



Pandemics, Outcomes of Polar Research and the Future

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Abstract

There have been many pandemic diseases in human history. Even in the 20th and 21st centuries, hundreds of thousands of people lost their lives due to diseases such as AIDS, cholera, influenza, SARS. One of the biggest effects on the rapid spread of diseases is the density of the population. World population density decreases in polar regions. With an area of 27 million square kilometers, 4 million people live in the Arctic region, and there is no resident population in Antarctica. However, in the established scientific stations, there are 4000 scientists in the summer and a thousand in the winter. Antarctica is visited by approximately 50.000 tourists every year.

The COVID-19 epidemic has spread to almost the whole world, and only 13 countries have not published any reports on the disease. Antarctica is the only continent that the disease is not known for. In addition to not having a settled population and not having a scheduled transportation route, strict measures applied to departures and returns to Antarctica prevented the disease from reaching here. Due to the global climate change that affects the entire world, especially the polar regions, agricultural areas and cities are changing, more diseases are experienced, and even diseases that do not exist before. It is anticipated that migration of climate change will occur due to all these. It is estimated that 200 million people will migrate by 2050, and the types of pandemics will increase and differ in this way. On the other hand, Polar regions bring new problems and solutions, as they are candidates for being the new future of humanity.

Keywords

Arctic, Antarctica, Climate change, Pandemic disease

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Introduction

The area to the north of the Arctic Circle (about 66°33' North latitude) is called the Arctic region and covers part of North America, Asia and Europe continents. Some regions of the USA, Canada, Denmark, Iceland, Norway, Finland, Sweden and Russia are located in the Arctic. Covering 14 million square kilometers of the surface area, the Arctic Ocean is the world's shallowest ocean and contains 1/3 of the world's hydrocarbon reserves. Within the framework of the United Nations Convention on the Law of the Sea (UNCLOS), Coastal States have the right to use resources in the area up to 200 nautical miles from the shores of the ocean and also under certain conditions in the continental shelves. However, the conflicts, that have not been finalized yet in the Arctic about the determination of the continental shelves, continue (Kullerud et al., 2013). In 1996, the Arctic Council was established to ensure cooperation, sustainable development and the protection of the environment and culture among the Arctic states (USA, Denmark, Finland, Sweden, Iceland, Canada, Norway, Russia) (Arctic Council, 2007). In the Arctic region, where approximately 4 million people live, the population increases by 4% every 10 years (Heleniak et al., 2015).

The Antarctic region covers the Antarctic Continent and the surrounding Southern Ocean south of the Antarctic Front (approximately 58° South latitude) and some sub-Antarctic islands (Anisimov et al., 2001). Antarctica is the last discovered, coldest, driest, highest continent in the world, also has the lowest population density. More than 70% of the freshwater resources in the world are frozen on the continent of Antarctica (bbc.co.uk, 21.05.2020). It is known that the continent and the surrounding Southern Ocean, which is protected by the Antarctic Treaty and additional protocols and agreements, have hydrocarbon and other underground resources (Behrendt, J C., 1983). In addition, the second largest marine protection area in the world is located in the Southern Ocean (Jabour & Smith, 2018). Decisions on the continent,

which is not under the sovereignty of any country, are taken unanimously at the Antarctic Treaty Consultative Meetings held annually in alphabetical order, hosted by a consultative member country.

The Arctic and Antarctic regions have very opposite characteristics. Among these differences, it is possible to count its geographical location, topography, general climate conditions and ecosystem. Antarctica is a high continent with ice and snow covering the mountain ranges in the Southern hemisphere. The highest mountain is Vinson Massif and it is 4,897 meters. On the contrary, Arctic is a deep ocean in the Northern hemisphere. The deepest point is Litke at 5,450 meters in the Eurasian Basin. It is cold in both regions, but Antarctica reaches cooler temperatures. While all mammals in Antarctica are marine mammals, the North Pole hosts about 48 terrestrial mammal species. In addition to Arctic and Antarctic regions' characteristics, sea ice formation has the common characteristics. In Antarctica, the ocean surrounding the continent is covered with sea ice up to 18 million square kilometers in winter, but only 3 million square kilometers of sea ice remain until the end of summer. While the Arctic Ocean is covered with 15 million square kilometers of sea ice in winter, an average of 4 million square kilometers remains at the end of the summer season. Antarctic sea ice is typically 1 to 2 meters thick, most of the Arctic is covered with 2 to 3 meters thick sea ice (nsidc.org, 21.05.2020). Since the Arctic Ocean is mostly covered with sea ice and surrounded by land, precipitation is relatively rare. However, since Antarctica is surrounded by the ocean, humidity is higher. Antarctic sea ice tends to be covered mostly with thick snow.

Leaving aside the differences, the sea ice, which has a large area in both regions, is primarily affected by climate change. Oceans heat up 0.5°C every year. This warming not only affects the marine ecosystem, but also affects the global climate. The most effective input of the Great Ocean Conveyor Belt, which is the biggest factor of the climate system, is the salinity difference due to the sea ice formation and melting glaciers bring fresh water to the sea in the polar oceans (Seidov, Barron & Haupt, 2001). Sea ice also regulates the ocean-atmosphere relationship (Yang & Neelin, 1993) (Ma, Wang & Cao, 2020). Sea ice decreases in parallel with the increasing greenhouse gas density at the global level. This decrease operating a positive feedback mechanism, causes more absorption of solar energy, increases the heat budget, and the increased heat budget causes more melting (Curry, Schramm & Ebert, 1995). The melting of sea ice facilitates access to Polar Regions and natural resources there and reduces costs. The routes leading to sea transportation in the Arctic Ocean are called the new Silk Road. These results increase economic and geopolitical interest to the Polar Regions.

Sea ice is not the only area affected by global climate change. East Antarctic ice sheet, which is estimated to have formed 37.5 million years ago, and West Antarctic ice sheet, which are estimated to have formed 10-5 million years ago, are also melting due to global climate change (Huybrechts, 1993;

Jacobs, Hellmer & Jenkins, 1996). It is estimated that the complete melting of Greenland and Antarctic ice sheets will increase the global sea water level by 70 meters (Alley et al., 2005). Melting of ice sheets will also cause the release of reserve methane gas that have been hidden for millions of years which is more effective than carbon dioxide as greenhouse gas (Wadham et al., 2012; Portnov et al., 2016). It is also possible that bacteria and viruses that have been hidden in these areas for millions of years will also be released. The studies carried out in subglacial lakes are also proof of this (Christner, Skidmore & Priscu, 2008).

Epidemics and Polar Regions

Many epidemics have been experienced in human history before. The most well-known outbreaks in the 20th and 21st centuries can be mentioned as influenza, cholera, AIDS and SARS (Morens, Folkers & Fauci, 2009). The COVID-19 outbreak in 2019 and 2020 has spread to all continents except Antarctica and has directly affected more than 5 million people (dated May 2020). Measures taken, economic and social difficulties have affected billions of people. In the Arctic, the number of COVID-19 cases exceeded 3 thousand. Even in the MOSAiC (Multidisciplinary drifting Observatory for the Study of Arctic Climate) expedition, in which the ice-breaking ship was used as an interdisciplinary natural laboratory, which was planned to carry out scientific studies in the region by staying stuck in the sea ice for about 2 years in the Arctic Ocean with international collaborations, COVID-19 cases were observed.

While no cases were seen in one polar region (Antarctica), COVID-19 was found in one out of every thousand people in the other polar region. Looking at the coastal states to the Arctic, the total number of cases has approached 2 million (0.036 cases / population), while there are 80 thousand cases around the Southern Ocean coastal states (0.00053 cases / population). COVID-19 is more common in the northern hemisphere because of population density, human mobility, and atmospheric transport. In addition, more isolated countries in the southern hemisphere have been more successful in implementing quarantine conditions. Nevertheless, the condition might change by the time for the Southern hemisphere since pandemic remains unknown in every aspect.

When human history is analyzed, it is seen that epidemic diseases spread in different ways. It is observed that trade routes and wars increase the spread in epidemics transmitted from person to person. Today, more than 90% of global commercial transportation is made by seaway which is one of the most important tools of trade in history. This also led to epidemic diseases. During the First World War, the Spanish Flu, which started to spread in Europe in 1918, moved to Australia in 1919 with a ship expedition, which caused loss of 10,000 lives.

Ships are evaluated under quarantine conditions during routine operations. In Turkey, the Ministry of Health General Directorate of Border and Coastal Health (HSSGM) scope of operations carried out by ships of the Maritime Declaration of Health must do before arriving at Turkish ports.

“Within the scope of the International Health Regulations (2005) published by the World Health Organization, the “Maritime Declaration of Health” which shows the state of health on the ship has to be filled by ship’s captain or if there is a ship physician, it is arranged together with the signature of the two before the arrival of the ship (online application, e-mail or fax via the relevant Coast Health Inspection Center). If there is not enough equipment to send the notification on board, it is delivered to the relevant Coast Health Inspection Center official on arrival of the ship. The Marine Declaration of Health must comply with the example set out in Annex 8 of the International Health Regulation (2005).” (www.hssgm.gov.tr 20.05.2020).

In addition, before the ships enter the ports, they request “free practice” from the relevant health authorities. The ship is counted in quarantine until “Free Practice” is taken and tells the situation by flying a yellow flag. There is a similar practice in civil aviation, but passengers embark / disembarks even aircraft that cannot obtain “free practice” (International Civil Aviation Organization, 2013).

Due to the fact that different countries are located in the Arctic region and there is a resident population, there are regular flights and ships operating to the region. On the contrary, transportation to Antarctica cannot be provided on a scheduled basis. This prevents, individuals from accessing the continent through their personal initiatives, in other words, the spread of epidemic diseases to the continent.

Another effect of epidemics is experienced in community psychology in quarantine / isolation, disease / treatment processes. It is known that in isolated individuals, their tendency to depression, resort to violence and suicide rates increase. These are the same effects seen in communities living in polar regions (Kirmayer et al., 1999). It is known that people working in scientific stations in Antarctica also lead an isolated life (Zimmer et al., 2013). This social isolation is accepted as a guide for space researches (Suedfeld & Weiss, 2000).

Turkey and Polar Regions

It is known that Turkish scientists have been conducting research since 1967 on the continent of Antarctica. It is not known when Turkish scientific studies started in the Arctic. However, it can be said that the interest of the Turkish scientists in the Polar Regions began much earlier. On the World Map of Piri Reis dated 1513, the Land of Fire (Tierra del Fuego), which is the closest area to Antarctica and located in the southernmost part of the South American

continent, is shown. It is known that Piri Reis's World Map dated 1528 shows Greenland, which is located in the north of the Atlantic Ocean, and the northeastern coasts of Canada.

In 2013, Turkish sailors Osman Atasoy and Sibel Karasu went to Antarctica during their world trips with their sailing boats called *Uzaklar II*, and in 2014, Turkish sailor Erkan Gürsoy crossed the Arctic Northwest Passage with his own built boat named *Altan Girl*. While polar researches carried out individual initiatives, the first institutional steps were taken with the establishment of the Istanbul Technical University Polar Research Center (ITU PolReC) in 2015. By the Antarctic Scientific Research Base Project taken under the auspices of the Presidency in 2017, importance of polar research to the Republic of Turkey are set out in the national and international levels. The First Turkish Antarctic Expedition (TAE-I) was held in March-April 2017 under the coordination of the Ministry of Industry and Technology and ITU PolReC. 9 researchers from 4 universities took part in TAE-I for about 30 days and started the feasibility studies related to the establishment of the Turkish science base. TAE-I has reached 15 thousand kilometers away from Turkey and made the furthest expedition in Turkish history.

The same year, the National Polar Science Program 2018-2022 (UKBP) was published with the participation of 120 researchers from 36 institutions. Prepared in parallel with the Scientific Committee on Antarctic Research (SCAR), UKBP has been gathered under 4 main titles as disciplines, physical sciences, earth sciences, life sciences, social sciences and humanities.

Within the scope of the Second Turkish Antarctic Expedition (TAE-II) in 2018, a camp was established on a land for the first time in Antarctica. The team of 10 of 28 total stayed in the camp set up on Robert Island and carried out their work. It has gained importance as the first time that Turkish scientists made the transition to studies in a system based on land. The team, which carried out research for 40 days, completed the ground feasibility for the science base within these time and 15 scientific projects were done. TAE-II was completed in April 2018.

The Third Turkish Antarctic Expedition was held between February and March 2019 with the participation of 25 researchers. The expedition, which is important for the first time due to the hosting of foreign researchers in a Turkish polar expedition, has also gained importance due to the deployment of a 3-module camp site on Horseshoe Island, where is planned to establish a science base. 15 scientific projects were carried out successfully in 30 days. Within the scope of the expedition, an automatic meteorological observation station was established on Horseshoe Island in cooperation with the General Directorate of Meteorology of the Ministry of Agriculture and Forestry. With the hydrographic study conducted in cooperation with the Naval Forces Command, Department of Navigation, Hydrography and Oceanography, the sea floor mapping has been started in Lystad Bay in Horseshoe Island.

In July 2019, the first scientific expedition to the Arctic with 8 participants from five institutions is held and sponsored by Türkiye İş Bank. The team carried out the measurements and sampling of 15 projects with a small group in order to minimize the human footprint and continued to work in the region for almost a month. During the studies, the glider of the French National Scientific Research Council (CNRS) that failed during measurements in the Arctic Ocean (autonomous vehicle that measures at sea and moves using the floating flotation center) has been rescued. Projects are especially carried out to understand global climate change and the effects of people on the environment; by determining microplastics, organic and inorganic pollutants in the oceans and their sources, pollution in the atmosphere was measured by air quality measurements. Meteorology and sea ice observations were made and ecosystem monitoring studies were carried out. In addition, while working to raise awareness in the society, a documentary about the campaign was published.

Due to its political, scientific, and strategic importance, polar research is carried out under a national umbrella in many countries. For instance, the British Antarctic Survey, a queen-bound unit in the UK, and the Australian Antarctic Division, which is affiliated to the Ministry of Agriculture, Water and Environment. In this sense, Scientific and Technological Research Council of Turkey (TUBITAK) Marmara Research Center (MAM) Institute of Polar Research (KARE) was established to execute polar research under a national umbrella in December 2019.

During the very latest expedition conducted in Antarctica, 24 researchers participated in the Fourth Turkish Antarctic Expedition (TAE-IV) held in February-March 2020 to carry out 15 scientific projects for about 1 month. During which 2 Global Navigation Satellite System (GNSS) stations installed on Horseshoe Island. In addition, a GNSS station was established on Dismal Island, 70 kilometers away from Horseshoe Island, in cooperation with the Ministry of National Defense Map General Directorate. In TAE-IV, which included 3 physical sciences, 3 life sciences, 4 social sciences and 5 geo sciences, a total of 15 projects, measurements done, and samples were taken to monitor global climate change. Along with sea and lake sampling, snow and various life sciences sampling was also carried out. TAE-IV team continued to work in the region at the time of record high temperatures measured in Antarctica. These record air temperatures, which emerged as an effect of global climate change, caused great changes in the region, allowing researchers to carry out their daily field studies for longer periods of time.

While Turkish scientists have been conducting individual studies since 1967 with international collaborations, collaborations have been taken into an institutional framework as of 2015. Projects, accepted by TÜBİTAK ARDEB call, are also sent to the continent to take part in the scientific bases of foreign countries in Antarctica. Since 2015, more than 30 Turkish scientists have worked at foreign country bases with bilateral collaborations.

After performing the expeditions, transfer of scientific samples to Turkey take approximately 2 months. After the analysis of samples, the results of the projects carried out are also published in national and international articles. 24 papers, 3 in physical sciences discipline, 13 in life sciences discipline, 7 in geo sciences discipline and 1 in the social sciences discipline, have already been published (kare.mam.tubitak.gov.tr, 21.05.2020). It is also known that there are publications in the preparatory stage.

Turkey is a non-consultative state to the Antarctic Treaty and it is not entitled to vote in decisions taken regarding the continent. Under the Antarctic Treaty to be a consultative state, it has been stipulated to carry out significant scientific research. The publications made within the framework of the projects carried out within the scope of the TAEs show the significant scientific research. Another requirement is to have full membership to the Scientific Committee on Antarctic Research (SCAR). Turkey is an associate member to SCAR since 2017. Application for full membership was planned to 2020 meeting. However, cancelation of the meeting because of COVID-19, application to SCAR is postponed to next meeting. Turkey is an observer to Council of Managers of National Antarctic Program (COMNAP) since 2018. Turkey's application for full membership in 2021 planned to perform, to provide another necessary condition to consultative status to the Antarctic Treaty.

Turkey's application for membership of the Arctic Council observer status has not been finalized due to lack of sufficient study in the field. Programming related to membership to the International Arctic Scientific Committee (IASC) will be made within the body of TÜBİTAK MAM KARE.

Fourth Turkish Antarctic Expedition and COVID-19

The Fourth Turkish Antarctic Expedition (TAE-IV) team, which the expedition was held in the 2019-2020 Antarctic season, was trained against the difficulties and emergencies that they might experience in Antarctica and onboard before the expedition. The team also underwent examinations and controls regarding health conditions determined by Istanbul Medical Faculty Underwater Medicine and Hyperbaric Medicine Department and Marmara University Faculty of Sport Sciences (Aktaş et al. 2017). It was seen that the entire team met the necessary health conditions. Additionally, the medical doctor, included in the expedition team, was given training on the prevention of epidemic diseases. Masks in N95 standards were distributed to all teams and measures were taken.

TAE-IV started on 9th of February 2020 and team reached to Sao Paulo/Brasil on the 10th of February, 2020. On the same day, the team transferred to Santiago, the capital of Chile, from here to Punta Arenas and finally to Puerto Williams on a local flight. The team, who stayed there for 2 nights and adapted to the climatic conditions and time difference, was also constantly

observed for cold symptoms. Team arrived to King George Island with a charter flight and embarked to chartered vessel. It has been confirmed that the ship’s crew has been in Antarctica for about 2 months and has not shown any cold symptoms, and the cabins allocated to the Turkish team have been disinfected and the precautions on the ship have been completed. In Table 1, the distribution of COVID-19 cases on the departure route and in the World is shown cumulatively. During the voyage, both scientific members and crew members were observed for cold symptoms.

Table 1. Cumulative COVID-19 Cases on the way to the Fourth Turkish Antarctic Expedition

Country/Date	09.02.2020	10.02.2020	11.02.2020	12.02.2020	13.02.2020
Turkey	0	0	0	0	0
Brasil	0	0	0	0	0
Chile	0	0	0	0	0
World	37.569	40.627	43.109	45.175	60.387

Source: World Health Organization

Return of the TAE-IV team to Turkey has been scheduled on March 18, 2020. However, the good weather conditions on the continent and less sea ice areas shorten the route. Also, because of wide spread of COVID-19 epidemic, return rescheduled on March 7, 2020 to Punta Arenas. On the March 8, 2020 team returned from Punta Arenas to Istanbul using same route. The team, who used N95 standards mask on the return route, was also recommended to stay in quarantine for 14 days and to apply to the health institution in case of any cold symptoms. In addition, the team was kept under surveillance by family physicians, and it was observed that there were no COVID-19 cases in the expedition team and / or their families at the end of 14 days. Along with the measures and strategic decision taken, additionally the weather conditions allowance made the early return possible. The time spent during the expedition has also led to the fulfillment of all planned scientific studies. It can be seen in Table 2 that the first planned dates are 17-18 March 2020, and the COVID-19 cases in the world are almost two times more than the cases at the time of return.

Table 2. Cumulative COVID-19 Cases on the Fourth Turkish Antarctic Expedition Return Route

Country/Date	07.03.2020	08.03.2020	17.03.2020	18.03.2020
Turkey	0	0	47	191
Brazil	19	19	234	291
Chile	5	10	156	238
World	105.063	108.994	191.473	209.838

Source: World Health Organization

Preparations for the Fifth Turkish Antarctic Expedition, which is planned to take place in the 2020-2021 Antarctic season, have been launched. COVID-19 is evaluated as a part of our daily life and updates are made in training of participants and health planning. It will be ensured that the designated expedition participants are subjected to the COVID-19 test at least 14 days before the trip date, and then the participants will be isolated in their homes as much as possible. In addition, improvements will be made regarding the prevention of epidemics in the training program/planning period. It is planned to provide personal protective equipment and materials to be used in the treatment of COVID-19 among the medical equipment and drugs to be found with the expedition team. In addition, the route will be preferred, which will be chosen during the flights by countries where COVID-19 cases are less common. There might be an arrangement of direct a flight to gateway to Antarctica is possible too. Just as an example, it was announced that Australia, one of the strongest actors of Antarctica, not much scientific projects will be conducted this year. The construction activities of the new station are also stopped (antarctica.gov.au 21.05.2020).

Conclusion

Understanding the future of the world means actually understanding the past and the present. Polar Regions contain information about the Earth's past, such as an almanac. There are various consequences due to global climate change; such as agricultural lands and freshwater resources are decreasing, more extreme weather events are experienced, and migration due to these effects is expected to occur. Turkey is also affected by these consequences as a mid-latitude country. Naturally, past can be studied from various samplings for different disciplines, however future models are mainly created with data collected from Polar Regions. Understanding the future of both our country and the world gives us ideas about what problems are waiting for us and how we should take measures.

Decisions on Polar Regions, which are not only scientifically but also politically, are made on different platforms by the votes of various countries. For example, while negotiations on the Arctic Ocean are carried out in the Arctic Council, decisions on Antarctica are taken by the votes of the consultative states under the Antarctic Treaty. Turkey's observer membership to The Arctic Council is in process, while working to become a consultative state to the Antarctic Treaty.

Being geographically remote from the Polar Regions causes to spend more time and effort on logistics and are limited with the summer season. The fact that the scientific data can be obtained only in the summer season causes deficiency in scientific studies. Nevertheless, efforts have shown by Turkey in recent years, scientific activities and supports starting from the top level of the state attracted the attention of other countries and appreciated. A great work is being done to make Turkey to have an active role on decision making about the Polar Regions.

When we consider all these, it is seen that in order to continue the successful studies in the polar regions even more successfully, it is necessary to have science stations that can provide year-round data in both polar regions and a Turkish flag ship that can be used to provide logistics and research in this station. This is also important for reducing the dependence on foreign sources in transportation to polar regions and especially for preventing epidemic diseases.

Turkey is a growing global power. We can see this in many areas. Even in the epidemic of COVID-19, Turkey helped many countries, gave hand without hesitation, and added new products to its industry. Turkey's increasing power by breakthroughs in all areas, an inevitable fact of being a force on the Polar Regions.

Even Turkey held its first national expedition to Antarctica in 2017, majority of international partners agreed on "Turkey's being on the right track with right strategies". In 2019, the first Turkish Arctic Scientific Expedition was held. Again, in 2019, the first Turkish facility was deployed in Antarctica. At the institutional level, the Polar Research Institute was established under the umbrella of TÜBİTAK in 2019. Antarctic expeditions host various countries as guest researchers and logistic and scientific support is provided to foreign countries when necessary in both polar regions. Considering all these breakthroughs it would not be wrong to call Turkey as a new polar power.

Antarctica is a continent dedicated to peace and science, and here we can see that scientists are helping each other without any discrimination. It becomes easier to understand solidarity in Antarctica considering Turkey's help to many countries during COVID-19 epidemic. For instance, Argentina and the UK signed a cooperation agreement in Antarctica in 2019, even though both have alleged rights over the same region in Antarctica. Turkey extended its help to many Antarctic states such as USA, Germany, UK, France, Italy during COVID-19 epidemic. Thus, it could be seen that there will be more collaboration between Turkey and those countries.

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