

# The role of marine microorganisms in offshore pollution remediation I

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Review

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## ABSTRACT

Marine environmental pollution has become an important issue of all over the world, and the treatment of Marine pollution has made rapid progress in recent years. Especially bioremediation using microorganisms as the main body plays an increasingly important role in the control of toxic and harmful pollutants in the sea. Expounds the basis for the development of bioremediation technology, microbial degradation effect, emphasizes the bioremediation the importance of the application in the control of Marine pollution environment, This paper introduced the new ideas, new methods, and the special function of the Marine microorganisms and the characteristics of the main pollutants in the Marine environment: oil, pesticide, red tide disasters and toxin and pathogenic microorganisms such as repair function of new achievements.

**Keywords:** Marine Microorganisms, Coastal Pollution, Remediation

## 1. INTRODUCTION

### 1.1 current situation of offshore water pollution

The ocean covers 71 percent of the earth's surface area, and seawater accounts for 97 percent of the total water volume (Hao Wu, Lin Guo et al. 2018). The ocean contains abundant living resources, especially contains hundreds of millions of Marine microbial groups (Gomez-Consarnau, Needham et al. 2019). With the rapid development of modern society and economy, the pollution of coastal waters has become a worldwide problem, it was seriously affecting the offshore ecosystem, particularly it has the emerged negative effect on the coastal ecosystem (Zhang, Alter et al. 2019). It has become a hot issue for repair the damaged marine ecosystem.

The offshore marine ecosystem reserves richful natural resources and breeds a variety of ecosystems, because it is a transitional zone that connected land and sea and it is affected by both land and sea. It includes estuaries, bays, coastal wetlands, mangroves, seaweed (algae) beds and coral reefs (Bolognesi and Cirillo 2014). But at the same time, the offshore areas are also fragile ecological sensitive regions, and it has great pressure. under the influence of human activities and global changes (Huang and Jin 2018).

Due to rapid economic development and excessive exploitation of ecological resources, more than 60% of the world's Marine ecosystem services were degrading (Richards and Day 2018). More than 35% of the world's mangroves and more than 20% of the world's coral reefs were destroyed, and another 20% of the world's coral reefs were degraded (Wei Qian, Jianxiang Feng et al. 2018). Some coastal wetlands lost more than 30%. The water of offshore was confirmed eutrophication in northern Africa (Huchzermeyer, Woodborne et al. 2017), North America (Bagdanaviciute, Umgieser et al. 2018), South America (Kandratavicius, de Ward et al. 2018, Lopez-Cortes, Vazquez et al. 2019), Brazil (Barcellos, Queiroz et al. 2019), Colombia (Tosic, Martins et al. 2019), Peru (Serna, Lahajnar et al. 2014), Asia (Chen, Liu et al. 2019), Japan (Senga, Sato et al. 2019), European Norway (Jonson, Borken-Kleefeld et al. 2017), Finland (Andersen, Aroviita et

al. 2016), Denmark (Tinunermann, Maar et al. 2019), Sweden (Henryson, Hansson et al. 2019), Germany (Felgentreu, Nausch et al. 2018), France (Ratmaya, Soudant et al. 2019), Italy (Spagnoli and Andresini 2018), Greece (Varkitzi, Markogianni et al. 2018), the former Soviet union and other countries (Zhang, Jin et al. 2017). One third of the world's coastal ecosystems was at the risk of serious degradation (ShuJiang, BaoQiang et al. 2016).

The marine offshore ecological situation is also very serious in our country (Juncheng, Zhongqiu et al. 2016). Since the 1950s, It has lost a large amount of bay area due to land reclamation, mariculture, land reclamation and port construction (Chartres and Noble 2015). Natural mangrove areas were reduced by about 73%, Coral reefs were decreased 73% ( Wei Qian, Jianxiang Feng et al. 2018). According to the 2016 China Marine environment bulletin, The coastal waters were heavily polluted with severe eutrophication in liaodong bay, Yangtze estuary, hangzhou bay and pearl river estuary (Jing Li , Qun Du 2019). The water of sixteen bays with an area of more than 100km<sup>2</sup> were found to be worse than category 4(Jing Li , Qun Du 2019).

Marine pollution and habitat destruction were lead to the loss of biodiversity and ecological imbalance, and it were seriously restricted the function of the ecosystem (Kuepper and Kamenos 2018). In order to rationally utilize and effectively protect the coastal ecosystem, it is urgent to protect and restore the coastal ecosystem while developing the social economy (Huaqing Ge 2018).

### 1.2 The existence and importance of Marine microbial diversity

Marine microorganisms are the most advantageous and characteristic Marine biological resources with the largest distribution and quantity (Ruocco, Costantini et al. 2016). The excavation of the Marine microorganism species diversity, physiology, metabolism, ecology and metabolism, it was not only in favor of the development and utilization of Marine microorganism resources, but also contributed to understanding the mechanism of the extreme life characteristics

of the Marine microorganisms and its environmental adaptation. (Si Zhang, Changsheng Zhang et al. 2010) As for the great important function and influence of Marine microorganisms in Marine geochemical ecology, such as the greenhouse effect, climate warming, environmental degradation, red tides, etc. (Gaurav, Sivasankari et al. 2017). Especially for Marine ecological environment safety and ecological environment health restoration, it has important theoretical value and practical significance (Zhang, Chu et al. 2017).

Marine microorganisms play an important role in Marine ecosystem (TANG, WANG et al. 2019). The composition of Marine microbial community mainly includes bacteria, archaea, protozoa, fungi and viruses, which directly or indirectly participate in the Marine biogeochemical cycle, including carbon, nitrogen, phosphorus and sulfur cycle (Wright, Gibson et al. 2019). These organisms mainly include light-energy producers and chemical-energy producers, as well as heterotrophic secondary producers, and mainly metabolize and utilize dissolved organic matter and nutrients through microbial rings (Caixia Wang, Yibo Wang et al. 2018). In recent years, research on the dynamic variation of the Marine microbial community structure, in large part based on time scales, from changes to the interannual variability, day and night not only illustrates the environmental factors and the relationship between microbial community, but also revealed the interaction relationship between microbial community and the role of ecological system as a whole (Liu, Wu et al. 2018). What's more, these studies also show that microbial communities are dynamic and elastic, the dynamics can be predicted in a typical region as it varies from day to night, season to season, and year to year (Neethu, Saravanakumar et al. 2019). Microorganisms play an important role in the function of Marine ecosystem (Caruso, Azzaro et al. 2016). We can study their diversity in natural evolution through the theories and methods of microbial systematics and metabolomics (Hautbergue, Jamin et al. 2018). The field validation of habitat suitability models of some fragile sea areas was established (Pereira and Aires-de-Sousa 2018).

Microorganisms have a strong adaptability to the polluted environment, and faithfully record the whole history of pollution in the form of different functional genes, so they become the main force of bioremediation of polluted environment (Lee, Lee et al. 2018;

Peng, Li et al. 2018). Therefore, how to make full use of Marine high-tech, modern molecular biological technology and microbiology technology, integration of relevant ocean science and technology strength, complementary advantages, joint research, innovative and forward-looking will guide meaning of the whole construction machinery, Marine microorganisms research, especially microbial remediation of Marine environmental pollution, Marine microbial control of red tide disaster, Marine microorganisms on Marine biological productivity improvement, development and utilization of resources of Marine microorganisms research necessary is imperative (Satheesh, Bakdah et al. 2016, Ncibi, Mahjoub et al. 2017, Varjani, Gnansounou et al. 2017, Jacquin, Cheng et al. 2019).

### 1.3 Significance of Marine microbial diversity survey

What is the significance of Marine microbial diversity survey for Marine pollution ecological restoration and Marine biological function research? What are the Marine microorganisms involved in environmental purification? This is the most important science problem.

The complexity of Marine environment leads to the diversity of microorganisms (Duran, Mendez et al. 2019). There are a large number of microorganisms in the Marine environment, which play an important role in material circulation, energy flow, ecological balance and environmental purification (Apprill 2017). Their high efficiency of reproduction, diversity of metabolism and rapidity of genetic variability enable their enzyme system to adapt to the changes of the external environment at the fastest speed (Cerro-Galvez, Montserrat Sala et al. 2019). It could be grow in various natural environments, and it have great potential to degrade or transform various toxic and harmful pollutants (Bonugli-Santos, dos Santos Vasconcelos et al. 2015). Fully exploiting Marine

microorganisms species and their genetic resources would be great significance in the treatment of marine environmental pollution, ecological environment restoration and development and utilization of microbial resources, which is also an urgent requirement for the sustainable development of marine business (Cerro-Galvez, Montserrat Sala et al. 2019).

Microorganisms in the coastal ecosystem plays an important role in ecological, The system have been regulated the global carbon (C) (Leonov, Sukhoruk et al. 2008), nitrogen (N) (Morando and Capone 2016), phosphorus (P) (LeBrun, King et al. 2018), biogeochemical flux (Li, Li et al. 2019), sulfur(S) (Jorgensen, Findlay et al. 2019)and iron (Baltar, Gutierrez-Rodriguez et al. 2018) by recycling soluble nutrients. It's very important to understand how microbial communities to respond to environmental change, For example the interference from human activities such as fishing and mariculture, bad weather and climate change (Yu, Zou et al. 2019). Reclaiming land from seawaters in because, wai sea aquaculture, reclaiming land from beach, port construction, such as yachts, frequent activity, the tourist season for travel to visit a large number of human activities, the beach hotel, the factory discharge, anchored, long-term a large number of fishing vessels, large-scale construction more ships and mangrove beach, oil production base, the fishing boat fish more, before the industrial sewage, for coastal tourism region and so on in recent years, industrial sewage, agricultural sewage containing chemical fertilizers and pesticides, city, town and rural domestic sewage, aquaculture wastewater of high density mariculture and Marine oil exploration and development and a lot of shipping accidents of spilled oil and other pollutants, confused Access to estuaries, bays and coastal waters (De Frond, van Sebille et al. 2019, Ding, Wu et al. 2019, Houde, Wang et al. 2019, Liu, Lin et al. 2019, Pazi, Gonul et al. 2019). What are the effects of these human disturbances on microorganisms near shore waters? We should apply different technologies to ecological restoration in different areas,

Previous studies had focused on the dynamics of microbial communities across time and space in natural

marine ecosystems (Biller, Berube et al. 2019). However, few researches have been conducted on the adaptability of microorganisms in the environment to the polluted environment and the effect of microorganisms in the polluted environment on the offshore bioremediation (Qian,W., Fen,J,X et al. 2018).

Bioremediation is a comprehensive good way and necessary means to prevent and control Marine environmental pollution and Marine ecosystem dysfunction (Paco, Jacinto et al. 2019). It was low cost, less side-effects, No secondary pollution, However, due to the complexity of the causes of offshore pollution, different bioremediation schemes should be adopted for different pollutants (Xu, Liu et al. 2018). Successful bioremediation technology would be built on a set of data analyses, there are three main factors: 1) the type of pollutant; 2) degradable microorganisms; 3) relevant environmental factors (Teng and Chen 2019).

#### 1.4 Prospects for development

It is an indisputable fact that offshore environment was been polluted, especially the offshore is under unprecedented pressure of environmental contaminated, a large number of industrial sewage, agricultural sewage containing chemical fertilizers and pesticides, domestic wastewater of city, town and rural, aquaculture wastewater of high density mariculture, and Marine oil exploration and development and a lot of shipping accidents of spilled oil and other pollutants, all of them confused spoiled into the estuary, the gulf and offshore (Alharbi and El-Sorogy 2019) . Although environmental protection awareness has been promoted in recent years, and the Marine environment has been improved increasingly, But there are still some areas with serious pollution (Alharbi and El-Sorogy 2019). In order to quickly and efficiently recovering the water pollution of offshore, Marine microorganisms with functions of phosphorus removal, nitrogen fixation, heavy metal removal and oil treatment are used for ecological restoration, and the expected targets can be easily achieved by utilizing the microbial characteristics of rapid proliferation and metabolic sensitivity (Peng, Li et al. 2018).

Marine microorganisms acts as important role in global biogeochemical cycles, Offshore environmental pollution was also affects the survival and reproduction of all living things including human beings at all times (Rios-Del Toro and Cervantes 2019). Marine microorganisms especially high abundance ratios in polluted environmental is also used in a variety of mechanisms to adapt and feedback the environment contamination, use a variety of mechanisms and pollutants, using and kinds of mechanisms to compete with pollutants, but the mechanism of Marine microorganisms adapted to pollutants as well as in the physiological and biochemical reaction is unclear (Wang,H,F, ChangY et al. 2018). In deep understanding of Marine microorganisms in various kinds of community structure and function (Luo qiong, He ying et al. 2017).

It is of great significance to screen for screening with functions of biodegradation of Marine microorganisms, and synthesize engineering bacteria with special degradation ability, for further studying the treatment effect of bioremediation, and obtain a new breakthrough in the treatment of Marine environmental pollution, so as to reduce the accumulation and transfer of pollutants in Marine habitats, maintain ecological balance and realize the sustainable development of Marine environment.

Environmental pollution always affects the survival and reproduction of all organisms including human beings, and organisms are also using various mechanisms to fight with pollutants, the so-called survival of the fittest (Ivanina and Sokolova 2015)! How do microorganisms in polluted environments, especially in high abundance, survive? What kind of mechanism survives is the key question that needs to be discussed further. The offshore ecosystem is an important part of the global ecosystem and an area seriously disturbed by human activities. Therefore, it is of great significance to protect the habitat safety and ecological health of the offshore ecosystem and maintain the sustainable development of the offshore ecosystem.

Based on the above principles, Marine ecological restoration methods developed or under research make full use of microorganisms, plants and animals, etc.

(CHENG, LIU et al. 2017, Bird, Tague et al. 2019). In addition to pollution removal and water purification, Marine ecological restoration also has the function of habitat restoration and resource conservation. Among them, Marine microorganisms are the most widely distributed and abundant microbial community in the ocean, which has important theoretical value and practical significance for the safety and health restoration of Marine ecological environment (Qian wei et al, 2018).In addition to pollution removal and water purification, Marine ecological restoration also has the function of habitat restoration and resource conservation. Marine ecosystem has complex network relationship and interactive function between organism and environment, so Marine ecological restoration work is still a long way to go.

The offshore ecosystem, with its dual attributes of sea and land, is not only extremely important, but also extremely vulnerable to human activities. To control the polluted Marine environment, we need to consider not only environmental engineering schemes, including controlling the total amount of pollutants discharged, cutting pollution and reducing emissions, dredging and dredging, etc. (Swan, McPherson et al. 2016, Yang, Li et al. 2019). The structure and function of the damaged Marine ecosystem should be gradually restored by means of ecological restoration, and eventually develop towards a virtuous cycle. In fact, the ecosystem has the ability of self-regulation and self-purification. Producers, consumers and decomposers of different levels of the ecosystem play an important role in material circulation and energy flow, and can effectively absorb, degrade and transform harmful substances in the environment to achieve ecological restoration (Ostroumov 2017, Jacob, Buffard et al. 2018, Cammen, Rasher et al. 2019, Rullens, Lohrer et al. 2019).

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### Competing interests

The authors declare that they have no competing interests.

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