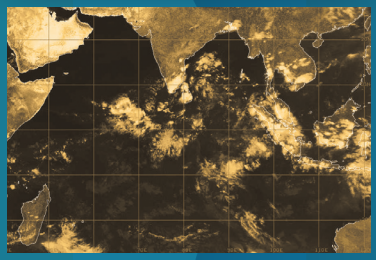

STIMSON

Indian Ocean Rising:

Maritime Security and Policy Challenges

Edited by **David Michel** and **Russell Sticklor**

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Table of Contents

Glossary

AAB . . . . . Abdullah Azzam Brigades
ABOT . . . . . Al Basra Oil Terminal
AMISOM . . . . . African Union Mission in Somalia
APEC . . . . . Asia-Pacific Economic Cooperation
APFIC . . . . . Asia-Pacific Fishery Commission
ASEAN . . . . . Association of Southeast Asian Nations
ATS . . . . . Amphetamine-type stimulants
AQ-AP . . . . . Al-Qaeda in the Arabian Peninsula
AQ-I . . . . . Al-Qaeda in Iraq
ArBL . . . . . Archipelagic base lines
BAB . . . . . Bab al-Mandeb
BIOT . . . . . British Indian Ocean Territory
BMP-4 . . . . . Best Management Practices Version 4
BOBP-IGO . . . . Bay of Bengal Programs Intergovernmental Organization
CBMs . . . . . Confidence-building measures
CENTCOM . . . . United States Central Command
CS . . . . . Continental shelf
CTF-151 . . . . . Combined Task Force 151
EEZ . . . . . Exclusive economic zone
EIA . . . . . Energy Information Administration (US)
E&P . . . . . Exploration and production
ESMR . . . . . Evolving strategic maritime regions
EU NAVFOR . . . European Union Naval Task Force
FAO . . . . . Food and Agriculture Organization
FDI . . . . . Foreign direct investment
FPDA . . . . . Five Power Defense Agreement
FSDS . . . . . Far Sea Defense Strategy
GCC . . . . . Gulf Cooperation Council
HMG . . . . . Heavy machine gun
HRA . . . . . High risk area
ICZM . . . . . Integrated coastal zone management
IMO . . . . . International Maritime Organization
IOC . . . . . International oil company
IOR . . . . . Indian Ocean Region

IRGCN ..... Iranian Revolutionary Guard Corps Navy
IRTC ..... Internationally Recognized Transit Corridor
ISA ..... International Seabed Authority
IUU ..... Illegal, unregulated, unreported
IWRM ..... Integrated water resources management
LNG ..... Liquid natural gas
LOS ..... Law of the Sea (also see UNCLOS)
MBD ..... Million barrels per day
MCEs ..... Maritime centers of excellence
MDA ..... Maritime domain awareness
MPA ..... Maritime patrol aircraft
MSC-HOA ..... Maritime Security Center – Horn of Africa
MSO ..... Maritime security operations
NATO ..... North Atlantic Treaty Organization
NOC ..... National oil company
P&I ..... Protection and Indemnity
PAG ..... Piracy attack groups
PCASP ..... Privately contracted armed security personnel
PLAN ..... People's Liberation Army Navy (China)
PMSC ..... Private military security company
SALW ..... Small arms and light weapons
SIOFA ..... South Indian Ocean Fisheries Agreement
SNMG ..... Standing Naval Maritime Group
SOH ..... Strait of Hormuz
SOLAS ..... Convention on Safety of Life at Sea
SPM ..... Single point mooring
SSBN ..... Ballistic missile submarines
STS ..... Ship-to-ship transfer
SUA ..... Suppression of Unlawful Acts
SWIOFC ..... Southwest Indian Ocean Fisheries Commission
TFG ..... Transitional federal government
TS ..... Territorial sea
TSA ..... Technical sharing agreement
UAV ..... Unmanned aerial vehicle
UKMTO ..... United Kingdom Maritime Trade Operations
UNCLOS ..... United Nations Convention on the Law of the Sea
UNEP ..... United Nations Environment Programme
WBIED ..... Water-borne implemented explosive device
VBSS ..... Vessel boarding, search, and seizure
VLCC ..... Very-large crude carrier

Chapter Seven

Natural Resources in the Indian Ocean: Fisheries and Minerals

David Michel, Halae Fuller, and Lindsay Dolan

The Indian Ocean harbors an array of non-energy renewable and non-renewable resources. Various political, technological, and environmental factors affect the economic potential for developing these resources. The most commercially viable industries are fisheries and minerals. This paper will outline the current status of exploitation, emerging and existing trends, the future implications of these trends, and various legal and governance regimes that have sought to manage resource development in the region.

The Current Situation

Fisheries

Commercial and artisanal fisheries sustain the livelihoods of more than 38 million people worldwide.[1] In the Indian Ocean, fish production increased drastically from 861,000 tons in 1950 to 11.5 million tons in 2010. But while other world oceans are nearing their fisheries limit, the United Nations Food and Agriculture Organization (FAO) judges that, in certain areas, the Indian Ocean's resources have the potential to sustain increased production.[2]

The countries of the east Indian Ocean represent a significant proportion of world fisheries, although most commercial and artisanal activity takes place in coastal zones rather than in deep water.[3] The east Indian Ocean is home to 45 percent of the world's fishers and brings in catches of 7 million tons of fish per year, or 8 percent of total world fish production. Most of this catch is harvested close to shore, placing so much strain on coastal stocks that fishers have been forced to venture further out to sea and even into the exclusive economic zones (EEZs) of neighboring nations. Even so, this trend of fishing far from shore is still in its early stages. Deepwater catches represent less than 6 percent of total catches in Indonesia and 10 percent in Malaysia, for example.[4] Given the overexploitation and overcrowding of coastal fisheries, deepwater fish stocks represent a potential new frontier for commercial and artisanal fisheries in the region.

The west Indian Ocean is also characterized by overfishing and growing exploitation of deepwater fisheries.[5] From 2000 to 2001 alone, total catches increased by 2.2 percent, representing a 10.6 percent increase over the previous decade.[6] Most of this change has been driven by the increasing exploitation of deepwater fisheries by non-littoral states such as Spain, Taiwan, Japan, France, and Uruguay.[7] Due to the overfishing of coastal stocks, many west Indian Ocean countries plan to expand their semi-industrial and industrial national

fleets to new fishing grounds in their EEZs. According to the FAO, most southwest Indian Ocean countries' fisheries have the potential to contribute a larger percentage of littoral states' GDP.[8]

The northwest Indian Ocean region has witnessed concerted government efforts to promote the fisheries industry, yet suffers from an overall lack of fisheries management.[9] Many countries in the region offer subsidies to fishers in order to boost development. The results have been mixed, however. Despite significantly increased fishing since 1990, actual catches have grown by only 12.3 percent. Catch limits are rare. Where they do exist, limits generally apply only to industrial fisheries, not the artisanal fishers who made up 80 percent of reported landings in 2002. The absence of sustainable fisheries management policies and declining stocks have reduced both commercial and artisanal fisheries in the northwest Indian Ocean. In addition, oil fires and weapons debris have polluted the ocean in this conflict-prone region, further degrading its fisheries.[10]

Australia is unique among the countries in the Indian Ocean region in that it has developed strict management controls and limits the exploitation of its fish stocks, resulting in a healthy fisheries industry.[11] From 2000 to 2001, the total fish catch from the Indian Ocean areas of Australia was 36,290 tons, representing 15.8 percent of the total catch for Australian fisheries. About 651 commercial vessels and 28,000 artisanal fishers operated in Australia's Indian Ocean waters during this period. As a result of successful management policies, the number of fish stocks classified as overfished or at risk of overfishing dropped from 24 in 2005 to 18 in 2008.[12]

Minerals

Polymetallic nodules and polymetallic massive sulphides are the two mineral resources of primary interest to developers in the Indian Ocean. Polymetallic nodules are golf-to-tennis ball-sized nodules containing nickel, cobalt, iron, and manganese that form over millions of years on the sediment of the seafloor. Typically found at four to five km in water depth, the nodules must be scooped up and brought to the surface. While polymetallic nodules cover vast plains, polymetallic massive sulphides form in highly localized sites—no bigger than a sports stadium—along hot springs in underwater volcanic ranges. "Massive" refers not to their size but to their mineral content, which contains copper, iron, zinc, silver, and gold. Sulphides are formed when cold, heavy seawater descends deep into the earth's crust and is heated by the magma. When the heated water buoyantly rises to the surface, it precipitates metals from the seawater and concentrates the minerals in deposits beneath and on the sea floor.

India received exclusive rights to explore polymetallic nodules in the Central Indian Ocean basin in 1987. Since then, it has explored four million square miles and established two mine sites. To be commercially attractive, nodule deposits must have a content of nickel and copper of at least 2.25 percent and a nodule density of 10 kg per square meter.[13]

Because of their gold content and greater copper composition, more recent commercial inquiries have focused on polymetallic massive sulphides. In July 2011, China was awarded the right to explore a 10,000 km^2 polymetallic sulphide ore deposit in the Indian Ocean.

Nevertheless, major obstacles have prevented sulphide deposits from being commercially viable in the past. Their local concentration makes finding them particularly difficult.[14] Seafloor deposits also tend to be much smaller than those onshore (seafloor deposits usually are one to five megatons, whereas onshore deposits can reach 50 to 60 megatons).[15] Furthermore, deep-sea deposits, which typically have a 0.2 percent concentration of rare earth minerals, pale in comparison to onshore Chinese concentrations of ore deposits, which can have 5 to 10 percent concentrations.[16]

Other minerals in the Indian Ocean include coastal sediments containing titanium and zirconium off South Africa and Mozambique, and tin placer deposits off the coasts of Myanmar, Thailand, and Indonesia. South Africa is the second largest producer of titanium dioxide and zircon in the world, largely due to its heavy mineral sands.[17] Tin dredged from this area amounts to 10 percent of world production and is worth about $100 million.[18] Elsewhere, heavy mud in the Atlantis II site in the Red Sea contains 94 million tons of ore, including 1.8 million tons of zinc and 425,000 tons of copper. These muds are licensed to Canadian firm Diamond Fields International and Saudi Arabian group Manafa.[19]

Ongoing and Emerging Trends

Population Growth

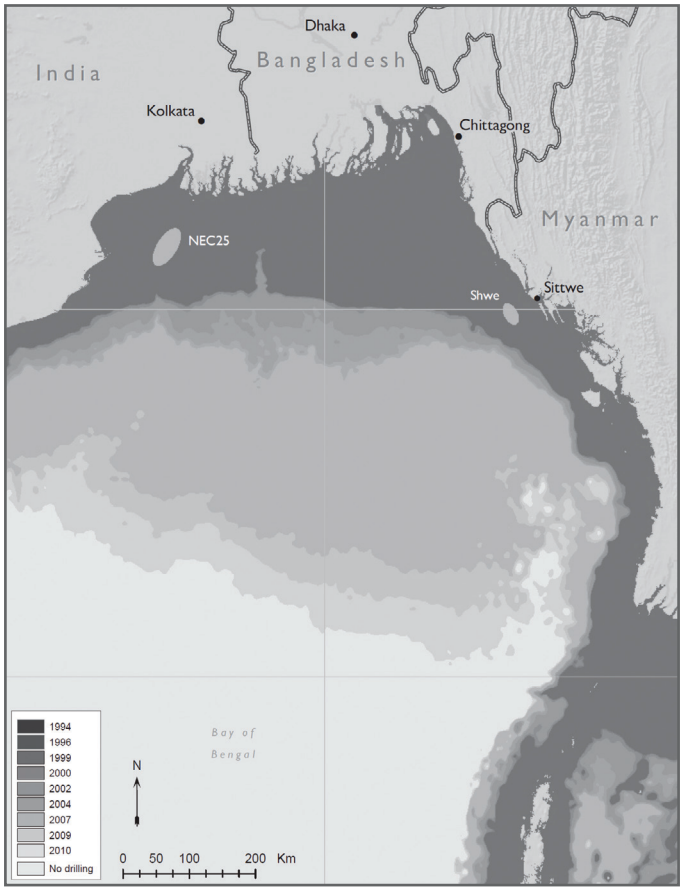
According to the United Nations Environment Programme (UNEP), over the next 30 years more than 6.3 billion people will move to already crowded coastal zones.[20] Such demographic growth has spurred artisanal fisheries in the Indian Ocean. Expanding middle class populations in China and other countries boost the demand for luxury fish such as bluefin tuna and shark fins, driving the overexploitation of those species.[21] A global shortage of fish is projected in the future. The FAO reports that 47 percent of global fish stocks are already fully exploited, while another 18 percent are overexploited.[22]

Environmental Degradation

Rising rates of pollution increasingly threaten Indian Ocean fisheries. Coastal fisheries are particularly vulnerable to agricultural run-off, sewage, and construction. Invasive species have spread as a result of the practice of dumping ballast water from ships.[23] Further, shipping lanes in the Indian Ocean are a main artery of the global energy trade, heightening the risk of oil spills as demand for fossil fuels increases in emerging economies throughout the region.

In 2010, scientists discovered plastic debris in all 12 water samples taken over the 3,000 miles of ocean between Perth, Australia, and Port Louis, Mauritius.[24] Deepwater fishing practices such as bottom trawling have also seriously damaged the ecosystems of continental shelves and slopes by leveling the sea bed, kicking up clouds of sediment, destroying coral, and generating huge amounts of bycatch (species which are swept up in fishing nets but thrown away because they lack commercial value). Meanwhile, fishing gear jettisoned or lost at sea continues to attract and ensnare fish for years after it is discarded—a process known as ghost fishing.[25]

Figure 7.1: Growth of Maritime Territory in the Bay of Bengal Accessible to the Most Advanced Deepwater Drilling Technology, 1994–2010



Source: Jared Bissinger, "The Maritime Boundary Dispute between Bangladesh and Myanmar: Motivations, Potential Solutions, and Implications," *Asia Policy*, No. 10 (July 2010).

Mining activity can also endanger marine organisms. Mining polymetallic nodules substantially disturbs the top few centimeters of sediment, leading to a mortality rate of 95 to 100 percent for macrofauna dwelling in marine tracks. Discharge of waste water from ships mining polymetallic nodules or massive sulphides also poses concerns. When these ships eject seawater after extracting its mineral content, the waste frequently contains trace metals, which interferes with the penetration of light through the top layer of seawater and reduces photosynthesis in surface layers. Temperature differences in the discharged and surrounding seawater also threaten life dwelling in the top layers of the ocean.[26] Sulphide mining machinery and processes alter fluid flows that sustain the ecological community, and it is uncertain whether species would be able to recolonize hydrothermal vents after operations cease.[27]

Technology

Technological advances have considerably increased commercial fisheries catches. Fishing lines can stretch as long as 120 km, and trawlers can cover large distances at high speeds and carry the equivalent of 12 jumbo jets loaded with fish. GPS and radar allow ships to venture into the open ocean and target lucrative fishing grounds with precision. As a result, deepwater fisheries have developed as a new frontier; in 2007, 40 percent of global marine trawling grounds were deeper than the continental shelf.[28]

In recent years, technology has had an even greater impact on the exploitation of mineral resources. Vehicles and machines can now operate in deeper waters than ever before. As Figure 7.1 shows, the amount of accessible seabed territory in the Bay of Bengal over the last 15 years has expanded considerably. Indeed, the Massachusetts-based Woods Hole Oceanographic Institution now has a vehicle that can access depths of 11 km, just one indicator that mining technology will soon follow.[29]

The Nautilus Minerals Solwara-1 project off the coast of Papua New Guinea illustrates the potential of such new technologies. Awarded its 20-year lease in January 2011, the Canadian firm will be the first to commercially mine undersea when the project begins operations in 2013. The technology employed by Nautilus makes use of remote-operated vehicles on the seafloor that crush the ore on the seabed before pipes lift it hydraulically to a surface vessel, which dewaters the ore and pumps the fluid back to the seafloor. The costs of Nautilus's groundbreaking project are expected to amount to $1 billion, a sum of considerable risk given that it invests in areas prone to volcanic activity.[30] But though some analysts suggest that few firms will finance these endeavors, another company, Neptune Minerals, is currently planning mines in the waters off New Zealand.[31] The Solwara-1 project is a positive indicator that technology to mine polymetallic massive sulphides is finally becoming a reality.

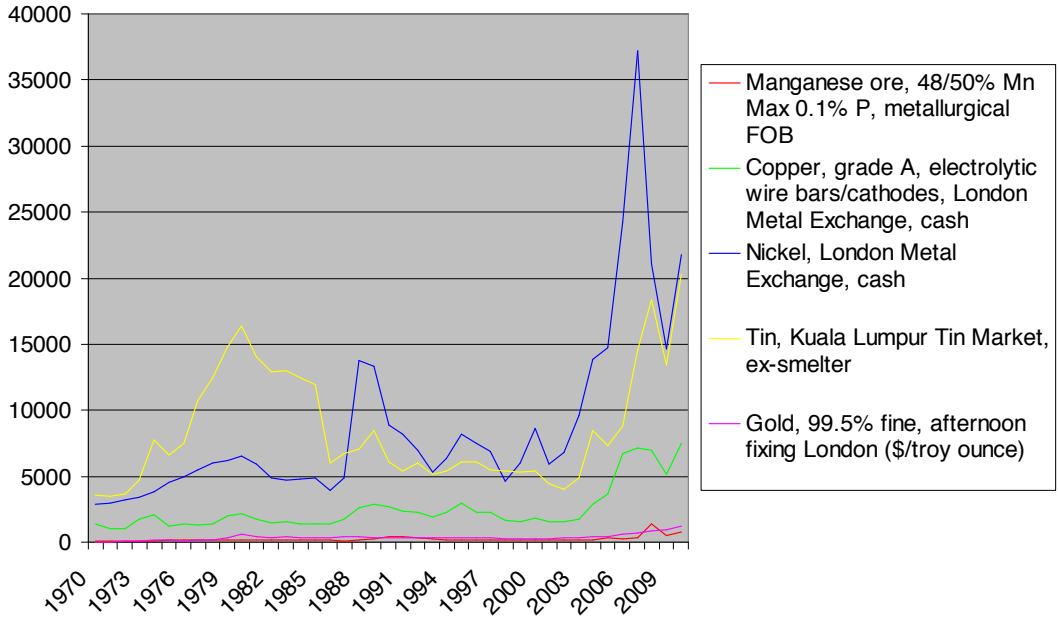
Even so, exploration for seabed minerals faces major hurdles. Only 2 to 3 percent of the global sea floor has been properly mapped, and just 0.0001 percent has been scientifically investigated.[32] Identifying resource sites whose value exceeds comparable onshore counterparts will prove a difficult task requiring ventures with uncertain rewards.

Aquaculture

Techniques for raising fish in captivity have existed for thousands of years. They range from simply attaching a mesh barrier over the outlet of a small river to state-of-the-art commercial fish cages and hatcheries. Artisanal aquaculture sustains many coastal communities, where small-scale fish farmers supplement family diets by raising fish or shrimp. Commercial aquaculture has been gaining ground in recent years, although problems with disease and nutritional value continue to exist when fish are raised in captivity. In spite of these setbacks, technological advances in fields such as biotechnology have spurred the growth of global aquaculture. The portion of fish produced by aquaculture and consumed by humans increased by 42.6 percent from 2006 to 2008 alone.[33]

Recent improvements in technology have opened the possibility of expanding aquaculture to the high seas. In 2009, a team of scientists from the Massachusetts Institute of Technology developed a self-propelled, submersible fish cage that can be moored offshore.[34] Submersible

Figure 7.2: Evolution of Mineral Prices, 1970–2011



Source: UNCTADstat, http://unctadstat.unctad.org/ReportFolders/reportFolders.aspx?sCS_referer=&sCS_ChosenLang=en.

ocean cages are still on the cusp of commercial viability, with doubts persisting about their ability to withstand rough open ocean conditions. Fish farms in North America and Europe have been the first to experiment with ocean cages, but since the Indian Ocean lacks a robust commercial aquaculture industry, it is unlikely that this trend will take root there in the near future.

Risks, Challenges, and Opportunities

Biodiversity Loss

Deep-sea biodiversity, like deep-sea resources, is still an emerging area of scientific study, and relatively little is known about the ecosystem in the deep sea. Estimates of deep-sea biodiversity range from 500,000 to 100 million species.[35] In the oceans as a whole, 10 million species exist, exclusive of microbes. When microbes are taken into account, deep-sea biodiversity is comparable to that of the rainforests.[36]

Marine life arguably offers just as much, if not more, economic value than the mineral resources that surround these species. Species living around hydrothermal vents, where polymetallic massive sulphides form, sustain life in a hostile environment of extreme temperatures and chemical energy. Microbial and prokaryote gene richness in the oceans, particularly in the deep-sea, is orders of magnitude higher than in the rest of the biosphere. Consequently, scientists find that studying the genetic makeup of these species yields unique conclusions about the origins of life on Earth and the potential for life on other planets.

Enzymes from these species are also being used for a variety of DNA-related products and technologies, including fingerprinting technology, and have substantially contributed to pharmaceutical research and products.[37] In the Indian Ocean, a peptide called Dolastatin-10 isolated from sea hare has served as an antitumor agent in clinical trials to treat breast and liver cancers, solid tumors, and leukemia.[38]

Deep-sea organisms also maintain the ocean ecosystem in ways that facilitate human use of ocean resources. Nutrients in the oceans that sustain fisheries are regenerated by deep-sea organisms. Some marine organisms absorb carbon during photosynthesis, which helps to regulate the climate; others also assimilate waste materials that pollute the ocean, acting as a "biological pump."[39]

Economic Implications

While it is difficult to quantify the value of potential marine mineral resources, the deep sea clearly has great potential as a source of minerals, and demand for these minerals is increasing. Prices of nickel and tin reached historic highs in 2007 and 2008 respectively, and copper and manganese have also risen in value relative to the last two decades (see Figure 7.2).

The Indian Ocean possesses some of the few remaining underexploited fish stocks in the world, making it likely that it will come under enormous pressure in the future as the next frontier of the global fisheries market. On the other hand, the heavy reliance of deep-sea fisheries on cheap fossil fuels could put the industry at risk from rising oil prices. Some deep-sea areas could become de facto marine reserves because of the prohibitive cost of exploiting their fisheries.[40]

Marine pollution threatens to reduce the value of Indian Ocean fisheries. Degradation of coastal estuaries, mangroves, lagoons, coral reefs, and kelp forests has destroyed the habitats of many species that support artisanal and commercial fisheries. In 2006, UNEP estimated the long-term costs of the 1998 massive worldwide coral bleaching in between $600 million and $8 billion over 20 years. The destruction of coral reefs and coastal ecosystems also impacts the tourism industry, which is estimated to bring in $30 billion annually.[41]

Stock market values for bioprospecting-related activities far exceed the value of products that have already been developed as a result of genetic use of deep sea organisms. This implies that the market takes into account the optional use of bioprospecting. The entire enzyme market is valued at $50 billion a year.[42]

Food Security

The depletion of Indian Ocean fish stocks could have serious implications for regional and global food security. More than a billion people worldwide rely on fish as their main source of protein.[43] The FAO reports that global fish consumption per capita increased from 16.2 kg in 2004 to 17.1 kg in 2007. Yet one recent study has projected that the world's fisheries will collapse by 2048 if catch rates continue unabated.[44] A 2010 report by the Pew Environmental Group helps put that prospect in context. Pew concluded that if countries with undernourishment levels greater than 5 percent had not overfished their waters, the additional fish catch in 2000 could have fed an additional 20-million people.[45]

Actors, Institutions, and Agreements

Several regional and international agreements exist to promote the sustainable management of the Indian Ocean's resources. Among these, the most important are 1982's United Nations Convention on the Law of the Sea (UNCLOS), 1995's FAO Code of Conduct for Responsible Fisheries, 1996's Indian Ocean Tuna Commission, and 2004's Southwest Indian Ocean Fisheries Commission. Most littoral states have also enacted national legislation to manage their fisheries and marine resources, such as Australia's 1994 Fisheries Resources Management Act and South Africa's 1998 Marine Living Resources Act.

The effectiveness of this legislation is limited by high levels of noncompliance. Fishers have little incentive to limit their catches since monitoring and enforcement of catch limits is low and marine legislation is outdated. In response to this problem, some fisheries have moved towards the decentralization and localization of management authority. Local communities in the southwest Indian Ocean, for example, have increasingly asserted their own regulations and enforcement of fish stocks.

Law regarding the extraction of manganese nodules is further developed than those governing sulphides. The UN Convention on the Law of the Sea established an International Seabed Authority (ISA) to oversee the prospecting, exploration, and mining of marine resources. Regulations also exist regarding nodule mining, but regulations on sulphides have been in a drafting stage since 2007. The creation of legal mechanisms to regulate sulphides has been delayed due to the lack of detailed scientific information on the environmental effects of ocean mining.[46] Commercial enterprises, however, have moved forward with the change in mining technology, rather than with the state of scientific research in the deep sea. In the interim, scientists have called on ISA to revise its stance on resources in international waters.[47] The present focus of ISA regulations is to ensure that resources are exploited in a way that supports "the common heritage of mankind," focusing on equitable distribution rather than on sustainability. Adopting conservation as part of the ISA platform is one method of promoting environmental impact assessments prior to exploitation, allowing time for scientific research to catch up with technological capabilities.

Notes

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