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MARINE PROTECTED AREAS (MPAS) IN AUGMENTING FISH BIODIVERSITY

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MPAs can be defined as a clearly defined geographical space, recognized, dedicated, and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values.

MPAs are clearly defined geographic spaces managed through legal or other effective means to achieve long-term conservation of nature and ecosystem services. They may range from no-take zones (full protection) to multiple-use zones (regulated extraction), IUCN.

India has a network of MPAs established under various legal frameworks, most notably the Wildlife (Protection) Act of 1972. This includes:

- **Marine National Parks**: Provide the highest level of protection, with strict regulations on human activities. Examples include the Gulf of Kachchh Marine National Park in Gujarat, the Gulf of Mannar National Park in Tamil Nadu, and the Sundarbans National Park in West Bengal.
- **Marine Wildlife Sanctuaries**: Allow regulated activities, such as traditional fishing, in designated zones. Examples include the Malvan Marine Wildlife Sanctuary in Maharashtra and the Gahirmatha Marine Sanctuary in Odisha, both of which are well-known for Olive Ridley Sea turtle nesting.
- **Conservation Reserves and Community Reserves:** These categories, introduced by the Wildlife Protection Act Amendment of 2002, promote community involvement and sustainable use, though they are less commonly used for purely marine areas.
- **Other relevant categories:** While not legally classified as MPAs, areas such as Ramsar Sites with marine influence (e.g., Chilika Lake), Ecologically Sensitive Areas (ESAs)

under the Environment (Protection) Act, 1986 (e.g., Lakshadweep coral reefs), and Coastal Regulation Zones (CRZs) all play important roles in marine conservation (Al-Abdulrazzak, D., & Trombulak, S. C., 2012).

Needs to establish MPAs

1. Designing a Marine Protected Area (MPA) on a tropical coral reef can improve reef quality and increase fish biomass, which is crucial for commercial fish stocks.
2. During the rebuilding phase of a fishery, it is important to protect depleted stocks and habitats by halting fishing on collapsed or near-collapsed stocks. This allows the resource to recover.
3. Protecting genetic structure by preventing population bottlenecks, preserving diverse age groups and subpopulations, and utilising an MPA network to safeguard fish genetic traits.
4. Limiting bycatch by temporarily or permanently closing areas with high discard rates.
5. Allocating use rights in specific locations to reduce competition or enhance opportunities for specific user groups (e.g., artisanal or recreational fishermen) (Laxmilatha *et al*., 2015).

MPAs Enhancing Fish Biodiversity

1. MPAs provide a safe habitat for fish to breed, grow, and recover, resulting in population growth.
2. Spillover Effect: Increased fish biomass in MPAs can benefit biodiversity beyond the protected areas.
3. Habitat Restoration: Preventing destructive practices like bottom trawling promotes reef recovery, mangrove regrowth, and seagrass bed expansion, which are important fish habitats (Lester, S. E., *et al*., 2009).
4. MPAs can serve as climate refuges, allowing temperature-sensitive species to survive warming waters (e.g., coral reef MPAs in the Pacific).
5. MPAs protect genetic diversity by increasing population sizes and reproductive outputs.
6. MPA networks promote ecosystem connectivity by providing corridors for larval dispersal, improving genetic flow and resilience across regions (Roberts *et al*., 2017).

Fig 1: Major Marine Protected Areas in India

Global Examples

1. The Great Barrier Reef MPA (Australia) has over 1,500 fish species and saw a 2x-4x increase in fish biomass in no-take zones.
2. Apo Island MPA in the Philippines has pioneered community-based conservation, increased fish diversity, and generated local income through ecotourism.
3. The Chagos Archipelago (Indian Ocean) is one of the largest MPAs with significant biomass recovery of predatory fish (Edgar, G. J. *et al.*, 2014).

Challenges include ineffective enforcement, paper parks (MPAs only on paper), stakeholder conflict (e.g., with fishers), and climate change compromising long-term effectiveness.

Innovations include AI-based monitoring (e.g., Global Fishing Watch) for real-time detection of illegal fishing and community-led MPAs that promote compliance and local benefits. Blue Carbon credits from MPA-restored ecosystems aid financing (Sala, E. *et al.*, 2021).

Conclusion

Marine Protected Areas are an effective strategy for increasing fish biodiversity, rebuilding overfished stocks, and strengthening ecosystem resilience. Their success is

dependent not only on designation, but also on effective enforcement, community engagement, environmental planning, and adaptive governance.

MPAs are not simply no-fishing zones. When well-designed, enforced, and community-supported, they serve as biodiversity banks, rebuilding fish populations, improving ecosystem resilience, and promoting sustainable livelihoods. Dynamic MPAs, blue carbon mapping, and AI-powered surveillance can transform MPAs' role as biodiversity hotspots in the Anthropocene.

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