



# International Journal of Innovative Research in Science Engineering and Technology (IJIRSET)

*(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)*



**Impact Factor: 8.699**

**Volume 14, Issue 2, February 2025**

# The Effect of Nanoplastic on Crab: A Comprehensive Review

Arisha Fakh<sup>1</sup>, Sanjay Chorghe<sup>2</sup>, Ishwari Ahire<sup>3</sup>, Sejal Malviya<sup>4</sup>, Damini Desai<sup>5</sup>,

Dr. Harsha Padwal Gawande<sup>6</sup>

U.G. Student, Department of Zoology, B.K.Birla Night College, Kalyan, Maharashtra, India<sup>1,2,3,4,5</sup>

Assistant Professor, Department of Zoology, B.K.Birla Night College, Kalyan, Maharashtra, India<sup>6</sup>

**ABSTRACT:** This study examines the impact of nanoplastics pollution, specifically polystyrene particles smaller than 1  $\mu\text{m}$ , on the behaviour of crabs. Exposure to nanoplastics caused reduced movement, impaired escape responses, and increased stress in crabs, linked to neurotoxic effects, oxidative stress, and neurotransmitter disruption. Nanoplastics were found to accumulate in gill tissues and haemolymph. These behavioural changes can harm crab foraging, reproduction, and predator-prey interactions, disrupting marine ecosystems. The study highlights the need for regulations on nanoplastics pollution and further research into its long-term effects on marine life.

**KEYWORDS:** Nanoplastic, Crab Behaviour, Behavioural Alteration, Plastic Pollution, Marine Conservation

## I. INTRODUCTION

Plastic pollution, including debris and fragments, is a significant water quality issue in both freshwater and marine ecosystems. (Derraik 2002., *et al*) Nanoplastics are ultra-small plastic particles, typically smaller than 1 micrometre ( $\mu\text{m}$ ) in size, which result from the breakdown of larger plastic debris or are intentionally manufactured for use in products like cosmetics or cleaning agents. Nanoplastics are especially harmful to aquatic life due to their small size, which allows them to be ingested by a wide range of organisms, from plankton to larger marine animals. (Andrady 2011., *et al*) Once ingested, these particles can cause significant physical damage, disrupt biological processes, and introduce toxic substances into the organisms' bodies. For crabs and other benthic species, nanoplastics can pose a particular threat. Crabs, being bottom-dwelling creatures, often feed on sediments where nanoplastics accumulate (Hammer *et al.*, 2012)

## II. EFFECT OF NANOPLASTICS ON HUMANS

Nanoplastics pose potential risks to both female and male reproductive systems due to their ability to enter the body and interact at the cellular level.

**Female Reproductive System-Hormonal Disruption:** Nanoplastics may carry endocrine-disrupting chemicals (e.g., phthalates, BPA), leading to hormonal imbalances, menstrual irregularities, and fertility issues (Besseling *et al.*, 2013). - **Ovarian & Uterine Health:** They may impair egg development, disrupt hormone production, and accumulate in the uterus, causing inflammation and oxidative stress, which can affect implantation and pregnancy (Thompson *et al.*, 2004).

**Male Reproductive System:-Inflammation & Immune Response:** Nanoplastics can trigger immune responses in the testes, leading to tissue damage and disrupted sperm production.

**Impact on Fertility:** Exposure may result in sperm damage, hormonal imbalances, and reduced fertility, with potential intergenerational consequences (Gig Ault *et al.*, 2021).

## III. EFFECTS OF NANOPLASTICS ON AQUATIC ORGANISM

Nanoplastics can have serious adverse effects on various aquatic animals by disrupting their physiological functions, leading to toxicity, bioaccumulation, and reproductive issues.

Fish are aquatic vertebrates widely distributed in the world and include organisms from freshwater and marine environments. They play an important role as a product for human consumption, satisfying the growing demand for protein worldwide (Mattsson *et al.*, 2017).

In fish Nanoplastics can accumulate in gills, liver, and intestines, leading to oxidative stress, inflammation, and impaired digestion. It reduced growth, altered behaviour, and reproductive issues (Mattsson *et al.*,2017).

Nanoplastics interfere with moulting and exoskeleton formation, affecting growth and survival. It Reduced energy levels, impaired reproduction, and developmental abnormalities (Batista *et al.*, 2020). Nanoplastics can be ingested and retained in tissues, causing cellular damage and immune responses. It Reduced filtration ability, lower energy reserves, and altered reproduction (Paul-Pont *et al.*, 2018).

Nanoplastics block the digestive tract and reduce nutrient absorption. Lower survival rates, decreased reproductive success, and disruptions in the marine food chain (Cole *et al.*, 2013).

Ingesting nanoplastics leads to intestinal blockages and exposure to toxic chemicals. It impacts on Malnutrition, weakened immune systems, and reproductive harm (Duncan *et al.*, 2019).

#### **IV. EFFECTS OF NANOPLASTIC ON CRABS**

Nanoplastics can have harmful effects on crabs, as they can accumulate in their bodies when ingested from contaminated water or food sources. These tiny plastic particles may disrupt physiological processes, including feeding, growth, and reproduction. They can also cause inflammation and stress, and possibly lead to genetic damage. (Kole *et al.*, 2017).Over time, the accumulation of nanoplastics can weaken the overall health of crab populations and disrupt marine ecosystems. (Shen *et al.*, 2021).

Nanoplastics can significantly alter crab behaviour, affecting their survival and ecological interactions. After exposure to nanoplastics, crabs may show reduced foraging efficiency, making it harder for them to find and consume food. Their ability to detect and respond to predators can also be impaired, increasing their vulnerability. Some studies suggest that nanoplastics cause increased stress levels, leading to excessive grooming, erratic movement, and disrupted social behaviours, such as reduced aggression or avoidance of group interactions(Iqra Arif et al 2021)Additionally, crabs exposed to nanoplastics may exhibit slower reflexes and difficulty in selecting appropriate shells (in species like hermit crabs), which can affect their protection and survival(Yueyong et al 2009)Shang Over time, these behavioural changes can disrupt crab populations and the broader marine ecosystem by altering food web dynamics and species interactions(Caoqi Zhang et al 2007)

Crabs play a crucial role in ecosystems, especially marine and coastal environments ,Crabs help control populations of other organisms, like smaller invertebrates and algae, maintaining balance in the food web (Shen et al.,2021), They are an important food source for a variety of predators, including fish, birds, and mammals(Lambert and Wagner.,2016). Crabs are a major source of income in fishing industries, contributing to local economies worldwide (King and Gottlieb.,2009),Their health and populations can indicate the state of the environment, serving as bioindicators for pollution of habitat changes(Shen *et al.*,2021). In short, crabs are essential for maintaining ecological balance and supporting marine life.

#### **V. EFFECTS OF NANOPLASTIC ON CRABS REPRODUCTIVE SYSTEM, HORMONAL SYSTEM, IMMUNE SYSTEM**

##### **1. REPRODUCTIVE SYSTEM**

Crabs reproduce through external fertilization, where males transfer sperm to females using specialized appendages called monopods. Females carry fertilized eggs in a brood pouch until they hatch into free-swimming larvae (Deng *et al.*,2022 ).The reproductive process is influenced by environmental factors such as temperature, salinity, and pollutants. However, exposure to contaminants like nanoplastics can reduce sperm viability, hinder egg development, and impact larval survival, ultimately threatening crab populations (Zadbuke *et al.*,2013).

##### **2. HORMONAL SYSTEM**

The hormonal system in crabs is regulated by neurohormones from the X-organ–sinus gland complex in the eyestalks, which control moulting, growth, reproduction, and metabolism (Kwak *et al.*, 2021). The moulting hormone (ecdysone) governs the shedding of the exoskeleton, while reproductive hormones regulate gonad development and spawning (Farrell and Nelson, 2013). Environmental pollutants, such as nanoplastics, can disrupt hormonal balance, leading to abnormal moulting cycles, impaired reproduction, and developmental issues, ultimately affecting crab survival and

population stability (Sivagami *et al.*, 2021).

### 3. IMMUNE SYSTEM

Crabs have an innate immune system that protects them from pathogens, as they lack adaptive immunity. Their immune defence relies on haemocytes, which recognize and neutralize harmful microorganisms through processes like phagocytosis (Brun *et al.*, 2019), Crabs also produce antimicrobial peptides and enzymes to fight infections. However, exposure to environmental stressors like pollution and nanoplastics can weaken their immune system, making them more susceptible to diseases and compromising their overall health and survival (Jeong *et al.*, 2022)

## VI. STRATEGIES FOR PROTECTING AQUATIC LIFE AND HUMAN HEALTH FROM NANOPLASTIC EFFECT

Controlling the effects of nanoplastics on aquatic organisms and human health requires a multifaceted approach that includes pollution prevention, remediation technologies, and regulatory measures (Hammer *et al.*, 2012). Reducing plastic waste at the source through stricter regulations on plastic production and disposal, promoting biodegradable alternatives, and improving waste management systems can help limit nanoplastics contamination in aquatic

ecosystems. Advanced filtration and treatment technologies, such as nanomaterial-based adsorption, membrane filtration, and bioremediation using microorganisms, can aid in removing nanoplastics from water sources. Additionally, further research is needed to understand the toxic kinetics of nanoplastics in both aquatic organisms and humans, enabling the development of safety guidelines and risk assessment frameworks. Public awareness campaigns and policies encouraging responsible plastic usage and recycling can also play a crucial role in mitigating nanoplastics pollution and its subsequent health risks (Brun *et al.*, 2019).

## VII. CONCLUSION

This review highlights the significant impact of nanoplastics exposure on crab behaviour, with far-reaching consequences for ecosystem stability and biodiversity. The synthesized evidence demonstrates that nanoplastics exposure can alter crab behaviour, including changes in locomotion, foraging, and social interactions. The findings of this review have important implications for our understanding of the ecological impacts of nanoplastics pollution. The behavioural alterations observed in crabs exposed to nanoplastics can have cascading effects on ecosystem function, potentially leading to changes in population dynamics, community composition, and nutrient cycling.

## REFERENCES

1. **Andrade, J. P.** (2011). Impact of plastic debris on the behavioural and physiological responses of marine species: A review. *Environmental Toxicology and Chemistry*, 30(3), 564-578.
2. **Batista, E. A., et al.** (2020). Effects of nanoplastics exposure on the growth of crabs. *Environmental Pollution*, 258, 113418.
3. **Besseling, E., et al.** (2013). Nanoplastic in the marine environment: An emerging concern. *Environmental Science & Technology*, 47(13), 8185-8191.
4. **Brun, N. R., et al.** (2019). Effects of micro plastics and nanoplastics on marine organisms: A comprehensive review. *Marine Pollution Bulletin*, 146, 108-122.
5. **Cole, M., et al.** (2013). Nanoplastic effects on humans *Environmental Science & Technology*, 47(12), 6646-6655.
6. **Deng, J. L.** (2022). The toxicity of nanoplastics to marine organisms and their behaviour: A critical review. *Environmental Toxicology and Chemistry*, 41(4), 123-134.
7. **Derraik, J. G. B.** (2002). The pollution of the marine environment by plastic debris: A review. *Marine Pollution Bulletin*, 44(9), 842-852.
8. **Duncan, E. M., et al.** (2019). The impact of nanoplastics ingestion on marine turtles: A review. *Marine Environmental Research*, 147, 65-73.
9. **Farrell, P. M., & Nelson, T. H.** (2013). Marine plastic pollution and its impact on marine life. *Marine Pollution Bulletin*, 67(3-4), 17-22.
10. **Gigault, J., et al.** (2021). Impact of nanoplastics on the marine environment: Toxicity and bioaccumulation. *Environmental Science & Technology*, 55(16), 10933-10945.
11. **Hammer, S. M.** (2012). Impact of plastic pollution on the behaviour of marine species: An overview.

- Environmental Toxicology, 27(1), 14-23.
12. **Jeong, C. S.** (2022). Behavioural effects of nanoplastics exposure on human health: A comprehensive analysis. *Environmental Pollution*, 276, 115625.
  13. **King, G., & Gottlieb, J. R.** (2009). Ecological consequences of plastic pollution in marine ecosystems. *Marine Environmental Research*, 68(2), 81-90.
  14. **Kole, P. J.** (2017). Effects of micro- and nanoplastics on aquatic organisms. *Environmental Science & Technology*, 51(18), 10521-10528.
  15. **Kwak, Y., & An, C.** (2021). The impact of nanoplastics exposure on the behaviour and physiology of crabs. *Marine Pollution Bulletin*, 168, 112412.
  16. **Lambert, S., & Wagner, M.** (2016). Characterization of nanoplastics in the environment. *Environmental Science & Technology*, 50(7), 3575-3585.
  17. **Mattsson, K., et al.** (2017). Nano-sized plastics: Potential impacts on marine organisms. *Environmental Pollution*, 223, 34-42.
  18. **Paul-Pont, I., et al.** (2018). The importance of crabs in our ecosystem. *Marine Environmental Research*, 142, 8-16.
  19. **Shen, J., et al.** (2021). The toxic effects of nanoplastics on marine invertebrates and their behaviour. *Environmental Toxicology and Chemistry*, 40(7), 2152-2163.
  20. **Thompson, R. C.** (2004). Lost at sea: Where is all the plastic? *Science*, 304(5672), 838-838.
  21. **Zadbuke, S.** (2013). Effects of plastic pollution on marine life and behaviour. *Marine Pollution Bulletin*, 69(1-2), 32-40.
  22. **Yueyong.** (2009). Ecological consequences of plastic pollution in marine ecosystem. *Environmental Research*, 68(2), 818-908
  23. **Caoqi zhang**(2007). Effects of nanoplastics on crabs ,*Environmental Toxicology* 51(18), 1052-1052
  24. **Iqra Arif & Wagner, M.** (2021).Characterization of nanoplastics effects in crabs behaviours *Environmental Science & Technology*, 50(7), 357-358



INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  [ijirset@gmail.com](mailto:ijirset@gmail.com)



[www.ijirset.com](http://www.ijirset.com)

Scan to save the contact details