Conserving Fish Wealth for Future Generations

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Fisheries play a crucial role in shaping aquatic biodiversity, while biodiversity itself can improve the benefits humans receive from fisheries through two major pathways: nutrition and resilience. In terms of nutrition, different fish species contain varying levels of essential nutrients. Some species are richer in nutrients such as omega-3 fatty acids, iron, calcium, zinc, vitamin A, or protein, allowing people to meet recommended dietary requirements with a smaller quantity of fish. In biodiverse ecosystems, the chances of finding species with highly beneficial nutrient profiles are greater. Moreover, combining multiple species with complementary nutrient compositions can further reduce the total biomass needed to satisfy dietary requirements. Therefore, diverse fisheries can provide balanced nutrition more efficiently than fisheries dominated by only one or two species. Biodiversity also strengthens the resilience and stability of fisheries. Ecosystems with a wide variety of species often contain nutritionally similar species that can substitute for one another if certain populations decline. In addition, species differ in characteristics such as temperature tolerance and responses to environmental stressors. This variation, known as response diversity, helps fisheries withstand disturbances like climate change, habitat degradation, or extreme weather events. As a result, ecosystems with greater biodiversity are generally more stable and capable of continuing to support human livelihoods and food security over time. These benefits are especially important in regions where communities heavily depend on capture fisheries for nutrition and income. While biodiversity loss is commonly viewed as a consequence of food production, conserving aquatic biodiversity may actually improve access to nutritious and sustainable food resources. Protecting diverse fish communities can therefore contribute both to environmental conservation and to human well-being.

Biodiversity and potential nutritional outcomes

The study revealed that countries with greater fish diversity are able to meet nutritional requirements with a smaller quantity of fish biomass. In other words, nations that possess a wider variety of fish species can provide healthier and more balanced diets more efficiently. For instance, in Kiribati, where around 221 fish species are available, nearly half of the recommended daily nutrient requirements could be fulfilled with only 128 g of fish per day. In contrast, Iceland, which has a comparatively lower fish diversity of about 56 species, would require almost 423 g of fish to achieve the same nutritional benefit. Statistical analysis further showed that with every additional fish species present in a country, the minimum amount of fish biomass needed to satisfy nutrient requirements decreased by approximately 0.5%. This suggests that increasing species richness not only improves nutritional efficiency but also creates more possible combinations of fish species capable of meeting dietary needs.

One of the major reasons behind this relationship is the concept of nutrient complementarity. Different fish species contain different nutrient compositions, and when species with unique nutrient profiles are combined, they collectively provide a wider range of essential nutrients. The study found that the most efficient dietary combinations generally included up to four species with distinct and non-overlapping nutritional characteristics. Since nutrient concentrations are not strongly correlated among all species, very few individual fishes are rich in every essential nutrient. However, by combining selected species, it becomes possible to fulfil multiple dietary requirements simultaneously. Countries with higher biodiversity were therefore found to possess greater nutritional trait diversity, increasing the likelihood of forming balanced and nutrient-rich fish portfolios.

Another important mechanism observed was the selection effect. Researchers identified the single fish species within each country that could independently satisfy nutrient requirements with the least biomass. Interestingly, biodiverse countries were more likely to contain exceptionally nutrient-rich species capable of meeting dietary needs more efficiently on their own. This indicates that greater biodiversity expands the nutritional possibilities available within a country's fisheries. However, complementarity does not automatically occur in every combination of species. To examine this, researchers compared optimised fish portfolios with randomly selected groups of species from each country's fish fauna. Randomly assembled portfolios in biodiverse countries still performed better than those in species-poor regions, requiring less biomass to meet nutritional targets. Nevertheless, the optimised combinations were far more efficient than random selections. The findings suggest that the broader nutritional variation present in biodiverse fish communities increases the probability of including both highly nutritious species and species that complement one another nutritionally. Consequently, biodiversity benefits

not only carefully planned fish-based diets but also everyday, naturally occurring patterns of fish consumption.

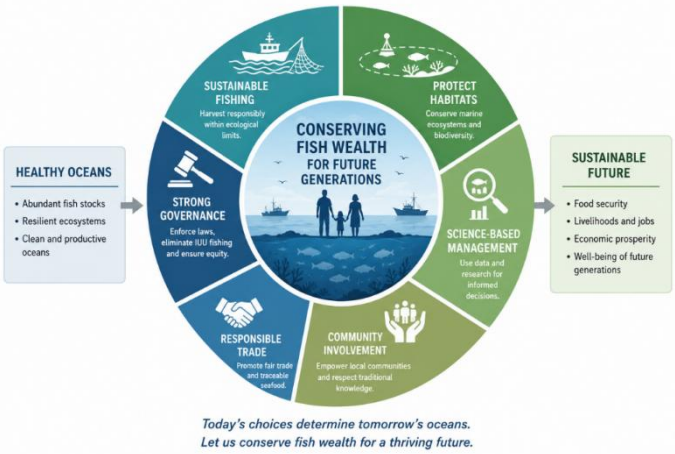

Fig. 1: Diverse Fish Species Support Healthy Ecosystems and Human Nutrition

Importance of Biodiversity in Fish-Dependent Countries

The benefits of fish biodiversity are especially important in countries where people strongly depend on fisheries for food, nutrition, employment, and livelihoods. This is particularly evident in many island nations such as Kiribati and in regions associated with major river systems like the Mekong River basin in Cambodia, where fish play an important cultural, social, and economic role. In many of these regions, malnutrition and micronutrient deficiencies remain major public health concerns, and fish serve as an affordable, accessible, and culturally accepted source of essential nutrients. The study highlights that conserving and sustainably utilising diverse fish species can significantly improve nutritional security while also enhancing the long-term stability and resilience of fisheries-based food systems. International trade in fish and fishery products further influences the relationship between biodiversity and nutrition. Trade can alter the variety of fish species available for consumption in different countries, reducing the direct dependence of diets on local fish biodiversity. Although the study did not identify a strong direct relationship between imported fish consumption and national biodiversity levels, many biodiversity-rich countries are currently undergoing rapid dietary and food-system transitions. Increasing consumption of farmed animal-source foods such as aquaculture products, poultry, and beef may reduce fishing pressure on wild stocks. However, many of these alternative foods are often less nutrient-dense than diverse wild fish species, potentially increasing the risk of hidden hunger and micronutrient deficiencies. These changing dietary patterns emphasise the need for policies that support the conservation, sustainable harvesting, and consumption of diverse native fish species. The study also suggests that the actual contribution of fisheries to nutrition may be much greater than official statistics indicate.

Fisheries data are often based mainly on commercial landings and market records, which frequently overlook subsistence fishing and locally consumed catches. In many developing countries, weak monitoring systems and incomplete taxonomic reporting further contribute to the underestimation of fish biodiversity and consumption. As a result, the true importance of diverse fish species in supporting nutrition and livelihoods is likely underestimated in global assessments. Strengthening fisheries monitoring, species-level documentation, and biodiversity assessments is therefore essential for developing effective conservation and food-security policies. Overall, the findings demonstrate that conserving fish biodiversity is particularly critical in regions where communities heavily depend on fisheries. Protecting diverse fish communities not only supports ecosystem sustainability but also helps secure resilient, nutritious, and culturally important food systems for future generations.

Conclusion

As the global population continues to grow, ensuring food and nutritional security while conserving natural resources has become one of the greatest global challenges. The study clearly demonstrates that fish biodiversity plays a vital role in supporting both human nutrition and the long-term sustainability of fisheries. Countries rich in fish diversity are better able to meet nutritional requirements with smaller quantities of fish biomass because different species provide complementary nutrients that together support healthier and more balanced diets. The findings further highlight that biodiversity strengthens the resilience of fisheries by increasing ecological and functional diversity. Fish communities composed of species with different traits, feeding habits, and environmental tolerances are more capable of withstanding climate change, habitat degradation, overexploitation, and other environmental disturbances. Diverse fish assemblages also reduce dependence on a few species and improve the adaptability of food systems under changing environmental and socio-economic conditions. Importantly, the benefits of biodiversity become even greater when multiple nutritional requirements are considered together. No single fish species can efficiently provide all essential nutrients, but combinations of diverse species can collectively fulfil a wide range of dietary needs while reducing harvesting pressure on individual stocks. These benefits are especially significant in regions where communities heavily depend on capture fisheries for food, nutrition, and livelihoods. However, increasing biodiversity loss, habitat destruction, pollution, and unsustainable fishing practices

threaten both aquatic ecosystems and the nutritional security of millions of people worldwide. Many nutritionally valuable small indigenous fish species remain poorly documented and underrepresented in fisheries statistics despite their importance in local diets and resilient food systems. Therefore, conserving aquatic biodiversity, improving fisheries monitoring, and promoting the sustainable utilisation of diverse native fish species are essential for securing healthy ecosystems, sustainable fisheries, and nutritious food for future generations. Protecting fish wealth today is not only an environmental necessity but also a critical investment in global food security, human health, and the resilience of future generations.

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