

## LESSONS LEARNED FROM LATIN AMERICA: FORTY YEARS AGO - THE METULA INCIDENT



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### Introduction

In 2014, rich in mythical anniversaries (including the 30 prolific years of ISCO), everyone talks about the 25th anniversary of Exxon Valdez, and rightly so. This incident deeply impacted the maritime and oil industries, and, above all, the regulatory states; therefore, it became and will forever be a mandatory reference in relation to oil spill control issues and their implications (e.g., OPA 90 and, later, IMO's OPRC).



Latin America also has its anniversaries, but they are not as highlighted as they should be. The VLCC Metula incident is one of those cases. It was an incident in cold water and weather conditions, previous to that of Exxon Valdez. Even earlier, the sinking of the Arrow in Nova Scotia (Canada), a previous and close in time incident that took place in the Americas, occurred, but we have to take into account that it was 25 times smaller in terms of oil spilled and environmental consequences. Why the lack of interest and absence of technical and scientific exchange about these incidents in Latin America? In the Metula<sup>1</sup> incident, we have to consider that even the closure of navigation through the Strait of Magellan was at risk. In that case, the vessels would have had to be veered to the dreaded Drake Passage, with the consequent danger and costs involved.<sup>2</sup> Answers may vary. The industry in developing countries does not help, because it prefers not to revive old demons by interpreting facts out of context, because this always generates negative opinions on safety and environmental effects of its activities. Nor do

environmental advocacy groups, which are still in the beginning stages and disorganized in Latin America (with certain exceptions, such as Brazil). These groups lack rigour and are too biased to give a rational interpretation of local incidents. As a corollary, it is not surprising that the media follows this same pattern and seldom investigates or mentions these past events that do not appeal to most readers in this time of immediacy and little reflection. However, some distinct progress could be pointed out in certain countries in recent years that enable them to pass some advanced environmental laws (e.g., Mexico). Notwithstanding, despite the exceptions, to change this general perception we must start by remembering and withholding our own lessons learned. It is interesting to reconstruct this case from our current perspective. Some documents that were classified then are available now, among them confidential telegrams from the U.S. Secretary of State during that pivotal era, Henry Kissinger.<sup>3</sup>

If 100 years later we are able to assimilate the facts of the disaster of the Titanic, which were so widely covered by the media and from which we still obtain transferable lessons learned, we should be able to assimilate the most recent lessons learned from disasters in our own backyard.

This paper aims to present a current and distinct approach to the Metula event, highlighting lessons learned for Latin America that are still valid. We have to remind the reader about the regional context: in 1974 Chile had latent topics and disputes on the Beagle Channel with neighbouring Argentina, and nationalist governments on both countries zealously nurtured all topics related to territorial sovereignty. Apart from the specific topic of the incident, it was probably not the best time for interacting among neighbours that were at the start of an arms race along the common border.<sup>4</sup> Subsequent events in response to this incident demonstrated the need for co-operation between both countries in that inhospitable, particularly sensitive environment that required that maritime actions be taken by both countries in support of the salvage.

### Actors and Context

Forty years ago, in 1974, two Latin American countries—Chile and its Navy, as the directly affected side, and Argentina, with its Harvella tanker for specific supporting actions—were involved in an incident when the Metula went aground in the Strait of Magellan, in Chilean waters.<sup>5</sup> The Chilean Navy had a pioneering role as Incident Commander. At that time this position was not even legally referenced as it is today. Chilean contingency plans were very elemental, at best. The Chilean Navy had few naval and air units stationed in the South at that time (the Lautaro tug, small patrol vessels, and DC-3 aircraft from the naval aviation), which would carry out crucial logistical tasks in the emergency.

Furthermore, the Chilean Navy would conduct support tasks through permanent forecasts presented by its efficient Hydrographic

and Oceanographic Service<sup>6</sup> and with other technicians in hull inspections and evaluations seeking to refloat the vessel, as well as permanent aerial surveillance. The Marines were assigned to observe the impact on the coast, which could be summarized as a primary location and quantification work of the affected coast, probably the collection of harmed wildlife and little else.<sup>7</sup> These were the specific resources—all military- technicians—that were available in that inhospitable end of the world.

We must also add another country regarding this incident: The Netherlands. VLCC Metula was registered in an overseas territory of the Netherlands; its captain came from that country, as did the carrier and its subsidiaries. Even the salvage company would be the renowned SMIT of the same origin.<sup>8</sup> It is also important to highlight the participation after the incident of several U.S. organisations, which were initially appointed as consultants by Chile and focused on requesting that the Coast Guard send a multidisciplinary task force to support this event.<sup>9</sup> IMCO (now IMO) collaborated with an expert scientist from the first days after the accident. P&I Club representatives, especially TOVALOP's representative<sup>10</sup>, along with representatives from Shell—the shipowner and also involved in this event as carrier—had to deal with the responsibilities and would maximize their efforts towards one primary purpose: the salvage and moving away of the vessel from the site of the incident as soon as possible.

This display of so many actors came about because there was no precedent of a disaster of such magnitude and in such extreme conditions. An estimated crude oil spill of 51,500 tons during the first days and another 2,000 tons of bunker C from a fuel tank, totalled more than 17,000 tons spilled in excess of the Exxon Valdez incident that took place 15 years later in Alaskan waters and was widely covered by the media. Comparing these two cases is not irrelevant: they both occurred in cold waters and extremely sensitive ecosystems, in sparsely populated areas, in comparable latitudes in the northern and southern hemispheres with minimal evaporation rates, and the product spilled was highly persistent and harmful to the environment. In both cases human errors made by the crew, and specifically by the officers, were decisive for the occurrence of the incident. It is paradoxical that while in such places there could be adverse weather conditions at certain times, when these events occurred the sea and winds were calm and visibility was normal and within the range expected for the evening hours during which both incidents took place. Engines and navigation equipment were working perfectly. However, there are some differences regarding response. In the Exxon Valdez incident indigenous populations were concerned, while in the Tierra del Fuego incident the nearby original population had been extinct for almost a century. Perhaps for that reason in the case of Exxon Valdez the largest coast treatment effort ever deployed to that date was carried out, while in the Metula case the response strategy selected was limited to discontinuous monitoring and subsequent sporadic assessment by scientific missions. After the first month of uncertainty and role clarification the missions started; they included scientists from Instituto de la Patagonia in Punta Arenas (a protagonist from the start of the incident) and University of Chile, and sponsorship by the National Oceanic and Atmospheric Administration (NOAA) that visualized the opportunity and potential scientific yield of the situation.<sup>11</sup>

To illustrate how environmental issues were handled in those days, a year earlier—in June 1973—the Napier tanker ran aground in the Aysen area (Guamblin Island), also in Chile. The result was a 30,000 ton crude oil spill. After an evaluation the authorities decided that the Chilean Air Force would fire rockets upon the ship to burn and eliminate the spilled oil. The decision was consensual and had the scientific support of the Catholic University of Chile.<sup>12</sup> This decision should not come as a surprise: six years before the same procedure had been carried out with Torrey Canyon, albeit with several questions asked in the UK about the validity of that strategy.

Regarding Metula, it was a long 19 days after the event that the first flight departed to get a detailed initial assessment. The flight was staffed by personnel from Chile's Instituto de la Patagonia, Texas A&M (member of the U.S. task force sponsored by the Coast Guard and the Department of Transportation) and IMCO.<sup>13</sup> The odd thing was that this was not directly supported by the Chile's Navy or Air Force so it was necessary to get a small private plane to perform this crucial valuation flight with renowned experts. The foreign experts went on board naval reconnaissance aircraft for the first time 25 days after the event, when the magnitude of the environmental catastrophe had probably been sized by the Naval Command in Valparaiso and government authorities in Santiago. It was in January 1975 that a joint science mission took place, including experts from Chile and the U.S. (NOAA, EPA, and the Coast Guard), to assess the effects on marine life and intertidal zones. New scientific assessments were performed by the U.S. a year later to find out the effects of oil weathering and environmental impacts on ecosystems. That incident would debunk the myth that oil was likely to disappear in the Atlantic Ocean or even the belief that the damage had been done and the constant tides would clean the coasts. The scarcity and lack of basic scientific information was evidenced by these actions.

## **Incident and Salvage**

Below we shall state some details of the incident on that austral winter night on 9 August, 1974.<sup>14</sup> Metula was registered in the Netherlands Antilles and was one of the first VLCC that crossed the strait. She was the fourth ship of those features to cross it, but it was the Captain's first time. Her dimensions were: length 325 m, beam 47 m, draft 19 m, power 90,000 HP. She had 206,000 tons of displacement and her crude oil cargo was 193,472 tons, with a value greater than 18 million dollars.<sup>15</sup> The shipowner was the Curaçaosche Scheepvaart Maats oil company, a Shell subsidiary, and it had been time-chartered to Shell Tankers B.V. of Rotterdam, and, in turn, voyage chartered to Shell International Marine (SIM) of London.<sup>16</sup> There was no doubt about the liability as carrier of the Dutch multinational oil company. However, this trip was under a contract with ENAP (Chile's National Oil Company), which was the owner of the cargo, since its purchase was FOB. This was an essential detail when determining the liability for potential compensation.

Regardless of the amount and due to subsequent consequences, it is important to highlight that the cargo came from Ras Tanura (Saudi Arabia) in the Persian Gulf and was thus Arabian Light Crude Oil.<sup>17</sup> With 34° API gravity, it is possible to understand its characteristics and persistence, especially in cold weather like the one it had to endure until the arrival to its final destination: Quintero Bay in Chile.

There can be little argument about the itinerary chosen to cross southern waters. Since Magellan's time, seamen have preferred the Strait to the waters of the Drake Passage. The cost of pilots could be largely offset by the time gains and decreased risks due to the permanent bad weather in the Passage area. Navigation in the Strait's restricted waters was then limited by the two narrows, which were very well known by Chilean seamen. To go through, it was necessary to take two pilots at the entrance of the eastern mouth of the Strait. The main complication for a vessel of this size was the exit of the First Narrows, which had to be performed a few hours before high tide. This meant sailing against the current, which favoured navigation due to the inertia increased by the full load

displacement. In summary, this meant that there were two possibilities to cross the narrows: in the morning or at night.

The captains of VLCC that had previously crossed over the narrows had specifically recommended doing it during daylight. As was established in subsequent investigations by the Chilean Navy, the pilots arrived on board the ship nearly half a day late due to operational issues with another ship. This would prove that Chilean authorities had not made provisions for a suitable manning for this service. The margin for Metula's Captain was thus reduced and the difficulty of the Captain's decision can be understood: shipowners requiring compliance with the time of arrival and the priority of safe navigation in restricted waters, which ended up taking place that day, in relatively calm waters.

The pilots, who came directly from their previous operation, boarded the ship in the evening. The engine was set at full speed to arrive to the narrows as soon as possible. Right then, an unexpected event occurred, and it is difficult to explain it, even today. The Chilean charts used by the pilots are widely used, but they did not coincide with those in the ship, produced by the British Admiralty.<sup>18</sup> In sum, the dangerous Satellite shoal located off of the First Narrows appeared closer than expected to the course that had been plotted as safe, therefore restraining the space to manoeuvre. As a result, the Captain tried to verify the pilots' navigation. According to the investigation, this meant a loss of valuable time, and confusion took over the bridge. It was impossible to stop the vessel, which was sailing at 14.5 knots, as this would have reduced the steering capacity due to the strong spring tide against her (close to 8 knots).



There was also no possibility of that massive vessel going astern. The attempt to circumvent the shoal with a zigzag manoeuvre failed and the vessel ran aground at 10:15 PM on the Satellite Patch Shoal with her bow in 15 metres of water.<sup>19</sup>

Oil spills from the fore tanks were immediately detected. The first report, issued the next day, mentioned a spill estimated at 6,000 tons. The hope of high tide (a 6-metre difference) had no results and two days later the situation worsened; the vessel was rotated by the nearly 50-knot wind and the tide. She ended up lying on the bank and its hull suffered further damage caused by rocks. To make matters worse, the engine room flooded, which caused a complete black-out.

The reports issued the following days showed crude oil spills that, on 22 August, reached 40,000 tons. According to direct references, significant oil leaks were detected as far in as 9 September, nearly one month after the incident.<sup>20</sup> Nobody in the area was prepared for an incident of this magnitude. This was proved by the fact that a whole 20 days—i.e., almost three weeks—had passed before technical and logistical problems were resolved and the oil transfer to the Argentine tanker Harvella started. Harvella had a 19,000 ton capacity and was in the area to help with the salvage. The operation was supervised by the company responsible and controlled by the Chilean authorities. Metula was unloaded and lightened for two weeks, which enabled her to be towed away from the shoal. Meanwhile, welding and collision mat works were performed on board. Four trips took place between August 28 and September 14, with an average of 12,000 tons each. The oil was transferred to the Norwegian tanker Bergeland, with some 100,000 tons of displacement, which was anchored to the West of the incident in the Bay of Felipe.<sup>21</sup> This operation required tight calculations by SMIT experts to determine the tanks to be unloaded. There was no equipment with such pumping capacity as required in the area.<sup>22</sup> A layer of water was left under the oil remnants to prevent subsequent losses. Notice the lead time: almost one month for the first oil transfer and then about 15 days to finalize the four manoeuvres and complete the total oil transfer. Taking into account the weather conditions and time of year, one cannot but admire the skill and professionalism of these sailors. The Argentine "Harvella" crew received further praise and recognition from SMIT Dutch experts.<sup>23</sup>

Lastly, on 25 September, the three SMIT Dutch tugs—Zwarte Zee, North Sea, and Smith Salvor—with a total power of 23,500 HP, were successful on releasing the grounded ship and towing her to the protected Bay of Felipe.<sup>24</sup>

After finishing the transfer on 10 October the vessel was towed to Brazil, because Argentina refused to authorize that she be anchored in its waters while her final destination was decided. After some time of being anchored near Ilha Grande, off Rio de Janeiro, the vessel was sent to Maliaño (Cantabria) where she arrived under the name Tula and was scrapped.

## Response and Environmental Impact

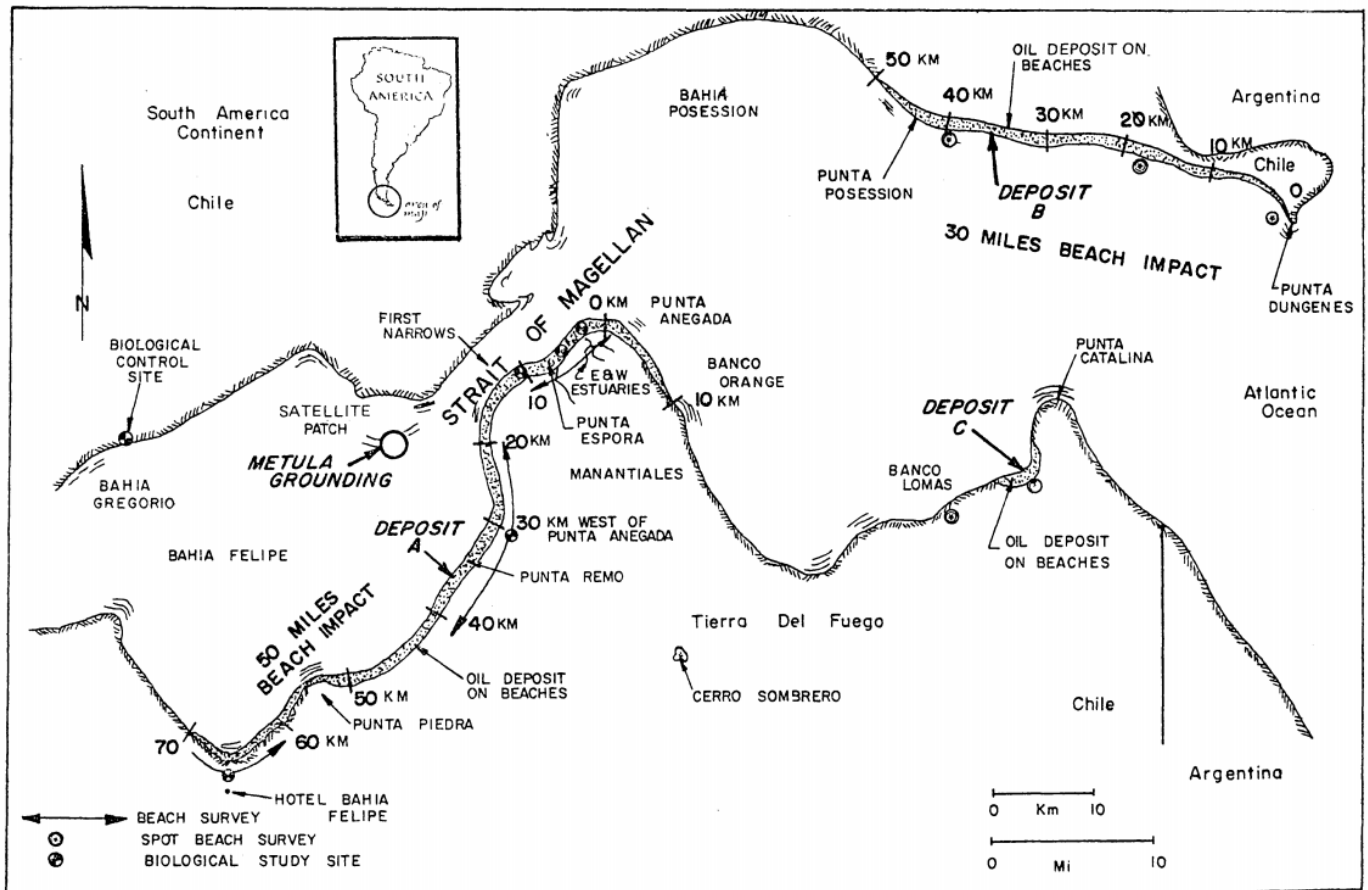


Figure 1. Site of *Metula* grounding and the associated oil-impacted beaches, according to field survey made in January 1975

The environmental consequences and damage to the ecosystem are detailed in papers compiled in several investigations, which can be found in the Proceedings of IOSC events made in the years following the incident.<sup>25</sup> We specially highlight Hann's works and scientific descriptions, the only ones written immediately after the event.<sup>26</sup> There were more than 2,500 square kilometres affected in the Strait area, both to the North and to the South of the Strait, on Tierra del Fuego's coast, with a total 270 km of coast affected to varying degrees. Reports are highly revealing about the state of the coast, and research papers highlight that years later there was petrification of oil layers in the more affected areas. In short, even today parts of the coast are literally asphalted. Those initial reports already accounted for marine and coastal wildlife mortality. They pointed out possible future effects on the migration of certain types of penguins and impacts to intertidal ecosystems.

Lack of proper scientific technology in Chile led to the first samples collected by experts to be sent for analysis to Coast Guard laboratories in Connecticut (U.S.) one month after the incident. Afterwards, the Chilean Navy took its own samples to be channelled internally and most probably with protocols developed with support from the Instituto de la Patagonia and national universities that were involved in the event.<sup>27</sup>

The reports also mentioned the following important issue: while it was possible to perform cleanup actions on the coast, it would be very difficult and expensive because of location, climate, ground, and tidal differences, as well as the staff and equipment logistics required. There was also complete uncertainty as to the amount of oil spilled, its environmental impact, and thus, which area had to be cleaned up. The possibility that the impact of cleanup actions would worsen the situation was not ruled out. A legal battle (with its implications about aids to navigation and Chilean pilots in the incident) took place alongside unanswered questions about financing.<sup>28</sup> However, the reports concluded that, if the decision was made to clean up the site, the narrows and the western area of the Strait had to be prioritized. The initial statement of the external experts would be crucial for the Chilean authorities when making the final decision on the best response strategy to implement under the circumstances. The authorities decided that the best strategy would be to monitor and assess the spill; in the author's opinion, all those directly involved agreed. Recognized strategies such as containment and recovery were not applicable due to the state of the sea and the lack of appropriate equipment for those conditions. The use of dispersants was discarded for logistical reasons rather than for their efficiency. The general belief in those days was that existing dispersants were effective. The problem was that the dosage required was 1-to-10 and those amounts were not feasible, even globally. Those were different times. However, the issue of sea coast treatment was more debatable. That issue was the result of an incipient NEBA without today's scientific rigour. It was undoubtedly called by the circumstances, but it supported the decisions taken by the authorities.

The environmental assessment performed after the incident by Canada's Emergencies Science and Technology Section considered the long-term natural elimination of oil spilled during this incident, which had no coast treatment whatsoever.<sup>29</sup> Nevertheless, according to scientific reports at the time, nowadays the incident would certainly qualify as an ecological disaster.<sup>30</sup>

## Compensation

Once again, we must not lose perspective: it was the mid-70s, a time when the first environmental movements and pressure were emerging in developed countries, in the form of "green" parties. IMCO had just been able to adopt a new environmental agreement

for vessels under its 1973 MARPOL Convention, which under Annex I would specifically regulate the prevention of pollution by oil from operational measures as well as from accidental discharges.<sup>31</sup>

Moreover, the important International Convention on Civil Liability for Oil Pollution Damage (CLC), adopted in 1969, would enter into force in 1975, probably due to the influence of its ratification by several countries due to many major incidents in those years—among them, the Jacob Maersk incident in Portuguese waters in 1975. Neither Chile nor Argentina were within the first countries that ratified the CLC. To date, Chile has ratified the 1992 CLC, but not the 1992 FUND Convention.

The Convention that would work in this case would be the private TOVALOP scheme, created in 1969 and parallel to IMO's CLC, which represented shipowners and charterers of supertankers such as Metula and were, in most cases, oil companies or their subsidiaries. TOVALOP was managed by ITOPF, which sought to consolidate its roles. Its initial compensation limits were considered very low from the start: US\$100 per ton of gross tonnage and a US\$10 million maximum limit per incident. Taking into account only the spill, this would have totalled approximately US\$5 million in the case of Metula.<sup>32</sup> Another private scheme in place was CRISTAL, in force since 1971. However, CRISTAL did not apply to this event because ENAP, the owner of the cargo, did not subscribe to the agreement—neither did the remaining Latin American national oil companies (NOC). The compensation amount stated by the latter was triple the amount established by TOVALOP. Metula was chartered by SIM, an international oil company (IOC), which was registered with TOVALOP; therefore, TOVALOP would compensate Chile for the damage caused by the spill. There is a clear difference between compensation amounts due to Chile's lack of foresight. This would have also been the case had there been a similar incident in any other country in Latin America, because processes for ratifying IMO conventions are very slow in the region—the reasons exceed the scope of this paper, but should be worked out by regional organizations.

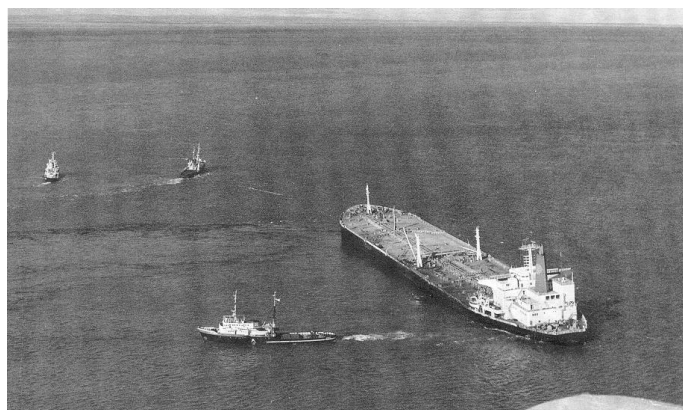
On 4 November, Chilean authorities reached an agreement with Shell Tankers B.V. Rotterdam for the latter to compensate the costs incurred as a result of the incident.<sup>33</sup> The agreement provided for:

- US\$36,185 for costs associated with refloating VLCC Metula and monitoring the environmental damage identified so far.
- US\$250,000 for costs related to paying the U.S. Coast Guard for its role in unloading and refloating the tanker.
- US\$25,000 towards two scholarships for members of Instituto de la Patagonia in Punta Arenas, to study ecological damage assessment and oil pollution control in the UK.

One last clause established a waiver to any further claims by either party. Although nowadays US\$311,185 would be worth five times as much, the amount sounds meagre considering the damage sustained.<sup>34</sup> At the time, the price for an oil barrel was US\$13.<sup>35</sup>

One cannot view these figures in today's light without considering the circumstances that originated them. The query that may arise is as to why the compensation agreement was signed so quickly—within three months of the incident—when there could still be instances of appeal after the incident was investigated, as well as potential claims for environmental damage after serious scientific research was carried out—the results of which were available several months later. In those times, Chilean law allowed for filing a claim for damages within up to two years after an incident.<sup>36</sup>

## Conclusions



The summary investigation filed by the Coast Guard of the Chilean Navy (Dirección de Litoral) was influential in exposing human factors that enabled the incident to happen. There is no doubt that actors shared the blame, and it would be impossible to replicate this blame-sharing exercise with today's standards and requirements. It is still hard to believe the Captain's defence theses that place the responsibility for the failure to set the ship to a new course on deep current problems that had not been studied in those times.<sup>37</sup> Further investigation criticised the lack of proper planning for the trip, especially, regarding navigating shallow and dangerous waters such as those of the Strait. Reinforcing watches and organising the work performed on the bridge better could have been useful. Starting the crossing manoeuvre in the narrows almost immediately after the pilots boarded was another likely cause for the incident. The lack of

prior analysis together with the pilots, of proper comparison of the different nautical charts, and the regrettable decision not to wait for the daylight hours, along with the Chilean pilots' noticeable fatigue, were reasons that very likely added fuel to the fire.

Forty years later, the lessons learned from the Metula incident are still valid.<sup>38</sup> Navigation prevention, contingency planning, disaster scenarios, sensitivity maps, assessment, effective response strategies, and appropriate logistics are essential tools that, for the first time, made their way into the vocabulary of several key actors in Latin America.

There were many consequences after the incident, such as improving buoyage in the Strait of Magellan, allocating new transfer boats for pilots in the Strait, incorporating aids to navigation that are enhanced by satellite connection, rearranging pilot assignment so pilots may have appropriate breaks, and internationally homologating Chilean Strait charts.

The case's consequences and scale should not be understated. It was the first VLCC that had a spill of this magnitude, losing more than 30% of her cargo. The Metula incident became a paradigmatic case worldwide for monitoring oil persistence in different types of affected habitats, i.e., the natural recovery of coasts affected by oil spills in cold climates. IMCO understood the need to invest in preparation and training for regulatory authorities in Latin America and, for the first time ever, established training programs on pollution prevention and control, which would develop over time.<sup>39</sup> Four years later, in 1978, Chilean ship Cabo Tamar spilled 12,000 tons of oil in the bay of San Vicente, near the strategic Talcahuano port. It was a complex and difficult case. Once again, ITOPF was there and worked together with experienced veterans from the Chilean Navy who had been at the Metula incident.<sup>40</sup>

Chilean Navy contingency plans and prevention schemes drew on the experience gained through the Metula incident, and response strategy decisions regarding this new scenario were consistent with present times.

Let us conclude with an anecdote. During the recent IOSC 2014 event, held in Savannah, Georgia, the author mentioned the 40-year Metula incident milestone as part of a presentation on safety and environmental issues related to oil spills in Latin America.<sup>41</sup> After the presentation, an excited attendee approached the author and thanked him for mentioning the incident. The attendee stated that he had been part of it and shared some of the details.

For many of us who delve in this topic, events such as the Metula incident mark our lives and even shape us professionally. The author would like to pay tribute to the attendee, Captain Francisco Pizarro, and to all of the other Chilean, Argentine, and Dutch actors who underwent that episode in Latin America, with some heroic features considering the circumstances in which it occurred and mentioning, above all, that there was no loss of human lives, which is always the first priority.

## References

- 1 <http://ioscproceedings.org/doi/abs/10.7901/2169-3358-1999-1-1075>
- 2 From the day after the accident, Chilean naval authorities in the area restricted navigation for vessels over 80,000 tons and/or with a draft of more than 50 feet.
- 3 [http://www.wikileaks.org/plusd/cables/1974STATE179876\\_b.html](http://www.wikileaks.org/plusd/cables/1974STATE179876_b.html)
- 4 Although it had no effect on the development of this incident, it is worth noting that in the nearby city of Punta Arenas, the main Chilean base in the South, curfew was in force until the early hours of the morning.
- 5 Schwarz, Jorge - El Caso Metula (The Metula Case), Edit. Instituto de Publicaciones Navales, Buenos Aires, 1978. This publication regarding Argentina's participation in the incident is recommended. The author was an Expert Senior Officer of the Argentine Navy who was directly involved in the operation, advising Argentine authorities on matters related to oil spill pollution. His story narrates the situation using fictitious names for its characters; it portrays the entire sequence of events and the actual operations performed for the Metula salvage, and it is a unique testimony about the circumstances experienced. Although the author did not venture opinion on the substantive reasons that caused the incident, he collected all the information available thus far from scientific reports, leaving no doubt about the extent of the damage done to ecosystems in the area. Even today it is a unique case in Latin America: the story is told by a protagonist in a maritime incident with oil spill consequences.
- 6 The Chilean Navy's Hydrographic and Oceanographic Service (SHOA, for its acronym in Spanish), has a well-earned reputation in Chile and among its peers throughout Latin America for the efficiency of its professionals and the quality and accuracy of its hydrographic and oceanographic publications. <http://www.shoa.cl/index.htm>
- 7 <http://www.gpo.gov/fdsys/pkg/CZIC-td195-p4-g86-1976/html/CZIC-td195-p4-g86-1976.htm>
- 8 Schwarz, Jorge - El Caso Metula, Chapter V, pp. 35-40 - Edit. Instituto de Publicaciones Navales, Buenos Aires, 1978. It is important to remark that the book emphasizes the salvage of the vessel with technical considerations that reflect a direct source of information from the Dutch company.
- 9 Ibid. Chapter VII, pp. 48-52. The U.S. had the Coast Guard's National Strike Force available at that time. It was the organization in charge of oil spill pollution control activities under the Clean Water Act (1972). When the incident occurred, Chile requested information from the U.S. government. Six days after the incident the Coast Guard sent a member of this specialized group as the first observer, and he provided advice to the Chilean naval command in charge of the disaster area during the following weeks.
- 10 TOVALOP – Tanker Owners Voluntary Agreement concerning Liability for Oil Pollution. It applied between 1969 and 1997 and it was the reason for the creation of the International Tanker Owners Pollution Federation (ITOPF).
- 11 <http://www.gpo.gov/fdsys/pkg/CZIC-td195-p4-g86-1976/html/CZIC-td195-p4-g86-1976.htm>
- 12 <http://rescateinternacionalchile.blogspot.com/2010/10/derrame-de-petroleo-y-posterior-rescate.html>
- 13 <https://www.princeton.edu/~ota/disk3/1975/7508/750815.PDF>
- 14 The following website (in Spanish) provides general information about the incident, collected from the available reports: <http://www.monografias.com/trabajos7/metul/metul.shtml>  
Author: D'Elía, Eduardo H.
- 15 <http://www.wtrg.com/prices.htm>
- 16 [http://www.helderline.nl/tanker/65/metula+\(2\)/](http://www.helderline.nl/tanker/65/metula+(2)/)
- 17 <http://www.eia.gov/todayinenergy/detail.cfm?id=7110>
- 18 According to the investigation, the Chilean charts were relatively recent, but the Admiralty charts were not. However, there were no differences between the two charts and discrepancies were merely apparent and were the result of the difference in the grid systems used. <http://www.monografias.com/trabajos7/metul/metul.shtml>
- 19 Schwarz, Jorge – Ibid. pp. 21-23
- 20 <http://www.gpo.gov/fdsys/pkg/CZIC-td195-p4-g86-1976/html/CZIC-td195-p4-g86-1976.htm>
- 21 Schwarz, Jorge – Ibid. pp. 84-94. This section describes the reasons that led to the decision to unload the vessel before attempting the refloating operation; however, in essence, the aim was to protect the remaining cargo, valued at more than US\$12 million at the time.
- 22 The Coast Guard was available and sent several pieces of equipment called ADAPTS that had a very high pumping capacity and were autonomous. Therefore, Metula's energy deficit was solved. <https://www.princeton.edu/~ota/disk3/1975/7508/750814.PDF>
- 23 Schwarz, Jorge – Ibid. pp. 134-138
- 24 It is important to note that the Argentine Navy Patrol Boat "Somellera" was present in the area from 18 to 23 August, but SMIT did not use her for the salvage operations. Reasons related to lack of agreement on the charter with SIM in Buenos Aires have been put forward. Schwarz, Jorge – Ibid. pp. 104-106. In the author's opinion it could probably have been due to very sensitive sovereignty issues at the time.
- 25 <http://ioscproceedings.org/>
- 26 Hann, Roy W. Jr. (1977) Fate of Oil from the Supertanker Metula. International Oil Spill Conference Proceedings: March 1977, Vol. 1977, Nbr.1, pp. 465-468. <http://ioscproceedings.org/doi/pdf/10.7901/2169-3358-1977-1-465>
- 27 However, let it be recorded that we were not able to confirm this with our research sources in Chile.
- 28 <http://www.gpo.gov/fdsys/pkg/CZIC-td195-p4-g86-1976/html/CZIC-td195-p4-g86-1976.htm>
- 29 Humphrey B. & Owens E. H. - EE-107 Report – Environment Canada – Environmental Protection Directorate, Dec. 1988 – page 109 [file:///C:/Users/multimax/Downloads/120AK%20\(2\).PDF](file:///C:/Users/multimax/Downloads/120AK%20(2).PDF)  
<http://www.sciencedirect.com/science/article/pii/S0025326X07003098>
- 30 <http://www.gpo.gov/fdsys/pkg/CZIC-td195-p4-g86-1976/html/CZIC-td195-p4-g86-1976.htm>
- 31 [http://www.imo.org/About/Conventions/ListOfConventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-\(MARPOL\).aspx](http://www.imo.org/About/Conventions/ListOfConventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-(MARPOL).aspx)
- 32 <file:///C:/Users/multimax/Downloads/Thesis%20final%20Hui%20Wang.pdf>  
<http://www.sciencedirect.com/science/article/pii/S0025326X07003098>
- 33 <http://www.gpo.gov/fdsys/pkg/CZIC-td195-p4-g86-1976/html/CZIC-td195-p4-g86-1976.htm>
- 34 <http://www.dollartimes.com/inflation/inflation.php?amount=1&year=1974>
- 35 <http://www.wtrg.com/prices.htm>
- 36 Schwarz, Jorge – Ibid. page 119

37 During the revision phase of this paper the author received the following remarks on this issue from Captain Francisco Pizarro (former Chief of the Bureau of International Affairs of the Chilean Navy): "... A remarkable USCG report we had available at the time stated that given the Strait's currents that run on the surface... after the tide changes nobody knows what happens to the water masses 20 metres deep. Upon analysing how water splits into two through the First Narrows, it is clear that there is a strong component towards starboard, which explains why, in a matter of five minutes, a vessel that was on track ran aground on the Satellite Patch Shoal (the author saw the original nautical chart used by Metula)."

38 <http://www.gpo.gov/fdsys/pkg/CZIC-td195-p4-g86-1976/html/CZIC-td195-p4-g86-1976.htm>

39 Roy W. Hann, Jr. and Harry N. Young, Jr. (1981) International Oil Spill Control Training Program. International Oil Spill Conference Proceedings: March 1981, Vol. 1981, Nbr. 1, pp. 113-118.

40 Captain Francisco Pizarro was the on-scene Commander of the Chilean Navy in this incident.

41 <http://ioscproceedings.org/toc/iosc/2014/1>

