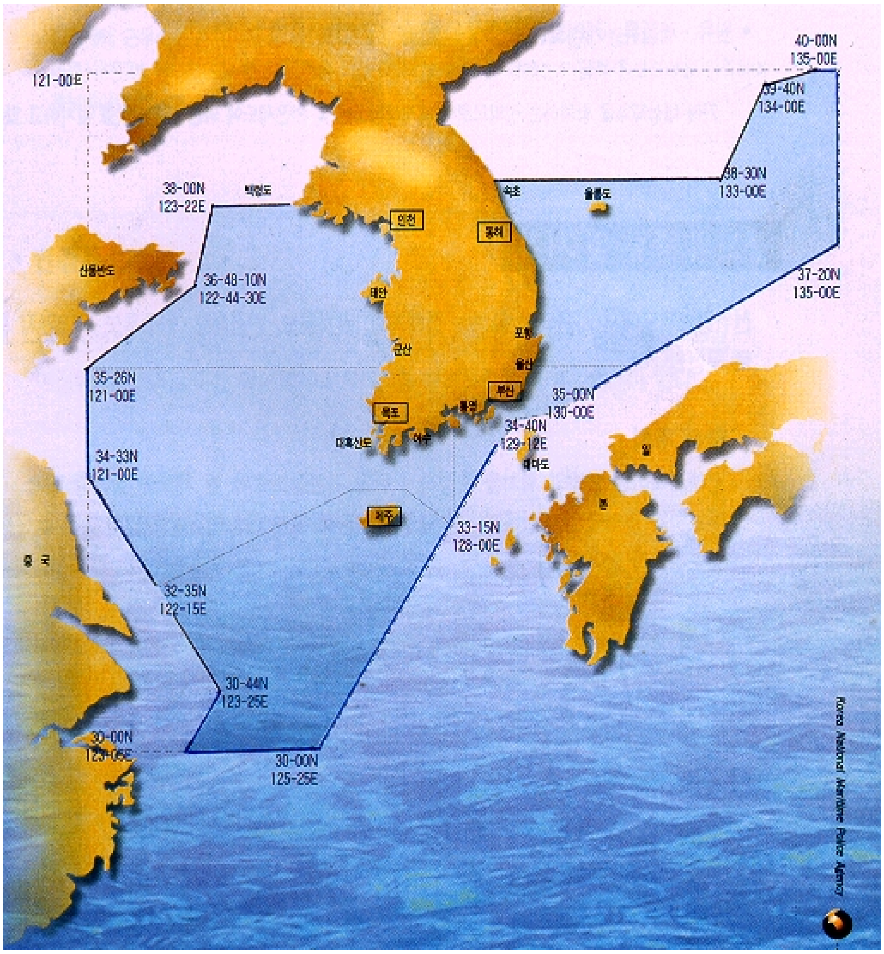

Fig. 2.4: The area covered by Korea Ship Reporting System

Even though KOSREP has been in operation for about 16 years, on average, only 228 vessels participate in the system, and only 540 vessels are on plot per year. KOSREP statistics during a five-year period from 2008 to 2012 are shown in Table 2.2.

Table 2.2: Annual number of vessels participating in KOSREP and on Plot

Year	2008	2009	2010	2011	2012
Annual participants	130	94	120	220	575
Vessels on plot	451	317	508	646	776

This very limited use of the KOSREP system means that it is either not well known to ship's officers, or they simply prefer the AMVER system. For the sake of comparison, the AMVER statistics for the same time period are shown in Table 2.3.

Table 2.3: AMVER statistics of average daily participants

Year	2008	2009	2010	2011	2012
Average daily plot	3422	3618	3780	4634	5305
Max vessels on plot	3688	3809	4092	5218	5461
SAR SURPICs	1003	1146	1980	2229	2465

The great disparity indicates that AMVER is the preferred system. To keep Korea a leader member of IMO, Korea should anatomize the reason why seafarer do not make positive participation and seek for better way to attract them to participate in KOSREP.

Relationship with private sector

Prior to 2012, there were a couple of volunteer maritime rescue groups which operated independently of each other, but with the establishment of the new SAR Act, which came into effect on August 23, 2013, these groups were subsumed into a new civilian volunteer maritime rescue organization. The SAR Act made provisions to establish a non-profit corporation to promote search and rescue situation and to help develop the salvage industries with following missions.

- Develop training and research and development of SAR and Salvage technology;
- Publish SAR and Salvage-related publications;
- Consult on SAR and Salvage issues;
- Public Relations regarding accident prevention and safety management;
- Perform SAR and Salvage-related assignments from government agencies;
- Collect, analyze, and disseminate of relevant information;
- Promote member welfare and other miscellaneous tasks

In addition to the above missions mandated by law, coastal SAR and beach lifeguard operations are included as core missions. The non-profit corporation formed after the new SAR Act was named the Korea Maritime Rescue and Salvage Association (MARSA-Korea). In spite of these efforts to establish an official volunteer corps, it is still not well-organized. MARSA is also far behind the volunteer maritime SAR organizations of other developed countries. This is likely due to the newness of the organization, and because civilians who are not professional (or even amateur) mariners may not understand the value of lifesaving volunteerism. Furthermore, there is not the long history of charitable giving for volunteer lifesaving groups as there is in the United Kingdom, United States, and other developed countries.

2.3 Chapter summary

With the painful experience of ferry disasters in Korea, the government ratified the international SAR Convention. The National Assembly renovated the SAR system to prepare for, and respond to, future maritime incidents by writing and passing a new SAR Act. However, it could be suggested that the current system still needs some adjusting. One suggestion is to integrate all resources into a single organization so that SMC could have overall command and control over SAR operation without any interference from other government entities and/or persons. The other suggestion is to find a better way to have more vessels participate in the KOSREP system so that vessels could give mutual assistance whenever in need. Another very important suggestion is to build a civilian volunteer SAR organization that can help mend the damage done to the KCG in the wake of the Sewol ferry disaster, to strengthen the relationship between public and private sectors, and to minimize the loss of life in coastal waters, at beaches, and off-shore. In this paper, the last issue—building a civilian volunteer organization—will be examined in detail to find the appropriate system for maritime situation in Korea.

Chapter 3

VOLUNTEER SAR ORGANIZATIONS

3.1 The United States

The United States Coast Guard

Before discussion the USCG Auxiliary, it is necessary to discuss the USCG itself, briefly. The USCG as it is known today is very different from its origin. The first iteration was the Revenue Cutter Service in 1790, which was charged with collecting tax and tariffs from maritime businesses. It had nothing to do with saving lives at sea. In 1878, the US Life Saving Service was formed, and it existed independently until 1915, when the “Coast Guard Act of 1915” was enacted by Congress. This act merged the Cutter Revenue Service with the US Life Saving Service into a single US Coast Guard. It was explicitly military, although it had law enforcement duties. Originally it came under the Department of Treasury during peace and Department of Navy during war. In 1967 it was moved to the Department of Transportation, and in 2003 it became the lead agency of the newly-formed Department of Homeland Security, where it remains today.

Although the USCG was obviously formed well before IAMSAR, it is clear from the size and scope of the USCG Addendum, that USCG takes

IAMSAR very seriously, and provides an excellent model for how nations ought to fulfill their responsibilities under the IAMSAR convention.

One way that the USCG fulfills its role as the maritime SAR service in the USA is by supporting an auxiliary organization. After reading this section, it may not be clear who supports whom. The USCG provides funding for the Auxiliary, and in return the Auxiliary provide enough manpower to nearly double the size of the Coast Guard. It is a wonderful case of symbiosis, from which everyone benefits, especially the boating public and shipping industry.

History of the USCG Auxiliary

The USCG Auxiliary was officially established as the United States Coast Guard Reserve by an act of Congress on June 23, 1939, the name was changed to the Auxiliary in 1941, when a Coast Guard Reserve much more like the Naval Reserve, a paid, part-time military force, was erected for the war effort.

Founding the USCG Auxiliary was the culmination of a few years of planning and politicking. The idea of an Auxiliary first came to a screenwriter near Hollywood, Malcolm Stuart Boyle, who was a member of The Pacific Writers' Yacht Club. The Yacht Club happened to be situated near two USCG cutters, AURORA and HERMES. After making acquaintance with one of the ship officers, Boyle wrote in a letter dated August 23, 1934:

> This brings me to the suggestion that a Coast Guard [Auxiliary] would be an excellent thing …to place at the disposal of Coast Guard officers, auxiliary flotillas of small craft for the frequent emergencies incident to your twenty-two prescribed and countless unexpected duties. (USCG Public Information Division 1948)

From this suggestion, five years passed until Representative Schulyer Otis Bland of Virginia introduced legislation. In that bill, the objectives of the USCG Auxiliary were laid out:

> (a) Safety to life at sea and upon the navigable waters, (b) the promotion of efficiency in the operation of motorboats and yachts, (c) a wider knowledge of, and better compliance with, the laws, rules, and regulations governing the operation and navigation of motorboats and yachts, and (d) facilitating certain operations of the Coast Guard (USCG Public Information Division 1948)

The bill also included provisions for funding the newly established Auxiliary by the Coast Guard. These funds were designated to be "available for the payment of actual necessary expenses of operation of any such motorboat or yacht when so utilized [on orders from the USCG], but shall not be available for the payments of personal services, incident to such operation, to other than the personnel of the regular Coast Guard." (USCG Public Information Division 1948) In other words, the USCG was only authorized to pay for actual boat operations and to pay the salaries of regular USCG officers assigned to Auxiliary duties.

Perhaps the most remarkable aspect of the Auxiliary in its early years was how active it was in the war effort. As of June 30, 1942, the USCG Auxiliary had 11,500 members and 9,500 member-owned and operated boats, of which 1,000 regularly served with the Coast Guard. (USCG Public Information Division 1948) The U.S. Navy, which has control of the Coast Guard during times of war, ordered the Auxiliary to guard a stretch of coast in the Atlantic Ocean and Gulf of Mexico; this is the closest to real combat the Auxiliary has ever seen. There was also a shore-based patrol effort to protect the USA from sabotage and infiltration. During this time period, the Auxiliary rescued many sailors and merchant mariners in the aftermath of German U-boat attacks. (Tilley 2002)

Current Status

The most recent version of the federal legal authority regarding the Coast Guard Auxiliary is found in the United States Code, Title 14, Part II, chapter 23, dated 2012. Despite the changes that have occurred in the USCG Auxiliary over the decades, the fundamental purpose of the Auxiliary has remained largely unchanged, even if expressed differently than in the original legislation:

§822. Purpose of the Coast Guard Auxiliary

> The purpose of the Auxiliary is to assist the Coast Guard as authorized by the Commandant, in performing any Coast Guard function, power, duty, role, mission, or operation authorized by law. (United States Code 2012)

The Auxiliary, then, assists the USCG with many missions, including SAR.

Organization

Before moving on to discuss Auxiliary SAR, something must be said about how the Auxiliary is organized. The basic unit of the Auxiliary is the Flotilla. Nearly every mission and mission hour happens at the Flotilla level by ordinary members. Therefore, even though the Flotilla is the lowest level, it is the most important level. It is the level at which nearly everything happens. Flotillas generally have about 15-50 members, depending on the area and activity. A flotilla is led by an elected Flotilla Commander (FC) and Flotilla Vice Commander (VFC). There is also a cadre of appointed Flotilla Staff Officers (FSO) that organizes and manages various programs, such as Operations, Public Affairs, Public Education, etc. Members of flotillas own the vessels, and groups of members work as the boat crew. However many vessels and the kind of vessels a flotilla as depends on how many members own boats, and what kind of boats they own.

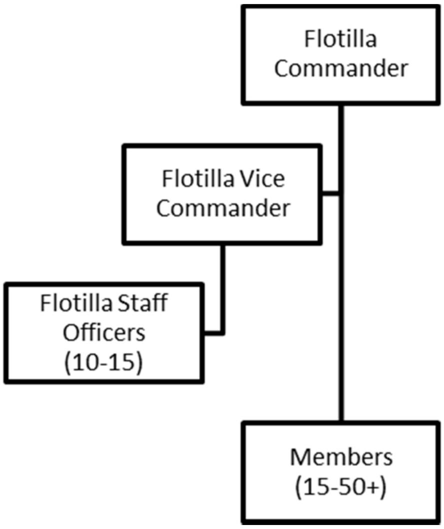

Fig. 3.1: USCG Auxiliary Flotilla Organization Chart

Groups of Flotillas make a Division. These are geographical. For example, Flotillas in the San Diego and surrounding areas will make up a Division. The Division is led by a Division Commander (DCDR) and a Division Vice Commander (VDCDR). The staff functions are performed by Staff Officers (SO) who organize and manage the FSOs of their particular program. This allows a Division to pool resources and lead a concerted effort over a greater area. For example, the SO-MT, is the Division Staff Officer for Member Training. Perhaps members want to study navigation. There may not be enough members of a single flotilla to justify having a course. However, if the SO-MT can arrange for members from various flotillas to join the course, then the number of students justifies the time and effort of having a course. Divisions are roughly, not exactly, equivalent to USCG Sectors.

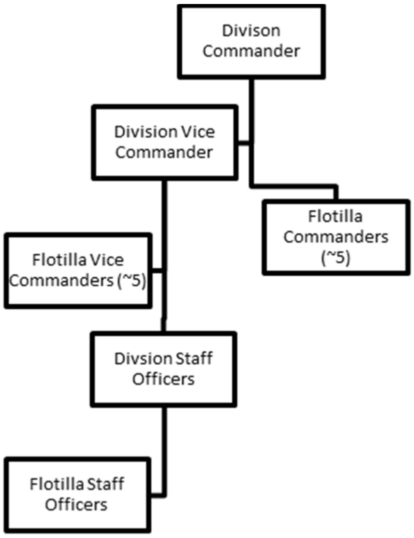

Fig. 3.2: USCG Auxiliary Division Organization Chart

Five or more Divisions make a District. Auxiliary Districts parallel exactly USCG Districts. Every District has an active duty USCG officer designated as the Director of Auxiliary (DIRAUX) who oversees the Auxiliary in the entire District. DIRAUX is assisted by a Warrant Officer or Petty Officer who serves at the Operations Training Officer, and by an enlisted person, usually a Yeoman or Store Keeper who performs the clerical duties. Often Auxiliarists will work in the DIRAUX office to help accomplish District Auxiliary missions by making sure paperwork gets done.

The District is led by the District Commodore (COMO) and he or she is assisted by a Chief of Staff (DCOS) and District Captains (DCAPT). There is also a layer of District Staff Officers (DSO) and Assistant District Staff Officers (ADSO) who run the various Auxiliary programs at the District level.

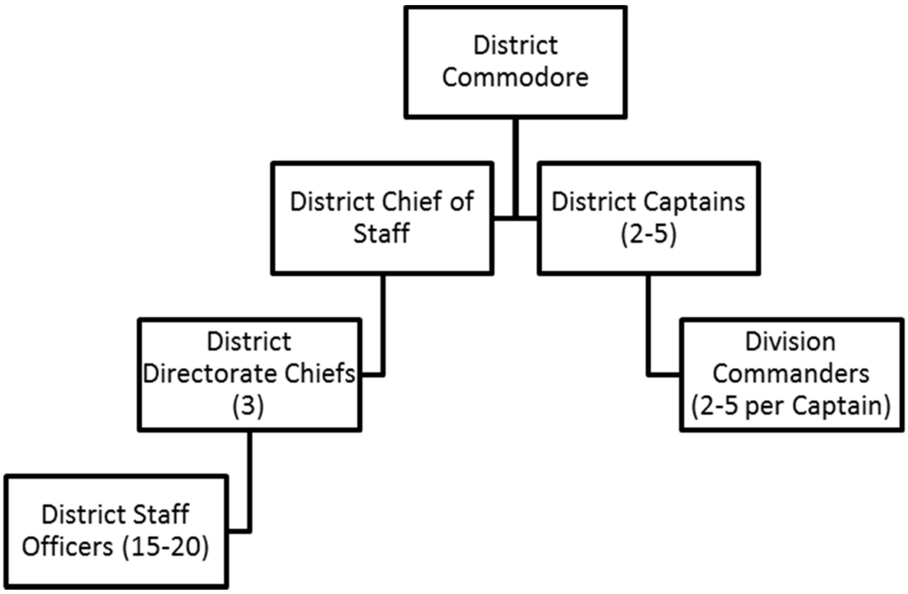

Fig. 3.3: USCG Auxiliary District Organization Chart

Korean readers may be amazed by the size and number of USCG districts, especially considering that Korea Coast Guard has 16 districts which are all much smaller than USCG/USCG Auxiliary districts. Due to the size difference between the two nations, a Korean Coast Guard Region is roughly the size of a USCG sector, while the KCG districts are similar in size to a USCG boat station. However, organizationally, the KCG regions are equal USCG districts, and KCG districts equal to USCG sectors.

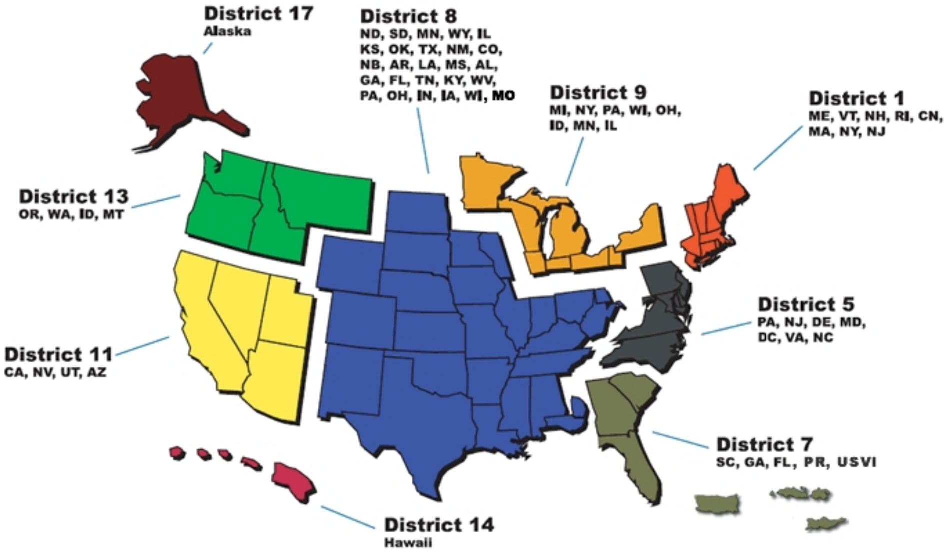

Fig. 3.4: USCG and USCG Auxiliary District Map

Above Districts is the National level. Here policies are decided and passed down. There is a National Commodore who leads the entire Auxiliary and is also the CEO of the Auxiliary Association, the non-profit arm of the Auxiliary. He is assisted by several Deputy and Vice Commodores who are in charge of areas and directorates. Directorates take care of Auxiliary programs on the National level, and they are reported to by the DSOs, who are in turn reported to by the SOs, who are in turn reported to by the FSOs. The FSOs administer programs at the local level. They have little say in policy, but are instead responsible for making policy reality through active programs at the local level.

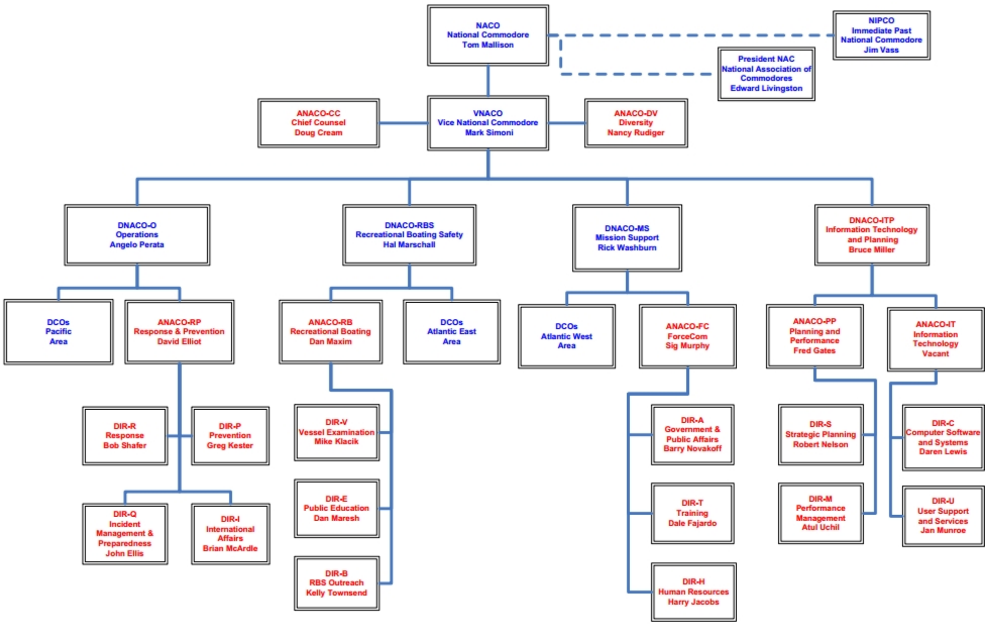

Fig. 3.5: USCG Auxiliary National Organization Chart

On the active duty USCG side, there is a Chief Director of the Auxiliary (CHIDIRAUX) stationed within the USCG Boating Safety Division. He has overall authority over all DIRAUXs and the Auxiliary as a whole. This is shown in Fig.2.6.

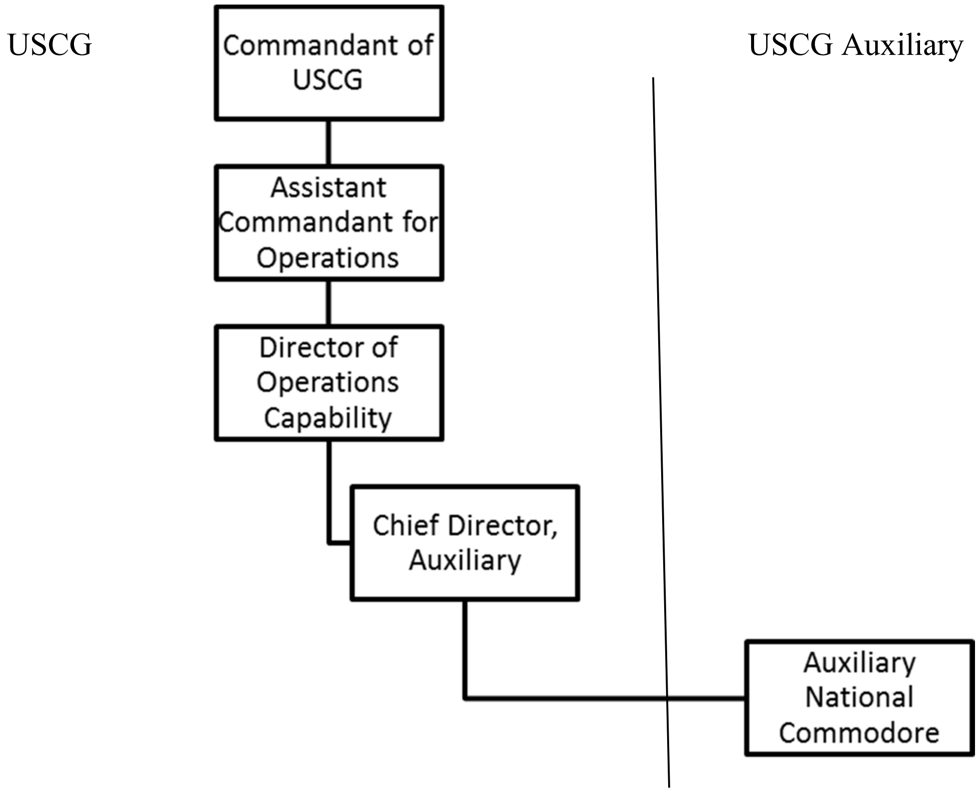

Fig. 3.6: Where the Auxiliary fits in the USCG Chain of Command

Auxiliary SAR

The basis for Auxiliary participation is summarized in the Auxiliary Manual (AUXMAN):

> Qualified Auxiliarists and their facilities may be authorized assignment to duty to assist with and conduct search and rescue operations in support of the Coast Guard. These duties include search planning, communications support, and search and rescue operations in navigable and sole State waters. (U.S. Coast Guard 2011)

Let us first look at what makes a vessel a qualified facility. The Auxiliary rarely owns its own vessels, and when it does, that vessel is owned by a flotilla or division. Instead, individual members own the vessels and they submit their vessel to inspection to make it an official facility when assigned orders. This means buying and maintaining the equipment proper to a SAR vessel: VHF maritime radio, signs, flags, several different lines, life buoys and other floatation devices, visual distress signals, life jackets, etc.

When under orders, a member-owned vessel becomes a US government facility:

> Auxiliarists may offer custody and control of facilities to the Coast Guard. Under 14 U.S.C. § 827-829, a facility offered for control and transferred to the Coast Guard is a public vessel of the United States and a vessel or aircraft of the Coast Guard, or a government and Coast Guard radio station, as applicable, from the time placed in Coast Guard service until released to the owner(s) or the owner's agent. (U.S. Coast Guard 2005)

This paragraph offers the Auxiliarist great protection. His vessel, being for the time a US government facility, relieves the owner of financial, insurance, and legal liabilities. The USCG reimburses vessel owners for the use of the vessel. That is, the USCG pays for the fuel used and pays a pro-rated fee for vessel maintenance. The USCG also insures the vessels while under orders. Also, the owner cannot be sued in civil courts for anything that happens on or related to his vessel while under orders. This is one of the most important features to remember about the Auxiliary: The USCG does not pay members for their time, but it does pay for member-owned facilities when under orders. The *Auxiliary Operations Policy Manual* discusses all of these issues and many others in great detail.

SAR Training

Not only must vessels be qualified for use in SAR missions, but the members must be qualified to participate. What makes a member qualified is the rather extensive training he undergoes. The first step is to become a qualified member of a boat crew. The member does this by engaging in written coursework and “on-the-job” training tasks under the supervision of a mentor. Upon satisfactory completion of the boat crew training, the member is tested by a Qualified Examiner (QE). The test is an actual operational training exercise, during which the member must prove his proficiency on board the Auxiliary vessel. If the member’s on-board performance satisfies the QE, once back to the dock, the QE will give an oral exam to the member to ensure that he understands both the practice and theory of working in a boat crew.

If the member prefers not to work on a boat, but rather work on shore in communications support, he will take the Auxiliary Communications Specialty course (AUXCOM), and pass through a series of tasks in a Performance Qualification System (PQS). Upon completion of the

AUXCOM course and Communications PQS, the Auxiliarist becomes a qualified radio watchstander. A radio watchstander may work with his local Auxiliary unit, or he may even be assigned to an active duty Coast Guard station to assist the paid staff. In these two ways can a member become a qualified participant in SAR operations as a simple boat crew member or radio watchstander.

To become a real SAR expert, however, requires more work. Having become a boat crew qualified member, the next step is to study the Advanced Coastal Navigation Course (AUXNAV). AUXNAV is a university level coastal navigation course. A member can do self-study, study under a mentor, or take a classroom course that is occasionally sponsored by his flotilla or division. There is a large and difficult final exam and the member must score at least 75% to pass. Upon passing the written test, there is then a practical test during which the member must prove his proficiency using a chart. This test includes course planning, plotting courses, etc. After successfully passing the AUXNAV course, a member may then register for a coveted slot to the Auxiliary Search Coordination and Execution Course (AUXSC&E). AUXSC&E is a very new course that replaces the out of date Auxiliary Search and Rescue Specialist course (AUXSAR). AUXSAR had become obsolete because of advances in technology. For example, in AUXSAR, students still had to calculate a datum using a tide and current table, and do all calculations by hand. That is a great exercise to help Auxiliarists understand the datum, but the real-world situation is such that an Auxiliarist will never need to calculate a datum. The datum will be given to him by the Rescue Coordination Center. The Auxiliarist's job is really just to get to the datum safely and start performing the search in coordination with the USCG or other agencies involved.

The AUXSC&E course can be offered in two venues: at a C-school or locally through the flotilla or division. A C-school is a secondary specialty school of the USCG.[4] Auxiliarists are given orders by USCG to attend a C-school, and the USCG pays for travel and per diem, which defrays the cost of hotel rooms and meals. For an Auxiliarist, being accepted to and attending a C-school is a great honor, and the new AUXSC&E is a very difficult C-School to get into. Once very interesting feature of the AUXSC&E C-school is the "Train The Trainer" (TTT) portion. The idea is that an Auxiliarist who studies AUXSC&E must also be taught how to teach it. That way, the new SAR doctrine taught in the AUXSC&E course can be spread. Graduates of the AUXSC&E (TTT) C-school are expected to go back to his local flotilla or division and teach AUXSC&E to other members who cannot attend the C-

[4]An A-school is the primary specialty school, such as boatswain's mate school or damage control specialist school, and can last several weeks to several months. A C-school is a week-long course that is added onto a seaman's rating. However, for the Auxiliary, a C-school is an advanced specialty school.

school. Since most members cannot attend C-schools, this is vitally important to spread the new USCG SAR theory and practice to local units.

Mission Orders

There are two types of orders: vessel and individual. The first assigns an Auxiliary facility to a mission; the second assigns individual members to a mission. These orders are requested and given through the AUXDATA Order Management System (AOM), an on-line order-issuing website. (U.S. Coast Guard 2013) .Generally, all orders must be issued through AOM; only in rare instances (such as national emergencies) may orders be verbal. (U.S. Coast Guard 2011)

It is this author’s impression that orders are not based on historic or statistical data, but rather on “gut feelings” that patrols are necessary. Thus patrols happen mostly on weekends, with holiday weekends enjoying more patrols than ordinary weekends. It’s a logical inference. Most recreational boaters boat on weekends, and on holiday weekends many more people boat than usual. When this author asked the USCG Recreational Boating Safety Office, the parent organization of the Auxiliary, if USCG assigns duty to the Auxiliary based on data or based on assumptions, the request for information was ignored.

Mission Reports

All mission activity is reported on a form known colloquially as the 7030 form, the "Activity Report - Mission (9-10) Rev008". Members record the mission type and hours devoted to that mission on this form. The form is then sent to an Information Services officer who enters the information into the Auxiliary's main database, AUXDATA. Members can access the information later by using a cumbersome web interface known as AUXINFO.

SAR Mission Statistics

The way the Auxiliary collects and stores data in AUXDATA makes it very difficult to discern when Auxiliary vessels are assigned a SAR mission by plan, and which Auxiliary vessels participate in SAR missions while already on patrol. As all the data is aggregated at the national level, a researcher would have to contact individual vessel coxswains and ask for their records in order to sort out who was assigned to what mission, and at what point that patrol mission became a SAR mission, and then at what point the SAR mission ceased, and the regularly scheduled patrol resumed. Not even the USCG has the capability to get that kind of detailed data—the details are lost at the local level. Instead, we can only examine the aggregated number of hours spent performing SAR operations, the number of lives saved or assisted[5], and the dollar value of property saved.

USCG Auxiliary Budget

The USCG spends $17.4 million USD per year on the Auxiliary. That is 0.24% of the annual USCG budget. (Barner 2012, 3) Much of this budget does not go directly toward SAR operations, but toward the salaries and benefits of USCG staff assigned to Auxiliary administration. However, due to the recording, reporting, and storing of this information, disaggregating the Auxiliary budget to discover what moneys go solely to SAR is not possible. So, we must take that budget as a whole, and consider the USCG Auxiliary as a whole, rather than disaggregating personnel and mission hours to exclude everything other than SAR. Conceptually, it’s possible to separate SAR from the rest of the Auxiliary activities, however, it should be understood that even missions such as Public Education assist the USCG to save lives, because Public Education classes are considered *preventative SAR missions* rather than *responsive SAR missions.* Thus, in the Auxiliary mind, SAR missions include missions other than those that are strictly recorded as SAR.

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[5]Lives saved are those in which the person was in immediate and grave danger; like a MAYDAY situation. Lives assisted are those in which the person was in danger, but that danger was not immediate or not grave; like a PAN-PAN situation.

There are approximately 31,000 Auxiliarists, and in 2012, they donated 4,643,890 hours.[6] Fig. 3.7 is a screen capture of the AUXINFO database interface showing the number of hours donated by members in 2012, broken into general mission categories.

Mission Hours as values	United States Coast Guard	All Units
ATON - Aids To Navigation (30,31,32)	4,477.75	4,477.75
AUXADMN - Aux Administrative Support (99)	0.00	0.00
AUXMP - Marine Patrols (01a,01b,02,03,22a,54a,55a)	407,883.90	407,883.90
CGADMN - Cg Administrative Support (08,92)	79,784.71	79,784.71
CGOPS - Cg Operational Support (07,20,22,26)	221,066.19	221,066.19
CVS - Commercial Vessel Safety	0.00	0.00
ELT - In Support Of Enforcement Of Laws And Treaties (27)	0.00	0.00
GOVSUP - Government Agency Support (41,42,43)	7,051.99	7,051.99
HS - Health Services	1,632.65	1,632.65
IA - International Affairs	8,428.08	8,428.08
ICE - Ice Operations Mission (53)	1,314.10	1,314.10
LO - Legislative Outreach	1,566.90	1,566.90
MEP - Marine Environmental Protection (28)	8,326.85	8,326.85
MS - Marine Safety	93,978.33	93,978.33
MT - (06) Member Training	124,028.64	124,028.64
No Mission Listed	23.00	23.00
OR - Operational Research	0.00	0.00
RBS - (99) Recreational Boating Safety	3,163,307.30	3,163,307.30
RN - Auxiliary Radio Net (29)	0.00	0.00
SAR - Search And Rescue (23,24)	60,958.30	60,958.30
UMDV - (11) Marine Dealer Visits	65,626.91	65,626.91
UPA - Public Affairs (10)	172,626.61	172,626.61
UPE - Public Education (04)	105,789.66	105,789.66
UREC - Recruiting Assistance (09,90)	17,499.34	17,499.34
VSC - (91) Vessel Safety Check	98,519.04	98,519.04
All Missions	**4,643,890.25**	**4,643,890.25**

Fig. 3.7: Member hours (2012) as recorded in AUXDATA

[6]Throughout this section, all figures for USCG Auxiliary activities and hours are taken from the AUXINFO interface of the AUXDATA database, as accessed on January 9, 2014, unless otherwise cited from another source.

Of those hours, AUXINFO reports that only 60,958.3 of the 4.8 million hours were dedicated solely to SAR response missions. (USCG Auxiliary 2012) As discussed above, it is an impossible task to disaggregate all of the hours donated by Auxiliary members in order to discern what money is strictly spent or saved by SAR response missions alone. However, this SAR mission-hours number is important because it is one of the few performance measures we have. Remarkably, the Auxiliary does not record SAR response time, only the amount of time spent on SAR cases. The Auxiliary also does not record where SAR incidents happen by latitude and longitude, but only by the district, division, and flotilla location, not by the location of the SAR incident.

Mission Hours as values	District 11	District 13	District 14	District 17	PACAREA
CALL OUT - Sar - Call Out (25)	0.00	0.00	0.00	0.00	**0.00**
OPS - (24) Sar Prosecution	2,410.90	725.30	45.10	123.10	**3,304.40**
SAR - (24) Sar Prosecution	371.90	40.50	56.90	3.20	**472.50**
STANDBY - (23a) Standby Bravo Status	15,694.90	2,843.50	347.40	77.80	**18,963.60**
SAR - Search And Rescue (23,24)	**18,477.70**	**3,609.30**	**449.40**	**204.10**	**22,740.50**

Fig. 3.8: SAR Mission in Pacific Area, by District, as recorded in AUXDATA

Notice, too, that in 2012 there were 0 SAR call-outs, meaning that the vessels were already on patrol; they did not come from a shore base specifically to do a SAR mission. The other remarkable number is that the vessels were usually in Stand-by (BRAVO) status, not actively performing a SAR mission. And, oddly, there is no explanation of how OPS-(24) Sar Prosecution is different from SAR-(24) Sar Prosecution. From this we can see that the Auxiliary has definite data collection and storage problems.

In 2012, USCG Auxiliary saved 155 lives. This was the fewest number of lives saved in years. In addition to the 155 lives saved in 2012, the USCG Auxiliary assisted over 4,000 persons, and saved over $31 million worth of personal property (also a down year for the USCG Auxiliary). Even if we cannot single out the portion of the budget dedicated solely to SAR response, and we cannot distinguish exactly the hours dedicated solely to SAR response, in terms of lives saved, assisted, and the dollar amount of property saved, the USCG is justified in spending the nearly $18 million annually to support the Auxiliary.

Model Maritime Auxiliary Guide

The final topic necessary in this lengthy background about the USCG Auxiliary is a publication produced by the International Affairs Department, the *U.S. Coast Guard Model Maritime Auxiliary Guide* (MMAG). The MMAG is a brief guide to help nations allied with the USA to form their own maritime Auxiliaries. In this guide is a vague method for assessing the needs of an Auxiliary, how to support the Auxiliary (government, private donations, or a mix), how to get started and organize, etc. In brief, a Coast Guard is supposed to assess their future needs and compare those to their current capabilities. Then the Coast Guard is supposed to establish its desired state—what capabilities it wants to have. Then the Coast Guard determines the gap between the current state and the desired state, in regard to equipment, personnel, and training. The assumption being that a maritime auxiliary can help a Coast Guard to fill the gap in their capabilities. (U.S. Coast Guard 2006)

Section Summary

This section has barely scratched the surface of the USCG Auxiliary, its resources, capabilities, organization, etc. It should be clear to the reader that the Auxiliary is a massive organization that is very well-organized and capable of augmenting the U.S. Coast Guard as a force multiplier. The most important point to remember is that the Auxiliary is wholly sponsored by the USCG, which reimburses members for use of their vessels.

3.2 The United Kingdom

Introduction

The Royal National Lifeboat Institution (RNLI) is the world's oldest civilian volunteer lifesaving service. It is also the largest and best-funded. Since its founding in 1824, it has saved over 140,000 lives, with the largest single lifesaving operation being in 1907, when two lifeboats, the Lizard and Porthleven, stationed out of Cadgwith, rescued 456 people from the Suevic, a passenger liner. (RNLI n.d.)

Founding and History

The actual founding of the RNLI was predated by various independent and local lifesaving services or rescue boats as early as 1776. Lionel Lukin designed and patented the first purpose-built lifeboat, an unsinkable coble (a type of open fishing boat) in 1785. In 1789 William Would have designed a boat that could right itself. Shortly thereafter, Henry Greathead designed and built a purpose-built lifeboat, the Original, which was both unsinkable and self-righting. At least 30 more of these boats were built and used by local lifesaving services around the UK.

The local nature of lifesaving services changed in 1824. Sir William Hillary was well-known for raising the largest private army that helped King

George III fight in the Napoleonic Wars, for which he was rewarded with a Baronet, a hereditary non-peerage title. Upon retiring to the Isle of Man, a self-governing British Crown Dependency in the Irish Sea, he witnessed first-hand the violence of the sea and the destruction and death the sea caused to ships and to mariners. He even participated in rescue missions himself. Recognizing that effective search and rescue was a task more than a single man or even a small group of men could handle, he appealed to the Admiralty, and even to the King, for help starting a lifesaving service composed of highly-trained CVSO. In *An appeal to the British Nation, on the humanity and policy of forming a national institution, for the preservation of lives and property from shipwreck*, Sir William Hillary called for a meeting of wealthy and powerful patrons:

> To the consideration of such meetings, I must respectfully beg leave to submit:
>
> That a national institution should be formed, equally worthy of Great Britain, important to humanity, and beneficial to the naval and commercial interests of the United Empire; having for its objects,
>
> First, The preservation of human life from shipwreck; which should always be considered as the first great and permanent object of the Institution,
>
> Secondly, Assistance to vessels in distress, which immediately connects itself with the safety of the crews.
>
> Thirdly, The preservation of vessels and property, when not so immediately connected with the lives of the people, or after the crews and passengers shall already have been rescued.

> Fourthly, The prevention of plunder and depredations in case of shipwreck.
>
> Fifthly, The succour and support of those persons who may be rescued; the promptly obtaining of medical aid, food, clothing, and shelter for those whose destitute situation may require such relief, with the means to forward them to their homes, friends, or countries. The people and vessels of every nation, whether in peace or in war, to be equally objects of this Institution; and the efforts to be made, and the recompenses to be given for their rescue, to be in all cases the same as for British subjects and British vessels.
>
> Sixthly, The bestowing of suitable rewards on those who rescue the lives of others from shipwreck, or who assist vessels in distress; and the supplying of relief to the destitute widows or families of the brave men who unhappily may lose their lives in such meritorious attempts. (Hillary 1825)

Although at first he received little monetary support from the British Government, his passionate and well-reasoned plea to the aristocrats and gentlemen of his day ultimately led to the successful founding of his proposed lifesaving service. The two most prominent figures to support his new institution were Thomas Wilson, an MP from London, and the Chairman of the West India Merchants, George Hibbert. The National Institution for the Preservation of Life from Shipwreck was registered as a charity on March 4, 1824, and the name was changed to the RNLI in 1854.

Before moving on to a description of the current RNLI, it is worth considering these six points that Hillary raises as precursors to the underlying philosophy of the SOLAS convention and the IAMSAR Manual.

Especially important is the fifth point, in which there shall be no distinction between British subject and alien, whether in peace or war. This universal recognition of mariners' humanity and dignity still informs and legally binds rescue crews today.

Current Status

The *RNLI Annual Report and Accounts 2012*details the founding and on-going legal status of the RNLI very succinctly:

> The Royal National Lifeboat Institution (RNLI) was founded in 1824, and incorporated under Royal Charter in 1860, with Supplemental Charters granted in 1932, 1986, 2002 and 2011.The RNLI is established as a charity in England and Wales, number 209603 and Scotland, number SC037736. It is registered as Charity number CHY 2678 in the Republic of Ireland. (RNLI 2013)

Registry as a charity is extremely important to RNLI's legal status. Without being a registered charity, it would be impossible to raise the funds to fulfill its lifesaving mission. As the UK Charity Commission website states:

> All charities benefit from a number of financial advantages, including exemptions from:
>
> - income or corporation tax on some types of income
> - capital gains tax
> - stamp duty
> - inheritance tax on gifts made in wills

> Additionally, charities pay no more than 20% of normal business rates on occupied buildings and can get special VAT treatment in some circumstances. (Charity Commission 2014)

One can readily see how beneficial Registered Charity status is to fundraising efforts due to the extremely generous tax breaks.

Organization

The RNLI is a vastly different organization than the USCG Auxiliary. The first aspect that is greatly different is the source of funding and RNLI's relationship to the UK Maritime & Coast Guard Agency (MCA). The RNLI is 100% supported by private charity. It receives no money or subsidy from MCA, nor from any method that may allow funds to trickle down from Parliament. Therefore, RNLI has paid staff that performs a great deal of marketing and fundraising duties. For every Pound the RNLI raises, 83 pence is dedicated to lifesaving, while only 17 pence goes toward further fundraising. (RNLI 2014) Not only does RNLI not get money from the MCA, but it does most of the lifesaving work that people would generally associate with a Coast Guard. That is to say, the MCA does very little SAR work in comparison to RNLI. In most cases, RNLI does the SAR operation, while MCA coordinates from an RCC.

The RNLI is not as hierarchical as the USCG Auxiliary. Whereas the Auxiliary website has many organization charts available, this author could not find an organization chart on the RNLI website. Lifeboat stations are organized under a divisional base, but the operational organization appears to be much narrower and shorter than the Auxiliary. There are 236 lifeboat stations, and RNLI continues to add more every year. They are more or less independent entities. However, all lifeboat stations must live up to the same high standards as demanded by RNLI policy.

> RNLI has a Trustee Board, made of very prominent members of British society. They are appointed by the Council, which is a larger group of prominent people, including His Royal Highness, the Duke of Kent. On a daily basis, the CEO and his staff carry out the business functions of the RNLI and work to achieve the strategic goals set by the Trustee Board. (RNLI 2013)

RNLI SAR Lifeboat Fleet

Another example of the extreme difference between the Auxiliary and RNLI is that the RNLI designs, builds, and owns its own lifeboats. Thus, whereas the Auxiliary has a mish-mash of privately owned vessels that become government facilities, the RNLI has dedicated special purpose lifeboats. It is worth taking some time to examine the RNLI lifeboat fleet. RNLI own 340 lifeboats, ranging from 3.8 to 17 meters LOA. There are three types of vessels: All-Weather Lifeboats, Inshore Lifeboats, and hovercraft.

> All-weather lifeboats (ALBs) are capable of high speed and can be operated safely in all weather. They are inherently self-

> righting after a capsize and fitted with navigation, location and communication equipment.
>
> Inshore lifeboats (ILBs) usually operate closer to shore than ALBs, in shallower water, close to cliffs, among rocks or even in caves.
>
> Hovercraft can operate in areas such as mud flats or river estuaries that are inaccessible to conventional lifeboats. (RNLI n.d.)

These boats are designed and built by a wholly-owned company called SAR Composites. Formerly, the lifeboats were manufactured by Green Marine, but when it ran into financial difficulties in 2009, RNLI acquired it to ensure that RNLI could continue to receive a stream of updated lifeboats. (RNLI n.d.) RNLI also owns its own repair facilities. All of this allows RNLI to maintain a standard fleet; the boats carry standard lifesaving kits, and crews trained to a very high standard.

The boats are kept either in berth or in a readily deployed dry storage system such as derricks at 263 lifeboat stations throughout the UK and Republic of Ireland. Fig. 3.9 on the next page is a map of RNLI facilities and lifeboats. The number(s) in square brackets ([-]) indicates the type of lifeboat(s) at the station.

Fig. 3.9: RNLI Lifeboat Stations Map

SAR Training

All lifeboat crew members undergo a 12-month probationary period during which they do “on-the-job” training at their local lifeboat station and working through a crew member development plan—a syllabus of designated tasks to learn in order to familiarize the member with the RNLI, lifeboat station, roles and responsibilities, etc. After six months, the member becomes eligible to attend the RNLI training college in Poole.

In many ways this is similar to the Auxiliary’s method of doing on-the-job training with a PQS to guide Auxiliarists. It is quite different in that for an Auxiliarist, attending a residential C-school is a rare honor, for RNLI members, attending the RNLI College is mandatory.

The RNLI College offers 40 courses, not all of which are SAR courses. The following is a list of courses offered for All-Weather Lifeboat volunteers. Not all of them take place at the college; some are done at the lifeboat station, some at the college, some by Mobile Training Units, and even some coursework is available on-line.[7]

The all-weather lifeboat course portfolio includes:

- Crew
- Navigator

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[7]The author did not have access to the on-line training to examine the courses available and the content, because it is available only to members.

- Search and Rescue Navigation
- Coxswain
- Trainee Coxswain
- Yachtmaster Offshore or Yachtmaster Coastal Examination
- SAR radio operators certificate (modules 1 and 2)
- Long Range Certificate
- Radar and Electronic Navigation Aids
- Search and Rescue Navigation
- Search and Rescue Command
- Search and Rescue Unit Handling
- Management, Command and Communication (RNLI n.d.)

Without having access to the RNLI resources, it is difficult to compare the RNLI courses to USCG Auxiliary courses. However, on the surface RNLI appears to have more advanced training than the Auxiliary. And the fact that all 4,000 lifeboat crew members enjoy such advanced training and annual re-training seems to be a distinct advantage over the Auxiliary's training system.

The author could not find an annual budget for operating the RNLI College. The costs appear to be bundled under a more inclusive budget line item. However Lloyd's Register Foundation has pledged or given £1.5 million over the five year period 2011-2015. (RNLI n.d.)

Mission Orders

RNLI members do not receive orders in the same way that Auxiliarists do. Rather, members have a pager, and when there is an incident in their Area of Responsibility (AOR) the member responds to the page and goes immediately to the lifeboat station. That is to say, RNLI SAR operates on 100% SAR call-out.

Mission Reports

The author is not a member of the RNLI, and thus had no access to the forms that RNLI crews use to report their activities, and a request to RNLI was ignored. However, it may be safely assumed that such reports do exist, because RNLI keeps extensive SAR statistical data, as evidenced by their highly detailed *Operational Statistics* report that is published annually.

SAR Mission Statistics

RNLI's performance goals are to launch within 10 minutes of notification and to reach 90% of all casualties within 10 nautical miles of the coast in 30 minutes or less. In 2012, the RNLI met the 10-minutes launch goal, and reached 92.1% of casualties in 30 minutes or less. (RNLI 2013) In 2012, RNLI launched 8,346 times, rescuing 7,964 persons, of which 328 were lives saved. That is nearly 22 people per day. 2012 was RNLI's sixth's busiest year, with 2009 being the busiest with 9,223 launches. (RNLI 2013) These figures do not include the lifeguards stationed at beaches, but strictly SAR vessels.

RNLI Budget

It costs approximately £385,000 per day to keep the RNLI going, which works out to £140,525,000 annually. (RNLI n.d.) In US dollars that is approximately $224,840,000.[8] All of this money is raised from private donors; RNLI is not supported by the government in the way the USCG Auxiliary is.

The RNLI spends 17 pence per Pound (p/£) on fundraising. (RNLI 2014)This is slightly above the British average of 12p. However, most British people think the figure is 42p/£. (Rowley 2011) The British Red Cross spends 19.8p/£ on fundraising. (Red Cross 2014)

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[8]Exchange rate calculated as £1 = $1.60, based on a survey of exchange rates throughout 2012.

The RNLI publishes an *Annual Report and Accounts*, as required by the UK Charities Commission, which details how it spends its money. Whereas it is nearly impossible to find details about how the USCG spends its Auxiliary budget, with RNLI, there appear to be no secrets at all. In 2012, Lifeboat and Lifeboat property and equipment accounted for 24% and 44%, respectively, of revenue expenditures. Lifeboat stations and Lifeboats and launching equipment accounted for 39% and 44%, respectively, of capital expenditures. It is clear that RNLI uses the vast majority of its funds directly supporting SAR missions.

Section Summary

RNLI is a venerable institution with a highly skilled volunteer workforce. They are fiscally conservative and put most of their funds toward their primary mission: SAR. Their resources are extensive, and their lifeboat fleet and training are truly world-class.

3.3 Comparison of USCG Auxiliary and RNLI

There are two primary models for volunteer SAR services: the USCG Auxiliary and the UK's RNLI. In this final section of Chapter 2, it seems appropriate to directly compare and contrast the two organizations for the benefit of Koreans who may want to know which organization should emulate.

Scope of mission(s)

The USCG Auxiliary is truly multi-mission. In addition to SAR, it performs recreational vessel inspections, teaches boating safety classes, assists the USCG with Maritime Environment Safety missions, verifies Aids to Navigation, performs marine patrols (especially in areas that are underserved by the USCG) and several other missions. It is a real force multiplier for USCG.

The RNLI is much more single-minded. It performs SAR missions and lifeguard duties.

Advantage: *Auxiliary.* It depends on what the Koreans want. If they want a multi-mission force multiplier, then the Auxiliary is the better model. If Koreans want to focus purely on SAR, then the RNLI is the better model. The drawback of the Auxiliary is that it is a *jack of all trades, master of none*. The drawback of the RNLI is that it is very narrow focus. This greatly affects member opportunities for participation. More missions mean a broader scope of participation. But it also means that the organization gets distracted away from the core SAR mission. However, in the final analysis, the question is: Which organization is more effective for a modern multi-mission Coast

Guard? And the answer is clearly the USCG Auxiliary, because it has the scope of mission and resources to grow and change as the USCG grows and changes.

Budget

In 2012 the Auxiliary had a budget of nearly $18 million, a figure that has not increased since 2009. This was entirely provided by the USCG. In the same year, RNLI had a budget of nearly $225 million. These funds were provided by private donors and established endowments from past donors.

Advantage: *RNLI.* Both organizations have advantages and disadvantages to their method of funding and budgeting. The advantage the Auxiliary has is that its budget is more or less automatic. It knows that it has $18 million, and members' fuel costs will be covered. The disadvantage is that if the U.S. government has financial troubles, it freezes budgets. This happened in 2013 under the famous sequestration by the Obama Administration. The RNLI has the difficult task of raising funds from private donors; however, the budget is so large that it gives the RNLI many more opportunities to provide members world-class training and state of the art boats and equipment.

Organization

The Auxiliary has an organization that mimics the USCG, which is appropriate for its multi-mission character. There are two types of officers, elected and appointed, who work together to complete program and organizational goals. This organization begins at the local level, moves up to the division, district, and finally national levels.

The RNLI appears to have just three levels: lifeboat station, divisions, and national. There does not appear to be the same emphasis on hierarchy (or "chain of leadership and management") that the Auxiliary has.

Advantage: *Neutral.* If Koreans opt for a multi-mission volunteer organization, then the more complex Auxiliary organization model will be necessary. If the Koreans opt for a single-mission SAR organization, then the RNLI-style organization will suffice. Having said that, even if the Koreans opt for a multi-mission organization, it should not need all four layers (Flotilla, Division, District, and National) of organization that the Auxiliary has, but rather the three levels the RNLI has. The number of layers is really a function of geography. The USA needs a fourth layer because it is so much larger than the UK or Korea. The UK and Korea are relatively close in size, and so it makes sense that they will have a similar number of layers.

Bureaucracy

The Auxiliary has a very complex bureaucracy, and members need to constantly fill out reports and forms. These reports are consolidated and entered into AUXDATA and those figures are used by USCG to show the U.S. Congress the value the Auxiliary brings to the USCG so that the Commandant can maintain the Auxiliary budget. These forms are ready available on-line for the public to see. Of the Auxiliary's 4.6 million hours in 2012, nearly 3.2 million of those hours were coded "99" a catchall category for internal paperwork such as filling out forms, attending meetings, traveling to meetings, making Auxiliary-related phone calls and e-mails, etc. That is to say that almost 70% of all hours volunteered are dedicated to the bureaucracy of keeping the organization going.

The RNLI does not have its reports or forms available on line. However, judging from the information shown in the *RNLI Operational Statistics 2012* publication on the RNLI website, it seems that they collect less data, and collect their data in a more efficient way than the Auxiliary. Advantage: *RNLI*. The fact that 70% of all Auxiliary hours are dedicated to bureaucratic duties is a clear indication that the Auxiliary is a bureaucratic nightmare. While the RNLI surely has its own bureaucracy that can sometimes seem bothersome to members—and, frankly, what organization doesn't?—its bureaucratic requirements pale in comparison to the Auxiliary.

Training

The USCG has many tried-and-true training manuals for its various missions, and is continually developing sophisticated PQSs to ensure that members are all trained to the same standard; a standard which is USCG-approved. Often, the training is the same as given to active duty USCG personnel. There is also an extensive selection of courses and tests on-line. The Auxiliary has the ability to train the local, regional, and even national level; however, national level training is difficult to get into. In 2013, all C-schools were cancelled due to the Obama administration's sequestration of funds; effectively eliminating national-level training.

The RNLI also has on-line training and a 12-month apprenticeship training period capped off by coursework at the RNLI College in Poole. Advantage: *RNLI*. Despite the Auxiliary having excellent manuals, PQSs, on-line resources and C-schools, the RNLI has all that plus a training college with state of the art facilities. The college is really the distinguishing feature of the RNLI's training superiority over the USCG Auxiliary. Also, whereas the USCG often eliminates funding for C-schools, RNLI abundantly funds its college.

Equipment

The Auxiliary has member owned boats with mandated safety equipment. The RNLI has custom-made lifeboats with standard safety equipment.

Advantage: *RNLI*. It seems like an advantage for members to own their own boats and have them transferred to the government while under orders; and it is beneficial for those boat owners. However, despite the standard equipment necessary to become a facility, the Auxiliary fleet is a mish-mash of everything from kayaks to trawlers to RHIBs to bass boats, sailboats, and cuddy cruisers. There is no "average" boat. It is pure chaos. The RNLI, on the other hand, has beautiful state-of-the-art All Weather Lifeboats that are self-righting, have a 250 NM range, and all the latest electronic navigation equipment and SAR equipment. In this case, the RNLI is vastly superior to the Auxiliary. Indeed, the RNLI's AWL fleet rivals the USCG's small boat fleet.

International Partnerships and Programs

Both organizations have programs dedicated to helping foreign volunteer SAR organizations. The Auxiliary has, as previously mentioned, a guidebook to help interested nations set up their own volunteer SAR groups. There is also an International Affairs directorate that is dedicated to promoting friendship between the Auxiliary and international SAR organizations. The drawback is that the State Department is also involved in International Affairs, adding to the bureaucracy and time it takes to complete projects. If a nation can endure the time and paperwork, the Auxiliary can offer help for free, but that help is limited to advising and consulting.

RNLI also has an international cooperation branch, but it charges a fee for its consulting services. In fact the RNLI has already done work in Korea, consulting with the Lifesaving Society Korea to do a coastal risk assessment. (RNLI n.d.)

Advantage: *Neutral.* The USCG Auxiliary cannot do anything on its own. It must involve the U.S. State Department. This is not only time consuming, but also saps the Auxiliary of its ability to deal easily and directly with a foreign association. However, all help will then be free. The USCG Auxiliary may not charge any fees to help a nation with its CVSO. It may be quicker and easier just to enlist the help of the RNLI, who is free to engage with foreign SAR organizations without interference from the UK's Foreign Office. But the consulting fees charged by RNLI could be cost-prohibitive.

Lives Saved/Rescued

This is where one can really see a difference in performance. In 2012, the Auxiliary reports 155 lives saved and 4,198 lives assisted (rescued)

(USCG Auxiliary 2012). In the same year, RNLI had 328 lives saved and 7,636 people rescued. (RNLI 2013) These figures do not include the lives saved and people rescued by the RNLI lifeguards.

Advantage: *RNLI*. They have more than twice the number of lives saved, and nearly double the people rescued as the Auxiliary.

Comparison Summary

While the USCG Auxiliary has many admirable characteristics, especially its support and sponsorship by the USCG, the RNLI seems to be the much better SAR organization overall. A Korean civilian SAR organization would do well to emulate the RNLI, however, it may be worth following the Auxiliary model in order to get the organization off the ground and active, and then gradually phase out the assistance from KCG and phase in self-sufficiency to become like the RNLI.

Table 3.1: Auxiliary vs RNLI comparison

Organization Characteristic	Auxiliary	RNLI	Neutral
Scope of Mission	○		
Budget		○	
Organization			○
Bureaucracy		○	
Training		○	
Equipment		○	
International Cooperation			○
Lives Saved/Rescued		○	

The primary barrier to entry for a Korean civilian SAR organization is money. RNLI has had over 200 years to build up capital and endowments in order to have the wonderful fleet and lifeboat stations it has. Korea could not reproduce this quickly. It is much too expensive of an endeavor. On the other hand, the USCG auxiliary has existed for 75 years. It began with private boat owners and continues to be successful with private boat owners. Therefore the more reasonable course of action—regardless of RNLI's superior lifeboat fleet—is to emulate the USCG Auxiliary, and use members' vessels with proper SAR equipment rather than using dedicated lifeboats.

Chapter 4

CHARACTERISTICS OF MARITIME INCIDENTS IN KOREAN WATERS

4.1Basic Analysis

Historical data for five years (2008-2012) of maritime incidents in Korean waters has been corrected and normalized, and it is time to briefly analyze the data. The following figures show the basic data break down. The reader should be aware that in all bar charts, the y-axis is always “number of incidents.”

What is important when analyzing the incident data is not creating a complex mathematical formula using calculus, differential equations, or even matrix algebra; those mathematics unnecessarily complicate the matter. Analyzing incident data is more a matter of common sense and pattern recognition. Pattern recognition is the most important skill. Pattern recognition can be done simply with a spreadsheet and pivot tables to create charts or graphs. Once patterns are recognized, then it is possible to see common features and anomalies or irregularities. Systems can then be created to account for the common features, and special subsystems or arrangements can be made to account for and answer for anomalies and irregularities. With this paper, I seek to recognize patterns in KCG incident data so that recommendations can be made to KCG to improve SAR capabilities.

The first step when looking at the overwhelming data was simply to plot where all of the recorded incidents occurred. The result is in Fig.4.1.

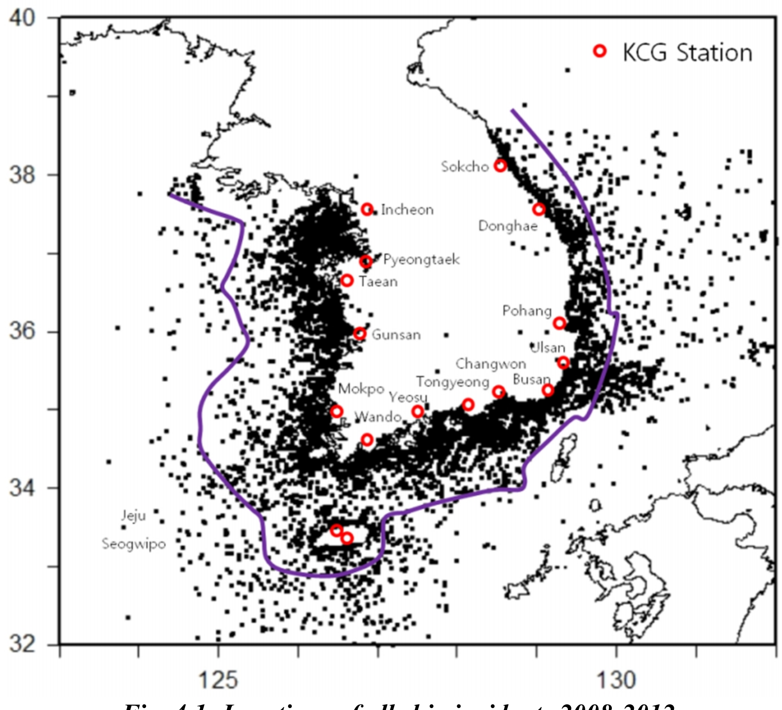

Fig. 4.1: Locations of all ship incidents 2008-2012

The red circles in Fig.4.1 indicate KCG district offices. The waters of Korea are divided into 16 districts (the Boryeong KCG district was not included in this study because it was newly established in 2014). Each district has jurisdiction in its particular part of the country. The purple line indicates the 12 NM Territorial Waters boundary. At first glance, one can see that the majority of incidents happen within that 12 NM boundary. Both the KCG office jurisdiction and the type of waters in which incidents occurred will be discussed later in this chapter.

The first data category was year, and I wanted to see if there was significant fluctuation from year-to-year. First, the five years of data plotted on a map, in Fig.4.2-4.6.

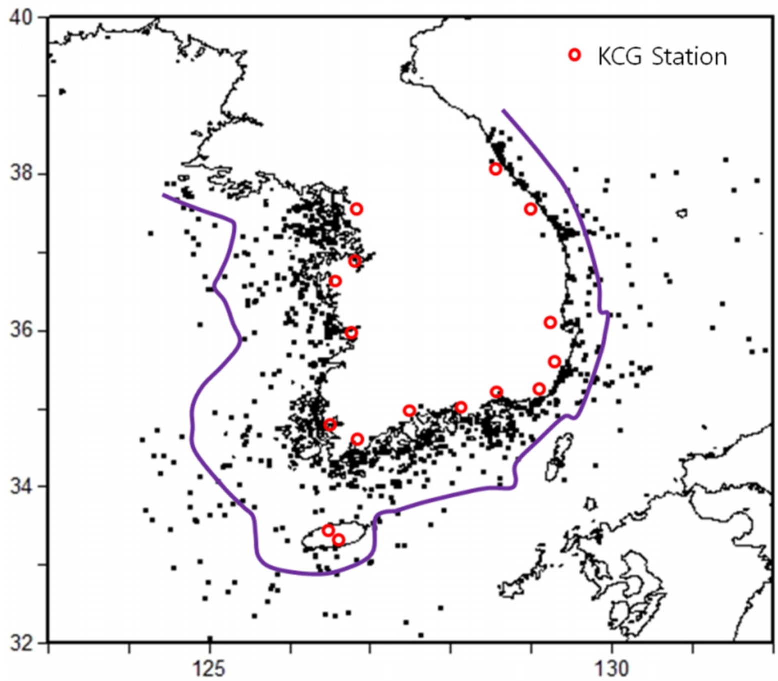

Fig. 4.2: Location of ship incidents in 2008

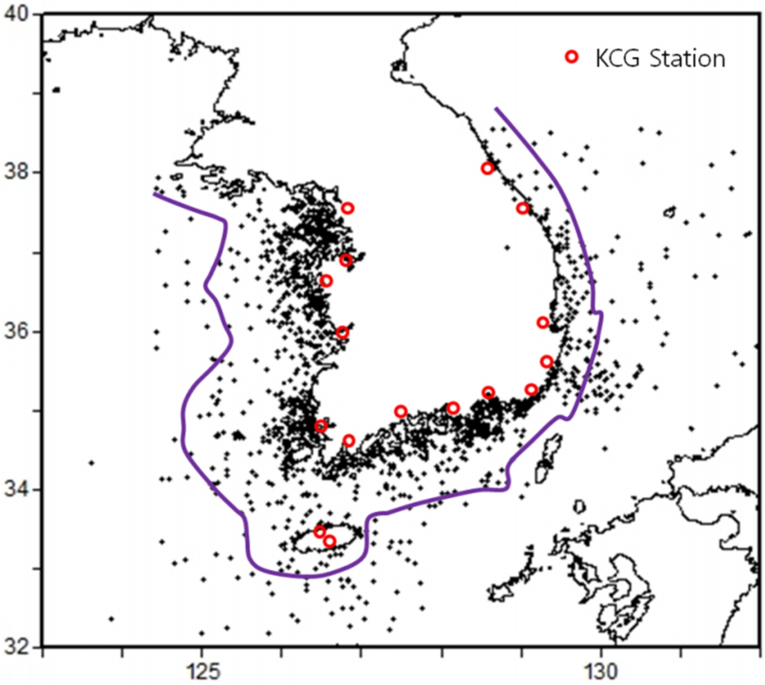

Fig. 4.3: Location of ship incidents in 2009

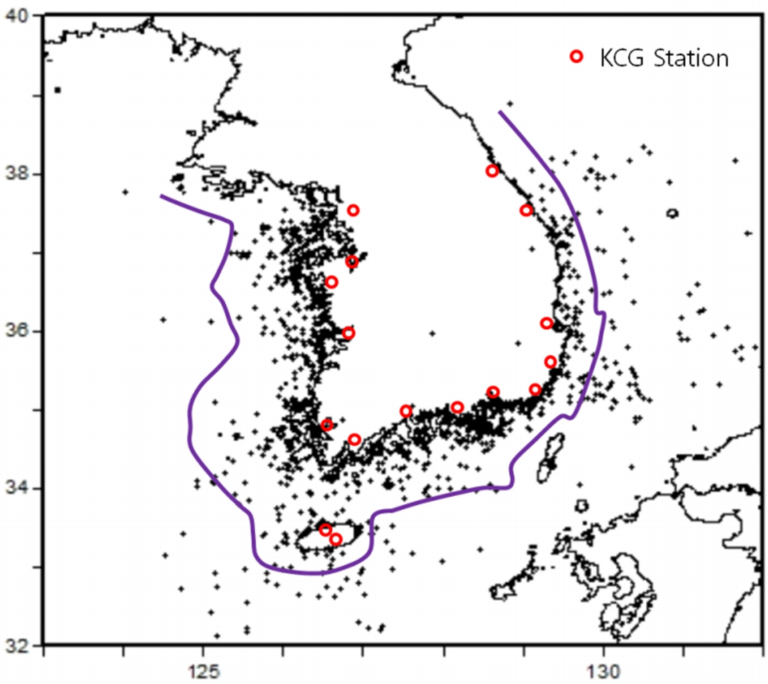

Fig. 4.4: Location of ship incidents in 2010

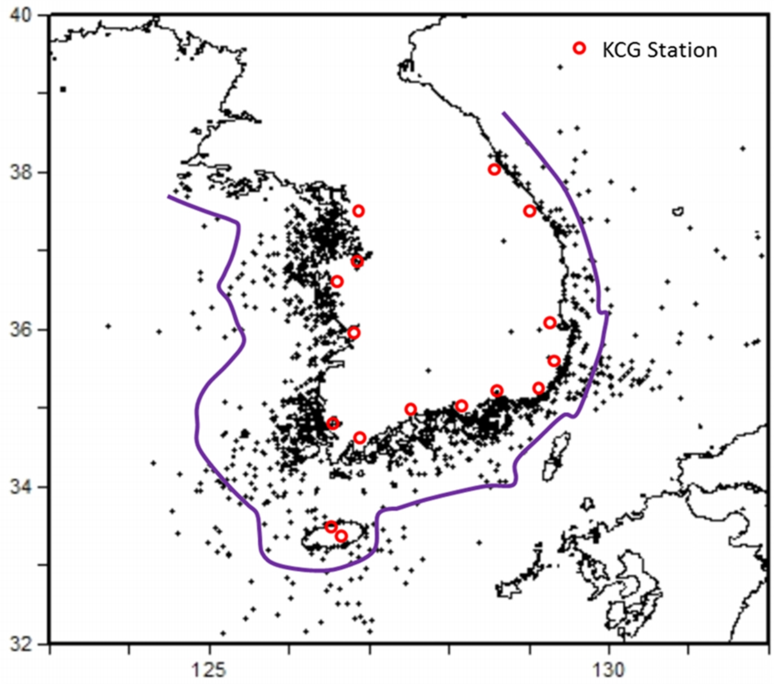

Fig. 4.5: Location of ship incidents in 2011

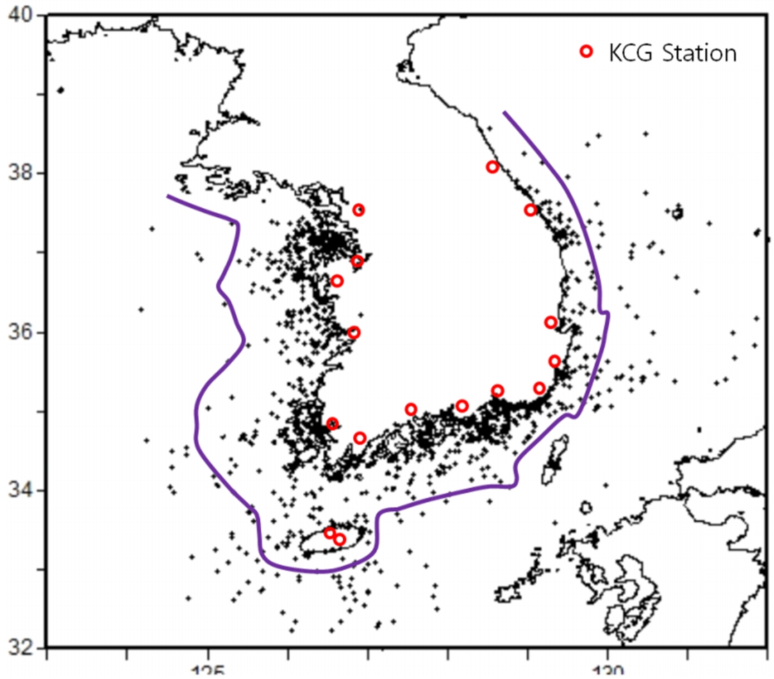

Fig. 4.6: Location of ship incidents in 2012

From looking at Fig. 4.2-4.6, it seems that there is some variation from year-to-year. However, the variation is not very clear from the plots. The variation in the number of incidents from year-to-year can be more clearly seen in the bar chart in Fig. 4.7.

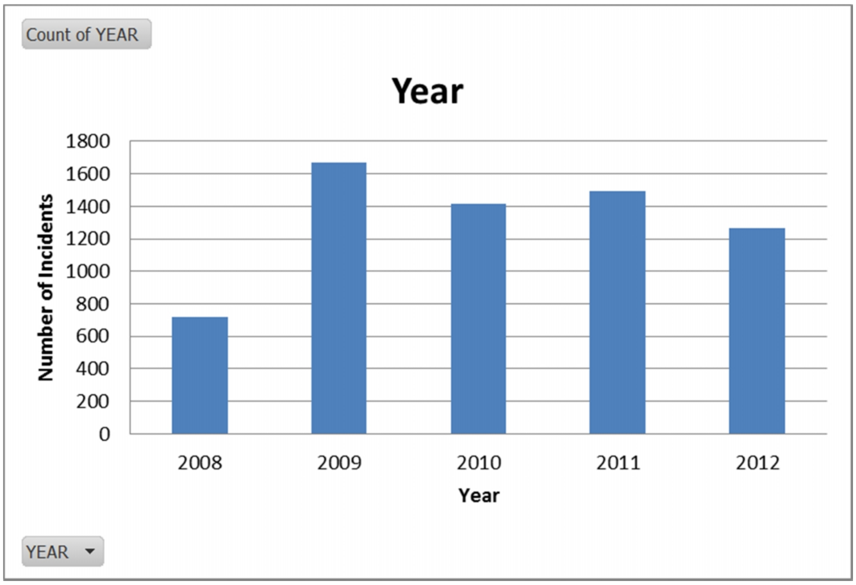

Fig. 4.7: Number of incidents by year

Fig. 4.7 indicates that number of incidents per year reached its peak in 2009; it is higher by a few hundred incidents than other years. 2008 is significantly lower than the next five years, indicating there was a data collection problem with the Korea Coast Guard prior to 2009. There seems to be a significant drop from 2009 to 2012, approximately 24%. This may be caused by any number of variables, so there does not seem to be a trend of fewer or more incidents per year. One cannot predict with any accuracy an estimate of the number of future incidents based on Year alone.

The next data category was month, and I wanted to see if certain months are more prone to incident than others.

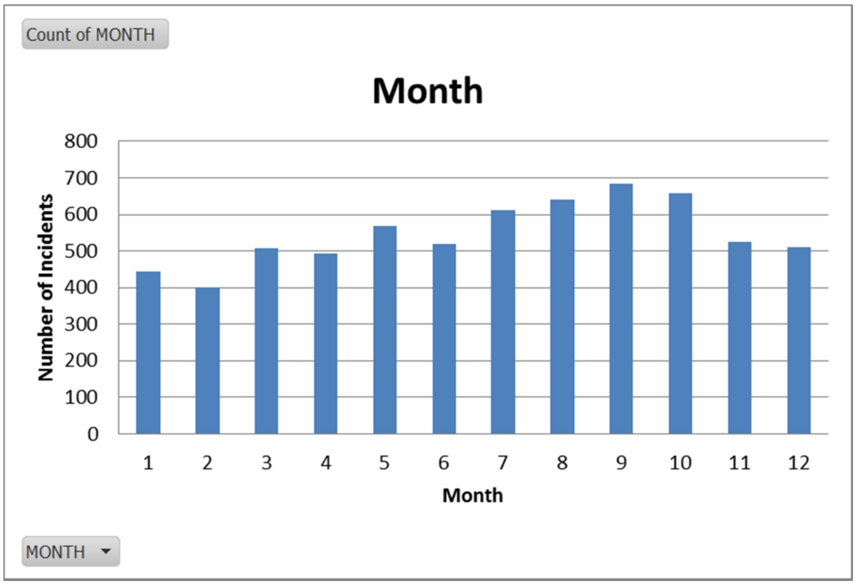

Fig. 4.8: Number of incidents by month

Fig. 4.8 indicates that September is the most common month for incidents. There seems to be a trend of more incidents occurring during the summer and early fall than during the rest of the year. This is likely due to the seasonal increase in activity due to good weather. Warmer weather means more activity on the water; and more on the water activity means more incidents. February tends to be a very cold month in Korea and the chart shows a significant drop in incidents, likely due to less activity on the water.

The next data category was Day, and I wanted to see if certain days of the month or if certain periods of the month (beginning, middle, and end) saw changes in the number of incidents.

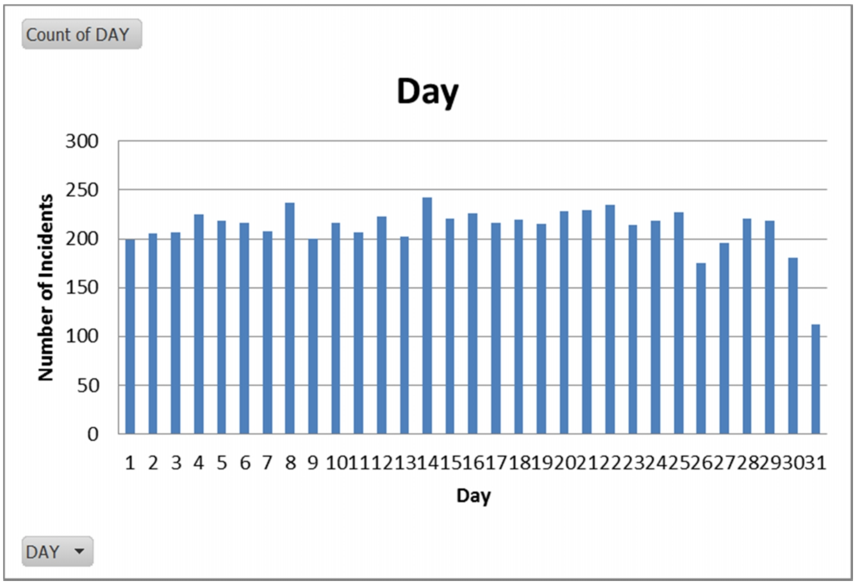

Fig. 4.9: Number of incidents by day of month

Fig. 4.9 shows that most incidents occur on the 14th day of the month. There is no discernable pattern that would indicate to mariners or SAR personnel what time of the month is most prone to incident. The rate of incidents seems rather steady. There is no jump or dip on pay day. The beginning of the month does not seem to be safer than the end. The number of incidents hovers around 200. The dip on the 31st is easily explained by the absence of 31 days in some months. I could not account for the dip on the 26th.

KCG did not record the Day of the Week data. Rather, I added the field into the spreadsheet and built the bar chart in Fig. 4.10. I was curious to see if one day of the week saw more incidents than others.

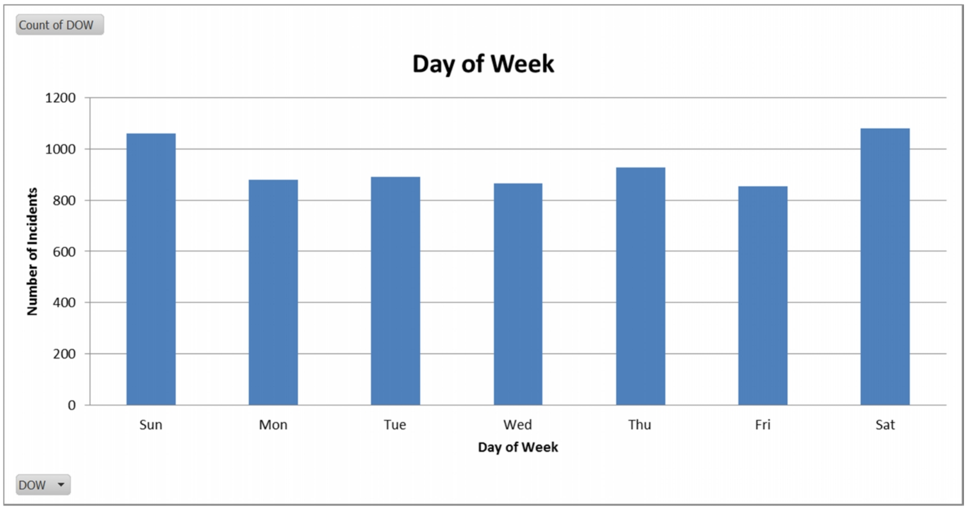

Fig. 4.10: Number of incidents by day of the week

It is clear that more incidents happen on weekends (Saturday and Sunday) than on week days. Later in the paper, I will see if there is a correlation between the type of ship and the day of the week on which incidents occur.

The next data category was hour, and I wanted to see if certain hours of the day, or if certain periods of the day (the various watches) saw changes in the number of incidents. I expected to see fewer incidents during the night because the amount of on the water activity drops drastically at night.

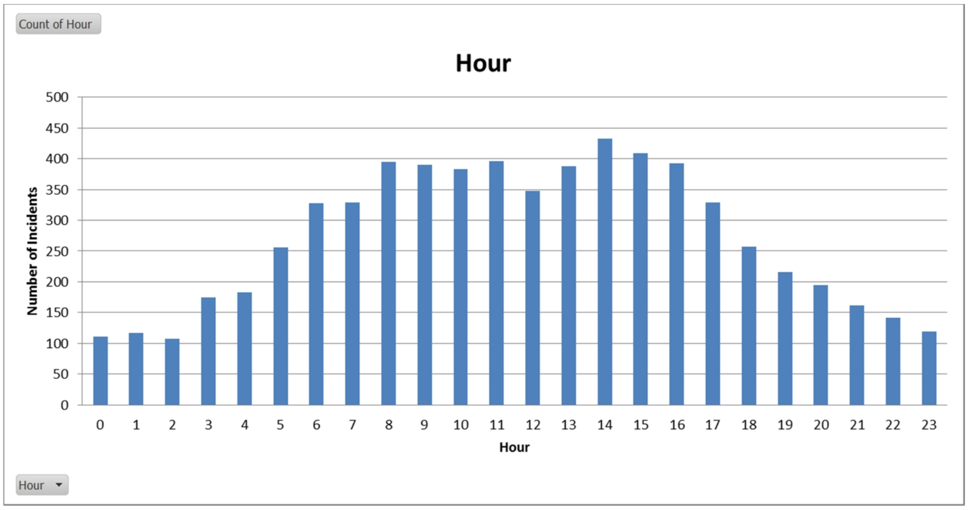

Fig. 4.11: Number of incidents by hour

As predicted, the number of incidents dropped significantly at night. It stands to reason that most incidents would happen during the working hours. The number of incidents peaks at 2 pm. This could possibly be explained by fatigue of having been on the water for several hours, and the tiring effect of having eaten lunch an hour or so earlier.

The next data category was the KCG district that has jurisdiction where the incident took place. Korea Coast Guard recorded incidents happening in all 16 districts: Gunsan, Donghae, Mokpo, Busan, Seogwipo, Sokcho, Yeosu, Wondo, Ulsan, Incheon, Jeju, Changwon, Taean, Tongyeong, Pyeongtaek, and Pohang. This does not mean that the SAR vessels were launched from the district headquarters, only that the incident in question happened within the jurisdiction of that district. It will be important to know which KCG districts are busier than others. Those busier districts might need more help from a CVSO than slower districts.

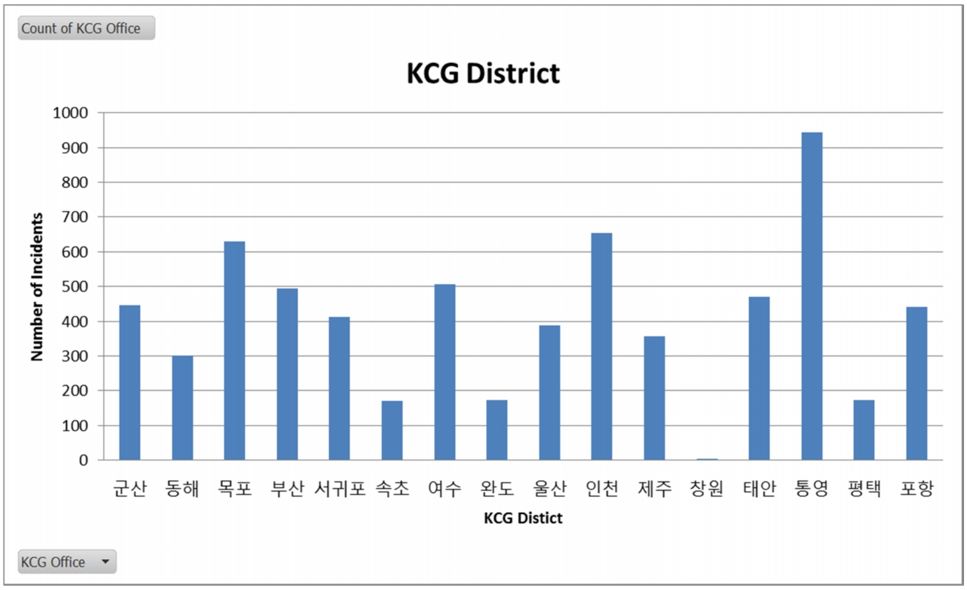

Fig. 4.12: Number of incidents by KCG Office

It is clear that Tongyeong is by far and away the busiest district when it comes to SAR incidents, with Incheon at a distant second, and Mokpo in third. Why Tongyeong has such a significant number of incidents is currently unknown.

Korea Coast Guard distinguishes eight types of waters: Territorial (up to 12 NM), Contiguous (12-24 NM), EEZ (within 30 NM), Open Sea, Straits/Narrows, In Harbor, Foreign Waters, and North Korean waters. In Harbor and straits/narrows are obviously within the territorial waters, but they are considered different categories due to their geographical features.

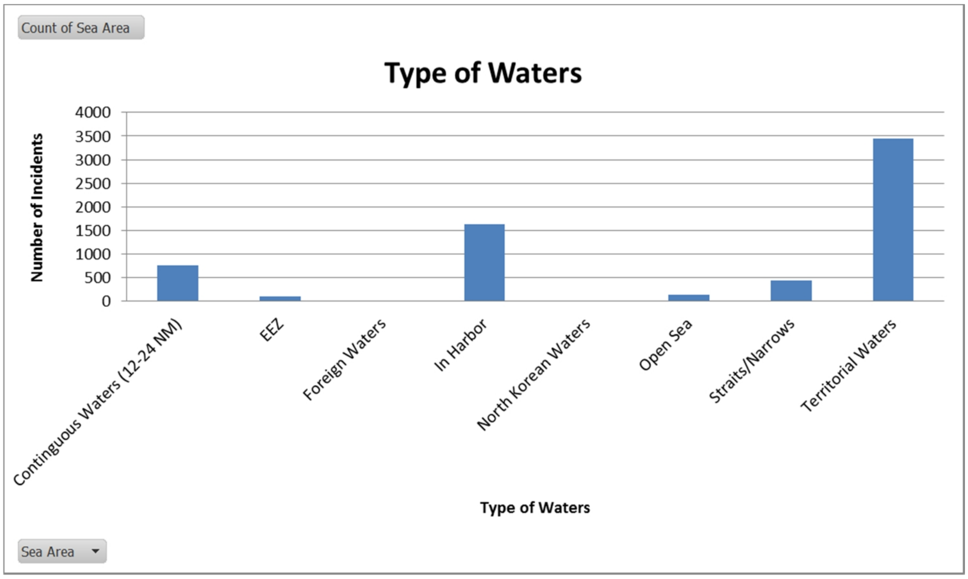

Fig. 4.13: Number of incidents by Type of Waters

More than half of all incidents happen in Territorial Waters (0-12 NM), followed by In Harbor, Contiguous (12-24 NM), and Straits/Narrows. It is clear, then, that any civilian volunteer SAR activity need not go too far from shore. Since harbors and straights/narrows are, by nature, part of the Territorial Waters, then we can say that 84% of all incidents happen within the 12 NM Territorial Waters limit.

The KCG distinguishes 13 different types of incidents: Adrift, Capsize, Collision, Engine Failure, Fire, Flood, Grounding on a hard surface, Grounding on a soft surface, Light Collision/Brush-up, Other, Propulsion Malfunction, Steering Gear Malfunction, and Sunken ship. I separated out collisions that had only one ship involved and created the category *allision.* A *collision* requires a minimum of two vessels. An allision is single vessel accident; the vessel underway either crashes into a vessel that is not underway or it crashes into an object such as a day marker. The important factor is that only one ship was involved. Legally, it is an important distinction. Also, the "light collisions," of which there were very few, were absorbed into the collision category. Fig. 4.14 shows these categories.

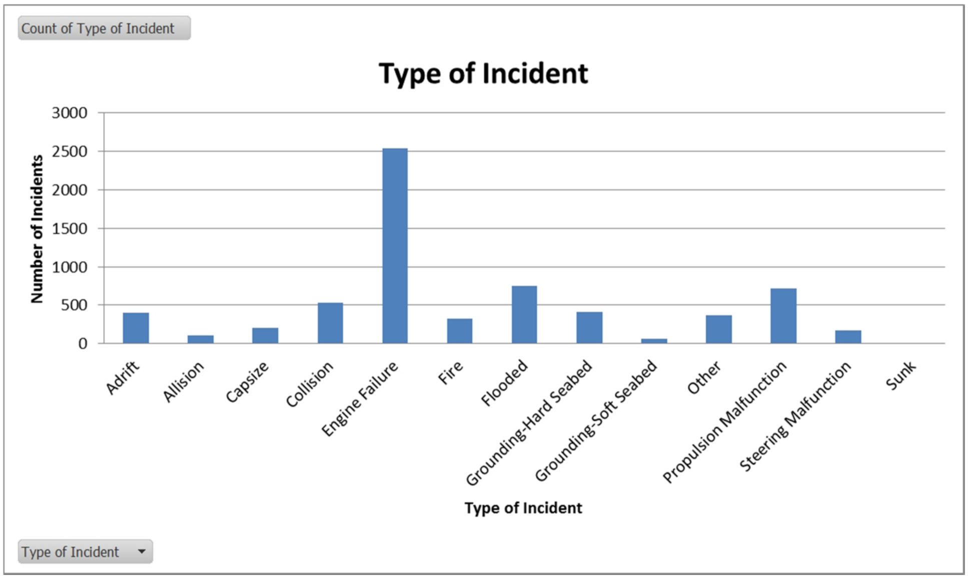

Fig. 4.14: Number of incidents by Type of Incident

Engine Failure is clearly the most common incident in Korean waters. There is no other incident that comes close. This category does not give any clues to what may be the cause of so much engine failure.

Also, it is worth asking if Engine Failure is truly an incident, or if it is merely a cause of an incident. It seems that when an engine fails, the vessel will go adrift and so adrift is the real incident, with engine failure as the proximate cause. However, this is the data as it is collected and disseminated, so it may be the case that as soon as the engine failed, the master of the vessel called for help, before the vessel went adrift. As it happens, Engine Failure is also listed as a cause of incident, which is the next category to be examined.

KCG separated causes of incidents into 11 categories: careless operations, defective material, engine failure, flooding, fuel depletion, load and balance error, mishandling fire, negligence, other, poor maintenance, and weather conditions. Careless operations and negligence seem to be the same thing; however, careless operation is about ship handling, while negligence is a broader category. Engine failure was a type of incident, and here it is a cause of incident. Mishandling fire has an unsure meaning. It could mean that mariners were using an open flame and mishandling that open lame caused a faire. Or, it could mean that the fire was started (for any reason) and the crew was unable to fight it effectively. Other is an extremely unhelpful category, because it prevents real understanding of what caused an incident.

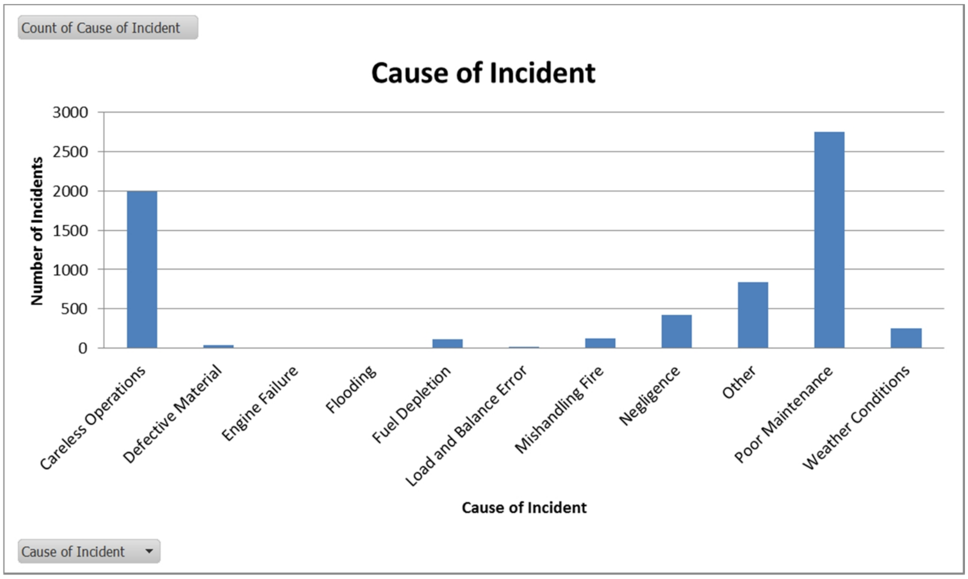

Fig. 4.15: Number of incidents by Cause of Incident

Poor maintenance accounted for 2,754 incidents, nearly half of all incidents. This tells us immediately that mariners or their companies are not maintaining the vessels well. Careless operations accounts for 1,990 incidents, nearly 1/3 of all incidents, indicating that ship handling skills are poor or lackadaisical. It is interesting how few incidents were caused by weather conditions, the next category.

The KCG distinguishes between nine types of weather conditions. They are organized here from best to worst: good, poor visibility, heavy weather warning, heavy weather alert, typhoon warning, typhoon alert, typhoon grade 3, typhoon grade 4, and typhoon grade 5.

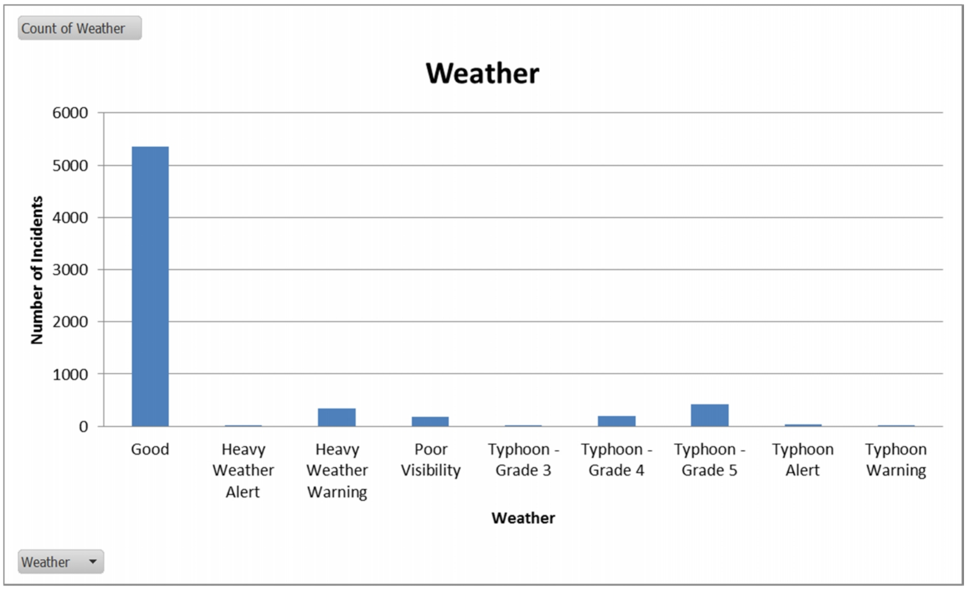

Fig. 4.16: Number of incidents byWeather Conditions

The vast majority (5,356) incidents happened in good weather. This means that weather is almost irrelevant to the number of incidents.

If engine failure is the most common type of incident, then one can hazard a guess that most incidents will involve only one vessel. Fig. 4.17 bears this out.

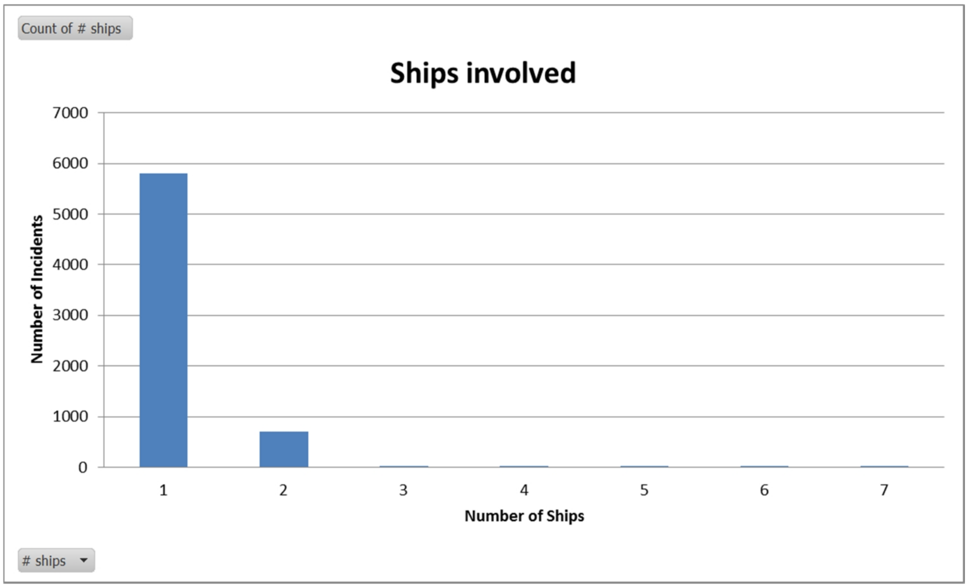

Fig. 4.17: Number of incidents by number of Vessels Involves

Indeed, the vast majority (5,811) of ship incidents involved one vessel. Two vessels accounted for 702 incidents. There were 31 three-vessel incidents; six four-vessel, one five-vessel, six six-vessel, and one seven-vessel incidents. This tells us that Vessel Traffic Safety is not a significant contributor to vessel incidents; traffic separation schemes, and aids-to-navigation appear to be working as planned. It also indicates that a single rescue vessel can most likely handle the incident without assistance (exceptions being passenger ship incidents, of which there are few).

KCG lists 14 different types of vessels: Fishing Boat (Trawler), Fishing Boat (Rod & Reel), Freighter, Government Vessel, Leisure—

Motorboat, Leisure—Unspecified, Leisure—Yacht, Oil Tanker, Other, Passenger Vessel, Personal Water Craft, Towed Vessels, and Guide Vessels.

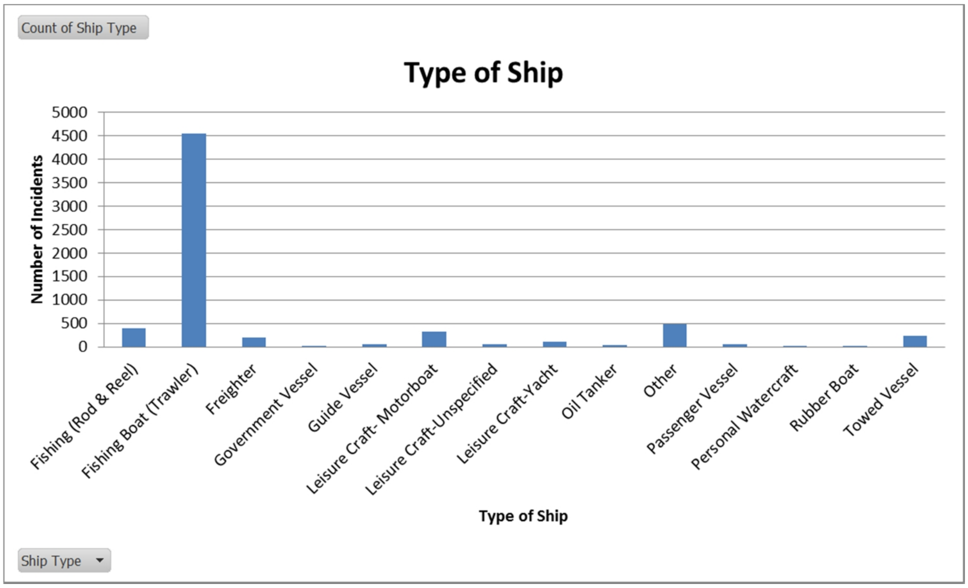

Fig. 4.18: Number of incidents by Type of Vessel

By far and away the most number of incidents involve Trawlers (4,558). The troubling category is "Other". It is difficult to understand how, with thirteen other types of vessels listed, that 485 vessels somehow could not be categorized accurately by KCG personnel. The third greatest number of incidents involved Fishing vessels using rod and reel (rather than nets), at 389 incidents, bringing the total number of fishing boat-related incidents to 4,947. One can assume that some of the 485 Other-type of vessel included some fishing vessels, also. With nearly 5,000 incidents out of 6,558 involving fishing vessels of one sort or another, it is clear that the greatest danger to maritime safety is fishing boats.

In any examination of maritime incidents, one must also look at the human cost. The next three figures (Fig. 4.19, 4.20, and 4.21) show the number of incidents by number of persons rescued, by number of persons died, and by number of persons missing.

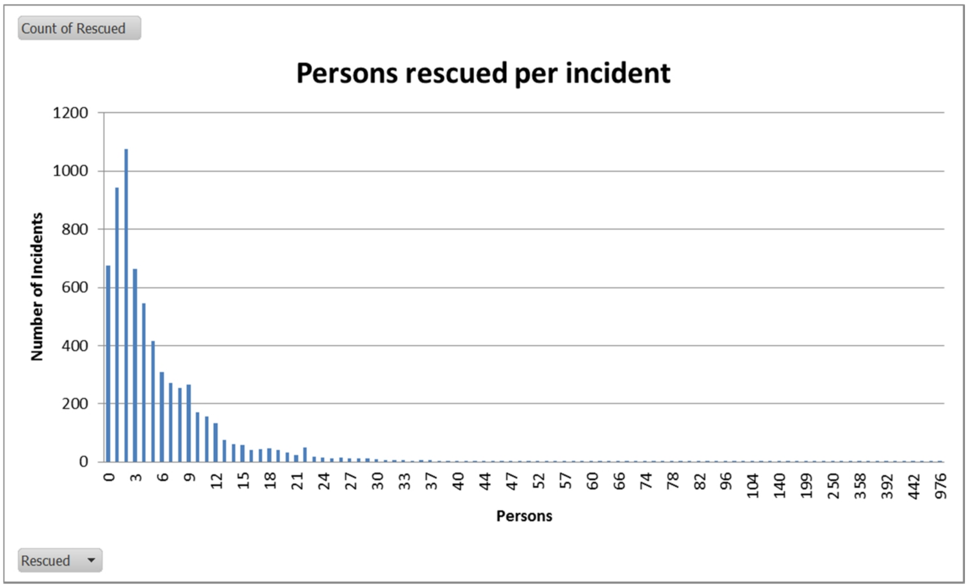

Fig. 4.19: Number of incidents by Number of Persons Rescued

If most incidents involve fishing vessels, which tend to have relatively small crews, then it makes sense that the majority of incidents involved only 0-10 persons being rescued. The reason for the large range of numbers is rather simple: small vessels have few people aboard while large passenger ships have hundreds of people on board. It also gives evidence that few maritime incidents are fatal, and even fewer have mass fatalities.

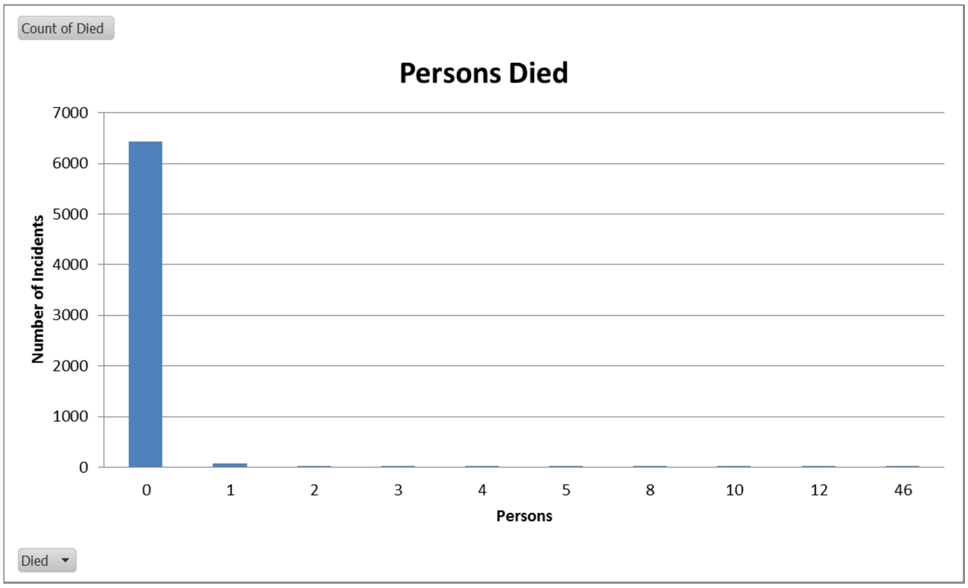

Fig. 4.20: Number of incidents by Number of Persons Died

There are very few fatalities in relation to the number of incidents. There were 119 incidents with fatalities, and 250 persons died in total. Seventy-nine of the 119 fatal incidents suffered only one life lost.

Fig. 4.21: Number of incidents by Number of Persons Missing

Just as with fatalities, the number of incidents with Persons Missing relative to the total number of incidents is quite small: only 81. And of those 81 incidents with missing persons, 37 incidents had only one person missing.

Table 4.1 on the top of the next page gives a summary of the most basic facts of the data. The results in Table 4.1 do not mean that September 14, 2009 at 2 p.m. has an unusually large number of one-ship incidents in which a fishing boat suffered engine failure due to poor maintenance in the territorial waters off of Tongyeong. This table does, however, give any examiner of the data a starting point for creating an algorithm, or method, for analyzing the data further.

Table 4.1: Summary of Basic Incident Data

Most common categories of incidents		**Number**
Year	2009	1,671
Month	9 (September)	684
Day (of the month)	14th	242
Day of week	Saturday	1,081
Time of day	14:00 (2 p.m.)	433
KCG District	Tongyeong	943
Type of waters	Territorial (0-12 NM)	3,443
Type of incident	Engine Failure	2,537
Cause of incident	Poor Maintenance	2,754
Weather conditions	Good	5,356
Number of vessels involved	One (1)	5,811
Type of vessel involved	Fishing Vessel—Trawler	4,558

At this point it is evident that the sheer volume of data is overwhelming and the various analyses, while useful, really do not give us any immediately useful numbers with which to run an experiment that can show us how introducing a CVSO can improve KCG operations, or which kind of CVSO is best for Korea. In order to resolve this problem, I have created an experiment to show how introducing civilian volunteer boats into the maritime milieu can improve KCG's SAR response time.

The basis of the experiment is rather simple. I posit the existence of CVSO member vessels at certain distance intervals within Korean waters. KCG vessels are also in the waters. Then I calculate the distance between the SAR vessels and the Distress vessel, and compare KCG and CVSO response times.

4.2 Chapter Summary

This chapter began by looking at five years of data provided by Korea Coast Guard. After normalizing the data and ensuring that it was free from entry errors, the data was analyzed to discern basic facts about maritime incidents, such as the type of vessels most commonly involved in incidents, what KCG district in which those incidents usually happened, what type of waters those incidents happened in, etcetera.

Once these basic facts were established, I then proposed a method for gauging CVSO performance using five scenarios. The results of this method are shown in the next chapter.

Chapter 5

DESIGN FOR AN OPTIMUM CVSO SYSTEM

5.1 Hypothesis of CVSO System

Since the current CVSO system is not on track, I set up a few hypotheses to test which CVSO system is the best fit for maritime circumstances in Korean waters as follows. It is assumed that:

- Rescue operation of CVSO is limited to the coastal water excluding the near shore area by accidents of recreational watercraft and swimmers, etc.
- Assisting resources are fishing boats engaged in in fishing activities in the vicinity of the incident, but not recreational craft, commercial vessels and aircraft
- all fishing boats in the coastal waters are responding to SAR operation on receiving distress signal or being instructed by KCG, even though all are not member of CVSO

And then I continue to work on the study by following steps as shown in Fig. 5.1

First, assume that most power-driven fishing boats in the coastal waters participate in this system to minimize loss of lives, even if about 1,800 fishing boats are, at present, registered as volunteer vessels.

Second, choose the specific area (Mokpo district) among RCC (or RSC) region and set up 5 scenarios for test the efficiency of each scenario.

Third, evaluate the value of each scenario with 2 factors of response time and cost and compare the results each other.

Fourth, take a good scenario out of the evaluation result and design the optimum CVSO system.

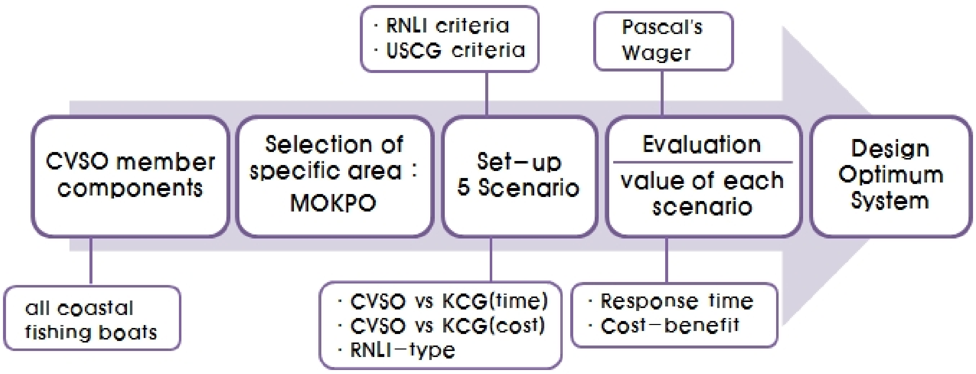

Fig. 5.1: **Flow chart of designing optimum CVSO System**

5.2 Method of Experiment

Preparing the method

First, I chose one KCG District on which to focus. The main purpose for choosing one out of 16 districts is to keep the amount of data under control. To run this method using all 6,558 incidents five times exceed the computing power available. I chose Mokpo, the district in which the Sewol Ferry disaster occurred. I then removed incidents that happened outside of the 12 NM territorial waters limit. The reason for this limit is that RNLI's benchmark that was discussed in Chapter 3 is based on a 10 NM limit. This left 606 incidents. These 606 incidents were then plotted on a Google ® map, using the beta application Fusion Tables. Incidents shown to have been improperly located on land were removed. An example of this is shown in Fig. 5.2.

Fig. 5.2: Example of incident mis-located on land

Upon removing all incidents allegedly on land, 554 incidents remain, as seen in Fig. 5.3. The incidents are indicated by the red/black dots.

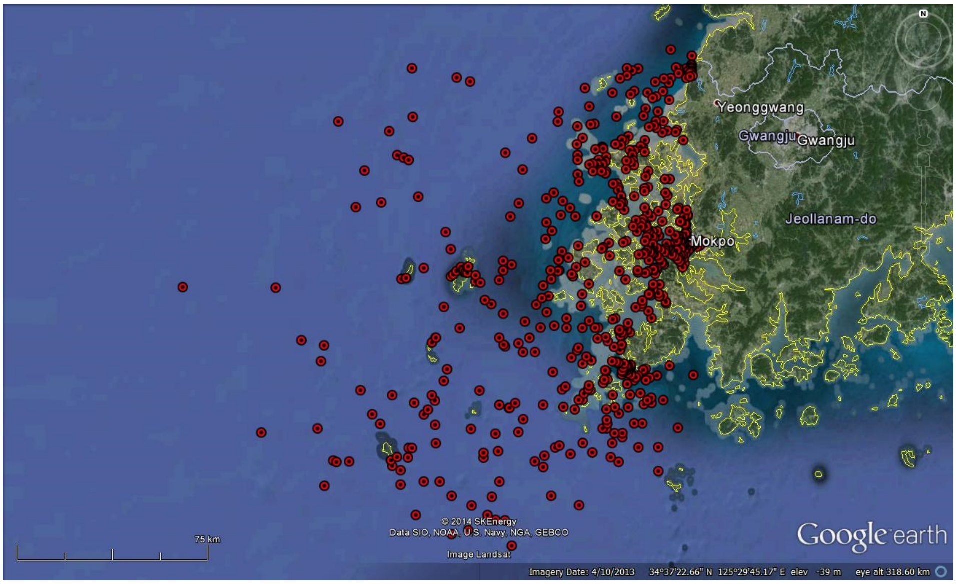

Fig. 5.3: Location of maritime incidents in Mokpo district

Next, a snapshot of an electronic chart from Korea Coast Guard showing where KCG vessels are located is used. The exact location is not terribly important, since the KCG vessels move throughout the day. The screenshot is more or less a snap shot of KCG vessels at that particular moment. No latitude-longitude data was given by the KCG, so this paper approximates their positions based on their location on the chart in the screen shot, so I have estimated the latitude and longitude. Then hypothetical CVSO vessels will be placed at intervals within the KCG district boundaries. These

CVSO vessels are selected from the fishing vessels locations as shown in Fig. 5.4. Once again, the exact latitude and longitude are not known, so I estimated the location. Fig. 5.4 shows KCG vessels as medium blue diamonds, and fishing vessels as light blue arrowheads.

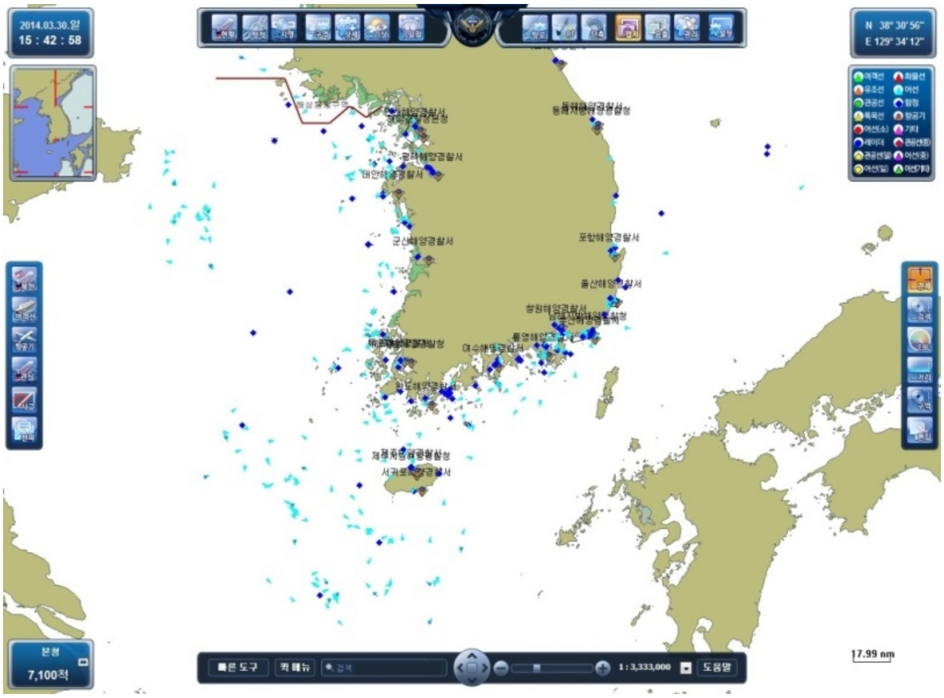

Fig. 5.4: KCG and fishing boat locations

KCG and CVSO vessels are equal in number. I place five of each vessel (KCG and CVSO) in the hypothetical scenarios. The reason for making the number of vessels the same is to avoid any appearance of favoring the CVSO. If I placed ten volunteer vessels but only two KCG vessels, it would appear to be an unfair test. However, it is likely that in reality, there would be more CVSO volunteers on the water than KCG vessels.

Choosing where to place the KCG vessels and the CVSO vessels was a moderately difficult task due to early technology restrictions. The mapping software originally used was not sophisticated enough to plot the KCG and CVSO vessels on the same map with the distress vessels, so I initially placed vessels by hand using the old fashioned technique of taping a map to a window and placing the other map on top, and I put a mark where the original map had a mark. However, once I discovered the overlay feature in Google Earth, I was able to take the screen shot of the KCG cutters as shown in Fig. 5.4 and lay it over and adjust it to approximately fit the map of Korea. This map overlay is shown in Fig. 5.5 at the top of the next page.

To place the KCG rescue vessels, then, I zoomed into the map, and placed an icon where the KCG vessel was indicated by the screenshot overlay. I then looked for fishing boats in the area and placed icons in those positions. I chose five KCG vessels and also chose (at my own discretion) five CVSO vessels.

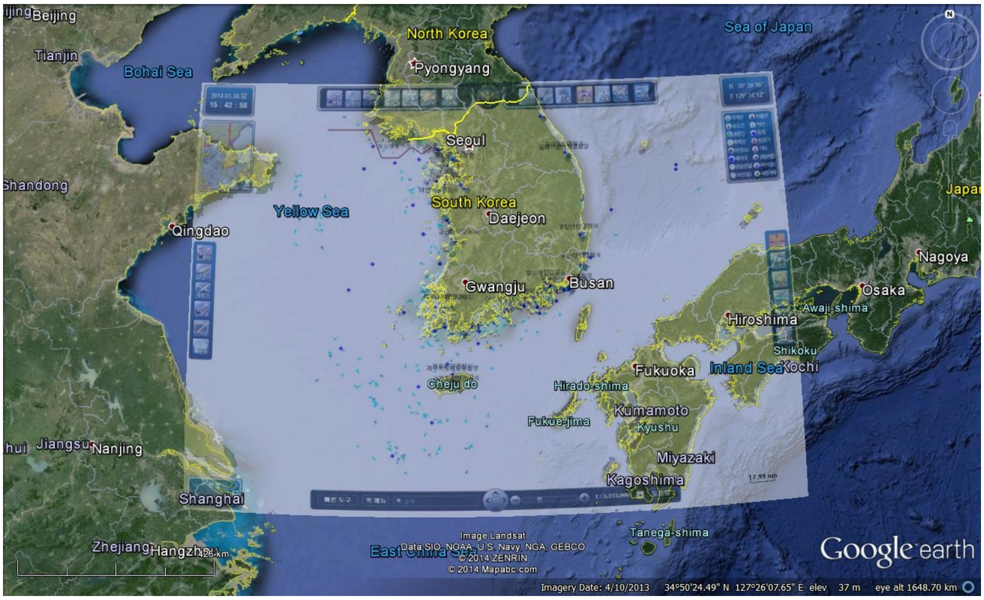

Fig. 5.5: Overlay of KCG screen shot on Google Earth

I strove to avoid placing CVSO vessels too close to KCG vessels assuming that it is more rational to have those vessels covering different patches of water. At the same time, I could not justify putting the CVSO vessels too far away, as it could put them at a distinct disadvantage even before they have a chance to have their performance calculated. The results of placing the rescue vessels using this overlay map are in Fig. 5.6. The KCG vessels are indicated by a blue/black square, and labelled “KCG” with a hyphen and number. Likewise, CVSO vessels are indicated by orange/black squares, and labelled “CVSO” with a hyphen and number.

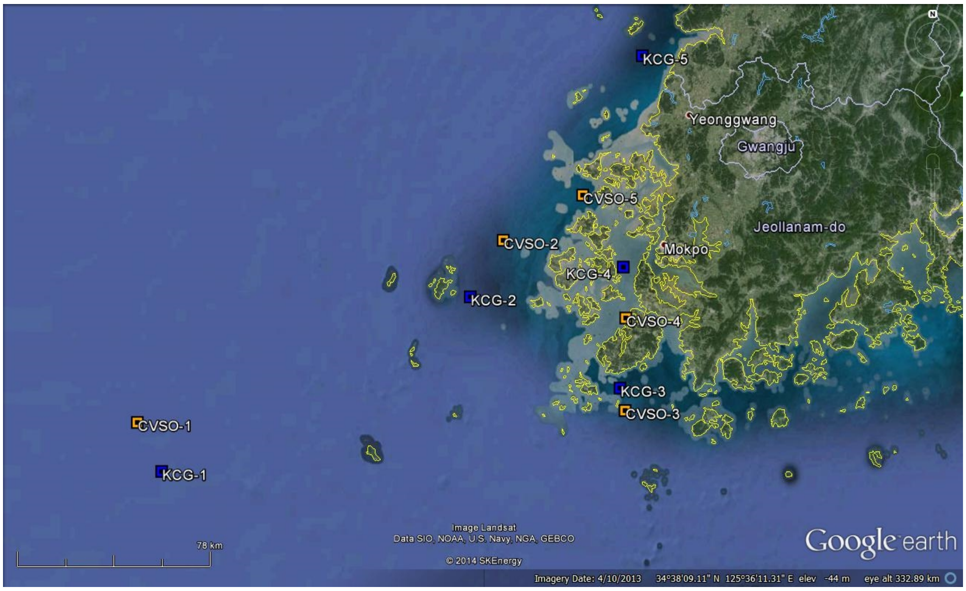

Fig. 5.6: Rescue vessel locations

Now it is time to put the maps together, so that one can see all 554 incidents together with the KCG and CVSO rescue vessels.

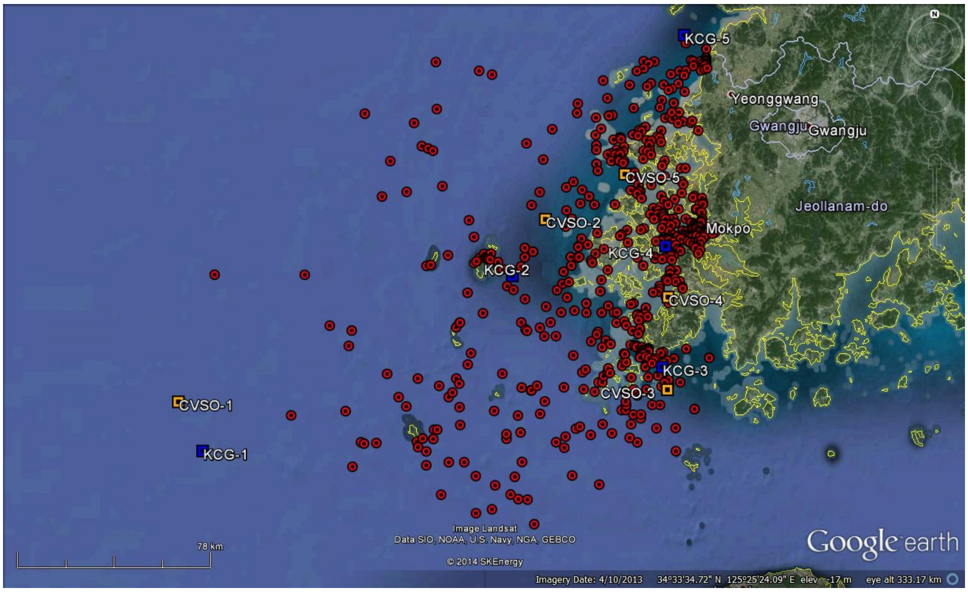

Fig. 5.7: Mokpo incidents and rescue vessels

Unfortunately, Google Earth and Google Maps do not have a feature that will allow for automatic time and distance calculations. For this, I have to switch to Microsoft Excel, and let it do the calculations.

Calculating distance on a sphere is a rather complicated matter. I used the Haversine Equation for solving distance on a sphere. The Haversine Equation is most often used for long distances, such as New York to Tokyo, and it is therefore "overkill" for two locations over such a small distance, but it was the best equation for use in a spreadsheet.

$$\Delta\hat{\sigma} = 2\arcsin\left(\sqrt{\sin^2\left(\frac{\Delta\phi}{2}\right) + \cos\phi_s\cos\phi_f\sin^2\left(\frac{\Delta\lambda}{2}\right)}\right)$$

This equation looks something like the example in Fig. 5.8, when entered into a spreadsheet cell:

=ACOS(COS(RADIANS(90-[**Distress Vessel LAT**]))*COS(RADIANS(90-[**Rescue Vessel LAT**]))+SIN(RADIANS(90-[**Distress Vessel LAT**]))*SIN(RADIANS(90**Rescue Vessel LAT**]))*COS(RADIANS([**Distress Vessel LONG**]-[**Rescue Vessel LONG**])))*3440.065

Fig. 5.8: Haversine Equation in Excel syntax

This calculation must be made ten times per distress vessel, because there are five KCG rescue vessels and five CVSO rescue vessels. Then I select the nearest KCG vessel and the nearest CVSO vessel simply by using the “MIN” function in Excel.

The next step is to calculate speeds, because KCG vessels and CVSO vessels likely do not travel at the same speed. For this step I chose a KCG P-boat, which is a rather typical vessel. It has a 200 horsepower engine and can travel up to 20 knots. A similarly equipped (200 horsepower engine) fishing vessel can travel at about 10-15 knots. Since the distance unit is the nautical mile (NM) and the time unit used is knots (nautical miles per hour), the calculation is the very straight-forward *distance divided by time equals speed* formula. This will very clearly show which vessel is quicker responding to the distress vessel.

Scenario Specifics and methods

Scenario A

At this point it is important to recall a bit of information from Chapter 2: Background, in the section about the RNLI. The RNLI has a benchmark that they must successfully reach 90% of distressed vessels inside a 10 NM boundary in 30 minutes or less. This benchmark is based on an

RNLI lifeboat that travels 20-25 knots. By the very nature of this benchmark, CVSO are likely to fail simply because their fishing boats are slower. A fishing boat traveling 10-15 knots will take about one hour to reach a distress vessel 10 NM away. Also, the RNLI benchmark is from a shore based life boat station out to a maximum of 10 NM. This study has the vessels responding from more or less random locations at sea, and responding to incidents in various area of the sea, not just to distress vessels within the littoral or territorial waters.

In order to do this, only those incidents within a 10 NM radius of the rescue vessels will be tested. KCG and CVSO are not being tested against each other, but against the RNLI benchmark. The result will simply be the number of incidents in which KCG and CVSO can meet the RNLI benchmark.

Scenario B

Scenario B is very similar to Scenario A in that it is measuring KCG and CVSO against the USCG benchmark. The USCG benchmark is much easier than the RNLI benchmark, as it requires arrival on-scene within 2 hours of notification out to 20 NM. (U.S. Coast Guard 2009) However, the first 30 minutes are assumed to be preparation time, so I set the time limit at 90 minutes. Only those incidents within a 20 NM of the rescue vessels will be tested. KCG and CVSO are not being tested against each other, but against the USCG benchmark. The result will simply be the number of incidents in which KCG and CVSO can meet the USCG benchmark.

Scenario C

In Scenario C, KCG and CVSO are put into head-to-head competition. Whoever reaches the distress vessel soonest is the winner of the mission, and the organization with the most number of missions won wins scenario C.

Scenario D

Scenario D is the same as Scenario C, but with cost as a factor. Surely, at 20 knots versus 10-15 knots, all other variables being the same, the KCG will almost always arrive sooner. By the nature of the vessels, the advantage belongs to KCG. We should then consider what it costs the KCG versus what it costs the CVSO. A KCG P-boat uses 63 liters of fuel in one hour. The typical fishing boat with a 200 h.p. engine as mentioned above uses 33.2 liters per hour. Using the government price for fuel, 939.9 won per liter, we can calculate how much each vessel spends on fuel. There is also the issue of salaries for boat crew. A P-boat will typically hold a crew of five. Assuming the average rank of the crew is *gyeong-jang*, the hourly pay rate per crew member is 17,500 won. The re-imbursement rate for a civilian volunteer is 9,650 per person. However, in the USCG Auxiliary, only the coxswain receives any reimbursement; the boat crew receives nothing but credit toward performance awards—no money whatsoever. In the RNLI, the crew and coxswain receive nothing. Therefore the in this paper I use the USCG method of paying only the coxswain in this study. This helps to mitigate the natural advantage KCG has. For the purposes of this study, the cost of amortizing and maintaining the vessels is not considered.

The problem we have, then, is that we are "comparing apples to oranges" when comparing the KCG P-boat to a civilian fishing boat. This is why, when creating a method for which vessel is better, we have to account both for speed and cost. To solve this problem, I created a scoring rubric as shown in Fig. 5.9. This scoring rubric is an adaptation of Pascal's Wager.

		CVSO Faster?	
		YES	**NO**
CVSO Cheaper?	**YES**	WIN	DRAW
	NO	Not possible	LOSS

Fig. 5.9: CVSO Result Rubric

CVSO vessels then have a 33% chance of being better than KCG, and a 33% chance of being worse than KCG, and a 33% chance of being more or less equal. It could be argued that a DRAW is a moral victory for the CVSO, and I think that is a fair point. The reason for this apparent asymmetry is that if the CVSO can do the mission either faster *or* cheaper, the KCG will not respond to the SAR call-out because it has other missions to accomplish that CVSO cannot perform, such as law enforcement or interdiction. Not responding to SAR call-outs but remaining on-task with other missions has a value, although calculating that value is far outside the scope of this paper. Therefore, giving the civilians credit for a WIN when the rubric allows for a

DRAW recognizes the value of allowing KCG to perform its other missions without interruption. For the CVSO to have a LOSS, the KCG must be both faster *and* cheaper. Success is determined by a simple majority of wins.

Scenario E

Scenario E is quite different from Scenarios A to D. In A to D, the USCG Auxiliary model of having vessels already in the water patrolling is assumed. It is also assumed that the CVSO is using fishing boats that are owned by CVSO members. In this scenario, we are positing that CVSO has lifeboats and lifeboat stations just like the RNLI.

To do this, I will not use the vessels labelled CVSO-1, CVSO-2, CVSO-3, etc., but rather I will place lifeboat stations on the west coast of Korea and at island marinas. I will assume an RNLI-style lifeboat, capable of 25 knots. These lifeboats must meet the RNLI benchmark. It should be noted that RNLI has lifeboat stations in even the smallest towns, many stations being less than 20 km apart. In this scenario, I have set up only 10 lifeboat stations, considerably fewer than RNLI would have in a similar size area. The benchmark used is the same benchmark that RNLI uses. The locations of the hypothetical lifeboat stations are in Fig. 5.10, indicated by the yellow pins.

Fig. 5.10: Hypothetical lifeboat stations

Assessment of each scenario

Scenario A

In Scenario A, CVSO had to reach 90% of distress vessels within a 10NM radius within 30 minutes. Of the 554 incidents, only 156 occurred within 10NM of a CVSO rescue vessel. Of those 156 remaining incidents, CVSO could respond to 80 in 30 minutes or less; a success rate of 51%. This success rate is far below the RNLI benchmark. By comparison, 252 incidents occurred within 10 NM of KCG vessels, and all 252 were responded to in 30 minutes or less; a 100% success rate.

It seems that Scenario A predicts that the CVSO is a failure.

Scenario B

In Scenario B, CVSO had to reach 90% of distress vessels within a 20 NM radius within 90 minutes. Of the 554 incidents, 421 occurred within 20 NM of a CVSO rescue vessel. Of those 421 remaining incidents, all 421 were responded to in 90 minutes or less; a success rate of 100%. It should be noted that another 15 vessels were reached within 90 minutes; however, these vessels were slightly outside the 20 NM radius.

It seems that Scenario B predicts that CVSO is a success.

Scenario C

In Scenario C, KCG and CVSO went head-to-head, and success rate was based strictly on time—who could respond faster. In this scenario, CVSO responded more quickly than KCG in 124 out of 554 cases; a success rate of 22%.

It seems that in Scenario C, CVSO is a failure.

Scenario D

In Scenario D, KCG and CVSO went head-to-head again. However, this time cost became a factor. If CVSO was either faster *or* cheaper, it was declared the winner of the mission. In this scenario, CVSO won 474 out of the 554 cases; a success rate of 86%.

It seems that in Scenario D, CVSO was a success.

Scenario E

In Scenario E, CVSO has lifeboat stations and lifeboats just as RNLI has. I placed ten on the west coast and on the adjacent islands. Once again, the RNLI's standard benchmark of a 90% response rate to distress vessels within 10NM of the lifeboat station is used as the benchmark for this scenario. In this scenario, 359 incidents were within the 10NM radius and all 359 were calculated to respond in less than 30 minutes; a 100% success rate. Another 43 vessels that were outside of the 10NM radius could also be responded to in less than 30 minutes.

It seems that in Scenario E, CVSO was successful.

Results Summary

The results of the experiment are summarized in Table 5.1.

Table 5.1: Results summary

Scenario	Description	Success Rate	Pass/Fail
A	Auxiliary Structure with RNLI Benchmark	51%	FAIL
B	Auxiliary Structure with USCG Benchmark	100%	PASS
C	CVSO vs. KCG (head-to-head)	22%	FAIL
D	CVSO vs. KCG (cost as determining factor)	86%	PASS
E	RNLI structure and RNLI Benchmark	100%	PASS

In the next chapter these results will be discussed and concluding remarks will be made for both the CVSO and for further research.

Chapter 6

DISCUSSION AND CONCLUSION

6.1 Discussion

In the previous chapters, we reviewed International SAR System and the Korean SAR system, the USCG Auxiliary and UK RNLI, the raw data delivered by KCG for maritime incidents for the five-year period from 2008-2012, and finally ran an experiment which tested how successful a hypothetical CVSO could be given certain characteristics or parameters. Of the five options calculated, two were extremely successful; one was very successful, while two were clearly failures. First, we will review the failures, and then consider the successful scenarios.

The most abject failure of our five scenarios was Scenario C, in which the CVSO and KCG competed head-to-head. This scenario shows what it would be like if the Korean government were to disband the KCG and replace it with nothing but a fleet of volunteers. The main problem with this hypothetical scenario is that the CVSO has only slow fishing boats. If the Korean government chose to disband KCG, it must have a new professional SAR agency ready to perform SAR operations immediately upon folding KCG. While President Park Geun-Hye has talked about disbanding Korea Coast Guard, as of writing this paper, no viable agency has been created to replace it. Based on this study, only 22% of maritime incidents could be responded to faster or at the same speed as KCG. This is a terrible percentage and it should give the Korean government a moment to pause and consider the negative repercussions of simply doing away with KCG entirely.

The next scenario in which the CVSO failed was Scenario A: an Auxiliary organization using the RNLI benchmark. Again, the problem stems from the physical limitations of the fishing boats that are used for CVSO SAR operations. A fishing boat traveling 10 to 15 knots simply cannot reach distress vessels 10 NM away in 30 minutes or less. It is absolutely impossible; the distance a fishing boat can travel in 30 minutes is about 5 to 7 NM. So it is quite unfair to judge fishing boats using a benchmark used to judge purpose-built lifeboats. This indicates that if Korea is going to have a CVSO, it must align its operational capabilities with expectations. The Korean government should not set the CVSO up for failure, especially considering the viciousness of the Korean media, who is looking for people and organizations to blame, even if unjustly.

The worst of the successful scenarios was Scenario D, in which the KCG and CVSO both respond, but the winner is the one who can respond at a lower cost than the other. Here it appears that the CVSO would be a very good supplement to the active duty Coast Guard, not replace it entirely. In this scenario, it is quite likely that the CVSO could assist the KCG in performing SAR cases when KCG is either too far away or already engaged in other missions, such as illegal immigration interdiction and fisheries protection.

There are two other successful scenarios, one in which the CVSO is an Auxiliary judged by the USCG benchmark, and the other in which the CVSO is structured like the RNLI and is judged by the RNLI benchmark. It may be interesting to note that the worst scenario was the Auxiliary structure judged by the RNLI benchmark. It would seem that mixing and matching structures and benchmarks is not a very good idea. Rather, one should choose one of the two models and use benchmarks tailored for that model. This leaves the reader with the natural question: *Then which model should we Koreans choose?*

I suggest that Korea should choose the Auxiliary model, and I have two very strong reasons for this suggestion. It is true that in Chapter 3, I wrote about RNLI in glowing terms. There is no doubt whatsoever that they have the better lifeboat facilities, a simpler and more streamlined bureaucracy, and world-class training. The RNLI is so good that the UK has a tiny Coast Guard that is miniscule compared to other developed nations. But there is a problem. The RNLI is an exceedingly expensive organization. As discussed in Chapter 3, RNLI has 200 years of lifesaving history; it is famous and well-respected; it is one of the most efficient charities in the UK; and it is capable of raising millions of dollars from corporate donors, individual donors, and even estates that bequeath small fortunes in gratitude for a family member's life saved. To be perfectly frank, a new Korean CVSO cannot do this, and to try to emulate RNLI from the beginning would be quixotic at best.

To start an Auxiliary, on the other hand, is quite affordable. As discussed in Chapter 3, the idea of an Auxiliary was begun by private boaters who volunteered themselves and their personally owned boats to help the Coast Guard fulfill its missions. Most of the expense is born by the members who are willing to take on the responsibilities of training and patrolling. In return the USCG offers members some reimbursement for fuel and pro-rated maintenance fees, insurance while under orders, and recognition. In terms of dollars spent, recognition is almost free; ribbons, medals, and certificates cost little to produce and distribute, but to Auxiliary members, recognition is better than money. Any person can win money, but only Auxiliarists can be awarded certain medals and ribbons, or other insignia, and there is a great deal of pride in winning unique awards.

It is clear that cost is the most important reason for choosing the Auxiliary model, but there is a second very important reason, and that is the scope of missions that an Auxiliary can do. This is a very appealing aspect, and one that the KCG should consider thoroughly. And considering that the Amended SAR Act of 2012 specified that the CVSO be multi-mission, the decision to choose an Auxiliary rather than an RNLI has a strong legal basis. There are several missions the Korean CVSO can introduce. Take for example, the basic data observed in Chapter 4. We learned that the most common maritime incident was fishing boat (trawler) with engine failure due to poor maintenance. This combination alone accounted for more than a quarter of all incidents. This sends a clear signal that what Korea needs more than anything else is a Commercial Fishing Vessel Examination (CVFE) program. Such a program would *prevent* about 500 SAR incidents per year, and it just so happens that the USCG Auxiliary already has a successful CVFE program that has existed for decades. If Korea chose to have a Korea Coast Guard Auxiliary that not only performed SAR missions, but also had SAR prevention programs such as the CFVE program, KCG would find that it would have many fewer SAR call-outs, and those call-outs could be performed by the Auxiliary. Meanwhile, the KCG vessels could stay on-task with other critical missions. This seems to be a winning combination; not only is the Auxiliary model affordable, but it is effective.

Another aspect of the USCG Auxiliary that is appealing to a Korea CVSO is the Public Education opportunities. In 2012 alone, the USCG Auxiliary provided 3,539 boating safety courses to over 90,000 students. (USCG Auxiliary 2012). These courses require no investment from the US Coast Guard, as the textbooks are published by the Auxiliary. Local units (flotillas) buy them from the national organization and then charge students a nominal fee to cover their costs and to raise money to support other missions. There is no record of how many lives the Auxiliary estimates it saves by offering these courses, but it must be significant if members are willing to volunteer to teach 3,539 courses per year. Again, this is an area in which the Korean CVSO could, like the USCG Auxiliary, help prevent maritime incidents so that the KCG will have less demand on its SAR services. For a small investment in material development and time, KCG could see its SAR costs lowered and have more time to focus on other core missions.

But what of the RNLI model? Does it not deserve serious consideration? Indeed, it does. The RNLI is a venerable institution with an admirable record of success. If Korea would like to have a CVSO modeled upon the RNLI, it should first erect an Auxiliary, and then over the course of decades phase out the Auxiliary model little by little as it phases in the RNLI model. This may seem to contradict what I said above—that mixing and matching is not a good idea—however, it does not. One must not have an Auxiliary and use the RNLI benchmark; that is the bad mix. Creating a new benchmark or having two benchmarks appropriate to the vessels on-hand is fine.

In the short term, meaning within five years, the first thing to do is to have most of coastal fishing boats become members of the CVSO and then establish the Korean CVSO according to the Auxiliary model. All USCG Auxiliary manuals should be translated into Korean and adjusted to meet Korean law and regulation. The membership training program should be in full swing. In addition to the core SAR mission, the CVSO should also have a well establish CFVE program as well as recreational boating safety vessel exams.

In the mid-term, which is within ten years, the national organization should be in full swing and the organization should be expanding into smaller areas. Members of the CVSO should be starting to integrate with their local KCG units and forming active partnerships, and begin to introduce some features of the RNLI model. At this stage, it should be possible, either with public or private funds (or both) to establish two boat stations with their own lifeboats as shown in Fig. 6.1. This would allow full coverage of the entire coastal area within one hour of response time (travel time to on scene) with following assumptions:

- Rescue boat speed : 25 knots based on RNLI lifeboat (20-30 knots)
- Response time: 1 hour, which is the average time of USCG (90min.) and RNLI (30min.) required response times.

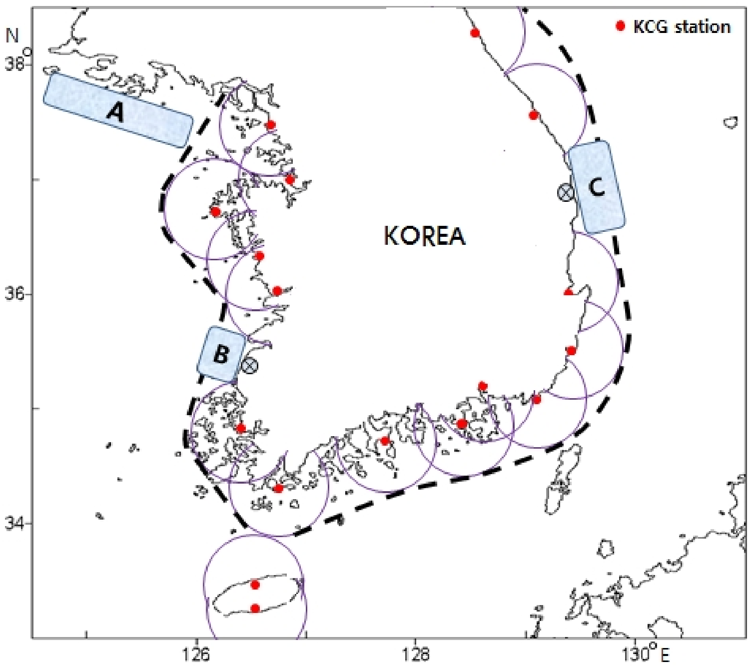

Fig. 6.1: Map of Korea with new benchmark and RNLI-type lifeboat stations

Fig. 6.1 shows the KCG stations as red dots. The 25 NM radiuses from each district headquarters are shown as purple arcs. The blue rectangles are those areas that cannot be covered by KCG within the stated parameters (25 NM in 60 minutes). It should be noted that Area A near the border with North Korea is too sensitive an area for civilian volunteers, and would therefore be covered by ROK Navy or KCG patrol vessels.

Area B and Area C would need a CVSO lifeboat station with lifeboat just as RNLI has. The new lifeboat stations are indicated by circles with an X in them (⊗). Area B is the area between Mokpo and Gunsan, with the area near Gusipo Beach being a possible location. Area C is between Pohang and Donghae, with the area south of Uljin, near Mangyangjeong Beach or the Uljin Expo Park being a possible location. With these two stations as test beds, KCG and the Korean people can decide if the benefits of the RNLI model meet the expenses of building the lifeboat stations and buying purpose-made lifeboats.

Another method for placing lifeboats and lifeboat stations can be developed using "heat maps". A heat map is a map that shows the density of the thing being measured; in our case, maritime incidents. In Fig. 6.2, there is a heat map of the incidents in the Mokpo district 2008-2012 as used throughout this paper. Red indicates the "hottest" areas; that is, the areas with the highest frequency of incidents, while the green indicates the incidents are fairly infrequent. Just as Fig. 6.1 showed gaps in SAR coverage, Fig 6.2 shows where extra capacity is needed to ensure complete and effective SAR coverage. In the case of the Mokpo District as shown on the heat map in Fig. 6.2, the islands with Heuksan-myeon and Bigeum-myeon could use lifeboat stations. The entire straits area from Beopseong-ri in the north, all the way south to Jodo-myeon could use lifeboat stations about every 20 NM. Heat maps such as the one below in Fig. 6.2 can make lifeboat station placement very easy. Since heat maps can be updated with every incident, the dynamic nature can help indicate where new “hot spots” are developing.

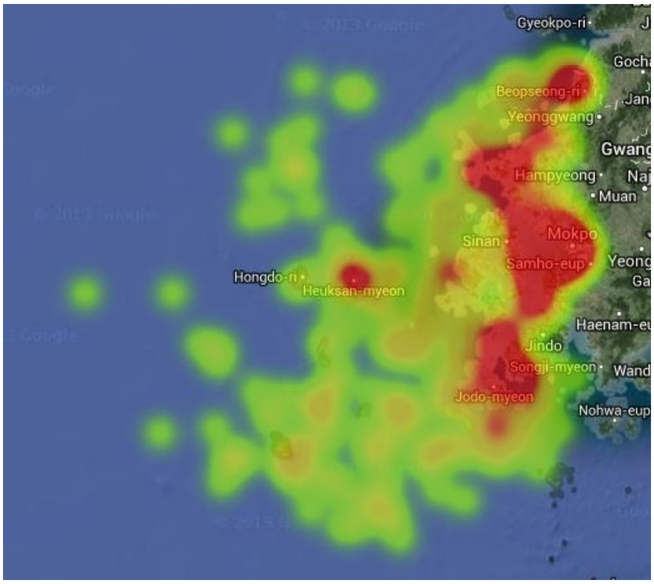

Fig. 6.2: Heat map of Mokpo incidents

Also, at this 10-year mark, both legal and financial foundations should be laid for massive private fundraising with the idea of building a base of capital from which the CVSO can start to invest in land on which to build future lifeboat stations. Meanwhile, the CVSO should have a set of public education courses and a marine environmental protection program established and fully operating.

In the long term, which is twenty years, the CVSO should have a steady stream of donations that can be used for continuing capital projects. It is hoped that the two lifeboat stations discussed above will have proven their value, and generated enthusiasm for more. Thus, by this point, the CVSO may have at least one corporately-owned, purpose-built lifeboat per KCG district, as well as vacant land ready for lifeboat stations in the remote areas.

By fifty years, the CVSO should be actively phasing in the RNLI model for SAR, while maintaining the Auxiliary organization structure to accommodate the non-SAR missions, such as the vessel exam program, public education program, and the marine environment program. It is assumed that throughout the history of the Korean CVSO, fundraising has played a major role in its activities. At this point, it is possible that the CVSO may be able to start covering its own operating costs, provided that the fundraising has been successful.

If I could emphasize one point above all, it would be that Korea must not try to reinvent the wheel. That is, it should not try to make a unique organization based on the idea that Korea's situation is unique; it is not. There are universal principles and no nation is so unique that it can live as if those principles do not affect it in the same way those principles affect everyone else. To try to create an organization that is unique is a waste of time, money, and effort. IMO and ICAO have already laid out a flexible framework that can work for every nation. A Korean CVSO would be wise, for example, not to write an operations manual from scratch, but to take the USCG Auxiliary operations manual, translate it, and 'tweak' it. A Korean CVSO would be wise to structure itself and its operations exactly as in *IAMSAR, Volume I*, because that is *the* standard by which all other signatory nations abide. When so much experience and study has already developed SAR systems that work, it does not make sense to try to recreate one from scratch. That is why in this paper I have sought to discover the optimal structure for Korea, not create an entirely new structure. The optimal structure for Korea is the USCG Auxiliary model, based on costs and the need for missions other than pure SAR response.

This study is not a mere case study. Rather, I developed a method that can be used in every nation seeking to establish a CVSO. Korea just happened to be the case that proved this method works; however this method can be used anywhere and everywhere, provided data is available. After this dissertation is published, this method will be used for the small island nations in the South Pacific to help them collect data properly, analyze the data, and then decide for themselves whether they would like an Auxiliary or a Lifeboat Institute for their own CVSO. The USCG Auxiliary in Guam and Saipan will use the method to test their value to the islands and verify their current mission assignments.

6.2 Concluding remarks

This paper focused on the USCG Auxiliary and UK's RNLI because these are the two primary models for CVSOs in the world. Even though other nations use the Auxiliary or RNLI model, each nation has differences in details, slight adjustments to the primary model specific to each country. If one were looking to expand the field for more ideas, one could look to the Canadian Coast Guard Auxiliary or the Caribbean island nations who follow the Auxiliary model, or look to the Société Nationale de Sauvetage en Mer (France), German Maritime Search and Rescue Service, Norsk Selskabtil Skibbrudnes Redning (Norway, also called Redningsselskapet), the Royal Netherlands Sea Rescue Institute, and Maritime Rescue of Japan which all follow the RNLI model. These two typical models have their advantages and disadvantages.

In this paper I have not sought to create a new civilian volunteer SAR organization for Korea, but rather to choose which of the two primary models is better for Korea. To do this I took five years of maritime incident data from KCG, chose the Mokpo District as the sample, and ran five scenarios and looked at success rates. Both the USCG Auxiliary-style operations measured by the USCG benchmark and the RNLI-style operations measured by the RNLI benchmark were successful. This led to other considerations, namely cost and missions. If Korea wanted a purely SAR response organization, RNLI has the better model and greater capability to save lives than the USCG Auxiliary. However, it is exceedingly expensive and Korea simply cannot make that kind of investment immediately. If Korea wants a multi-mission organization that it can establish with minimal investment and risk to the government, then the Auxiliary model is better.

In conclusion, taking into consideration the extreme difficulty of fundraising in Korea, CVSO should start by assisting KCG SAR operations with member-owned facilities stage in the same manner as the USCG Auxiliary. Then in the mid-term, along with advertising its performance to the public and gaining financial support from both government and personal donations, CVSO could phase-in features of the RNLI system by establishing at least two boat stations (Area B between Gunsan and Mokpo, and Area C between Donghae and Pohang as shown in Fig. 6.1) to respond to any maritime incident within 1 hour of accident occurrence within territorial waters. Furthermore, based on the data examined in Chapter 4, Korea Coast Guard needs more than just help with SAR response; it needs help with SAR prevention. RNLI's model does not accommodate SAR prevention programs as well as the USCG Auxiliary model. Therefore, based on costs, and based on the need for a multi-mission CVSO that can assist KCG in its many missions, the Korean CVSO should be established as a Coast Guard Auxiliary. Finally, this method is not a case study limited to Korea, but rather a generalizable method exportable to other nations searching for maritime SAR solutions.

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