Ecological Consequences of Fishing in Marine Ecosystem: A Review

Abstract

The dramatic increase of the use of the destructive fishing techniques and gear worldwide destroys fisheries, marine mammals and entire ecosystems. Along with the growing fleet come more fishing nets in the water, some of which are very non selective. It is impossible to catch only desired species, this harvest of non target species is called bycatch. Bycatch constitute all of the animals that are caught but not wanted or used or required to be discarded by management regulation. This includes endangered or protected species fish that are legally too small to catch or those that have to commercial value. It is estimated that bycatch makes up a quarter of all the fish caught but most of the bycatch are dead before being thrown back to the water. Equipment such as purse seine nets, longlines gillnets and trawls are especially harmful to the environment. They tend to catch juveniles fish, birds and other non target animals. Gillnets are also dangerous as many are discarded in the water yet continue to kill fish in what is known as ghost fishing. Trawls are especially dangerous as they produce significant bycatch while damaging the environment as they are dragged along the sea floor.

An article titled "**Ecological Consequences of Fishing in Marine Ecosystem: A Review** " by Shabir A. Dar discussed about the Marine Ecosystem maintains a degree of biodiversity and resilience, rebounding from disturbances to accumulate natural capital, biomass or nutrients, and support sustained biogeochemical cycles. Among the consequences, the structure of marine habitats that ultimately influence the diversity, biomass, and the productivity associated with biota. Fishing can change the composition of ecological communities, which can lead to changes in the relationships among species in marine food webs. Due to rapid geographical expansion and technological advancements, the catches have substantially increased and this has defiantly shown to put pressure on the ecosystem.

Introduction

There are growing and wide spread concern about the effects of overfishing on the populations of target species but little consideration of the more general effects of fishing on other ecosystem components. Thus, the review focuses on some of the wider implications of the effects of fishing on marine communities and ecosystems. Marine ecosystems are enormously variable, complex and maintain a high degree of biodiversity and resilience, rebounding from disturbances to accumulate natural capital (biomass or nutrients) and support sustained biogeochemical cycles (NRC, 1999). When loss of biodiversity precipitates decreased functional diversity, the inherent unpredictability of the system increases, resilience declines, and overall biological productivity reduced (Folke et al., 1996).

Fishing, even when not extreme, presents a very predictable suite of consequences for the targeted populations, including reduced numbers and size of individuals, lowered age of maturity, and reduced age structure. This is as true for recreational fishing as it is for commercial fishing. It is also followed by a less frequently predicted consequence to the ecosystems in which the exploited populations are embedded. There will be direct & indirect consequences of fishing practices which will alter the structure of marine ecosystem that will ultimately influence the biodiversity, biomass and productivity of the associated biota, removal of predators, which disrupts and truncates trophic relationship (Pauly et al., 1998) and endangered of marine mammals, sea turtles, some seabirds, and some fish (NRC, 1998). Fishing can change the composition of ecological communities, which can lead to changes in the relationships among species in marine food webs. These changes can change the structure, function, productivity, and resilience of marine ecosystems.

Bycatch is perhaps the most serious general environment impact of modern fisheries ecosystem. Because the process is out of sight of the public and there are few objective studies, the data base is inadequate and attention to the problem has been limited. However, the issue is so important that there is increasing public concern and cooperation between the fishing industry and regulatory agencies (Hill and Wassenberg, 1990). Habitat loss is an another the primary factor responsible for the rapid rate of species extinctions and the global decline in biodiversity that has been witnessed in the past few years. Habitat destruction through dynamite fishing and cyanide fishing, which are illegal in many places, harm surrounding aquatic habitat in great extent. Bottom trawling, the practice of pulling a fishing net along the sea bottom behind trawlers, removes around 5 to 25% of an area's seabed life on a single run (Maunder et al. 2006).

Ecological Consequences of Fishing

The most significant consequence of fishing may be decreased prey availability for predators in the ecosystem. Fishing may therefore, appropriate or other types of biological production, forcing dietary shifts among predators from preferred to marginal prey of lower energetic or nutritional value. Also, if fishing pressure is sufficiently intense on alternative populations that is compromises a predator's ability to make adequate dietary shifts, the results may be reduced foraging opportunities

Shabir A. Dar[1*], Saly N. Thomas and M. H. Balkhi[3]

[1&3] Faculty of Fisheries, Sher-e-Kashmir University of Agricultural Sciences and Technology Kashmir 190 006

[2]Central Institute of Fisheries Technology, Matsyapuri, Cochin- 682 029

and reduced growth, reproduction and survival. Fishing may indirectly affect trophic links by removing species that intense that initiate schooling behaviour in their prey, making that prey unavailable to other predators. So it will cause disruption in the food chain by removing the predators. Subsequently in reverse of this effect removing of one predator may create additional feeding opportunities for others, encouraging their population growth (Tasker et al., 2000). Regardless, there are the first line symptoms of disrupted food chain.

Serial Depletion

One of the considerable impacts of fishing involves the shift from the prized species to relatively less valuable species, as prized one decline in abundance (Dayton et al., 2002). When these less valuable species also decline, fishermen move into another species lower in the food web and so on. This sequential or serial overfishing of different species is characteristic of overfished ecosystem (Murawski, 2000). It is a contributing factor in the decline of entire assemblages of commercially valuable populations and has been reported from all major fisheries of the world (Orensanz et al., 1998).

Effects on Marine food webs of removing top-level predator

Another ecological shift among exploited populations is the shift among exploited populations is the shift from higher trophic level levels to lower ones. That is, subsequent to removing the top-level predator the larger, long lived species to the point of fishery closure or economic extinction, the fishery turns to the capture of the prey species. This "fishing down the food web" is a top ecological problem, having its predictable influence through the removal of predators at the peak trophic levels with concomitant changes in their competitors and prey (Vivekananda et al., 2005).

Effects on marine food webs of removing lower trophic- level species

Lower trophic level species like sardines, herring, and anchovies typically mature rapidly, live relatively short lives, and are extremely abundant. As a result, they are among the most heavily exploited species in the world. Single species models, particularly those based on maximum sustainable yield, suggested that lower trophic- level species have tremendous potential for sustainable exploitation. Thus, intense harvesting of these species can affect ecosystems in two different directions from intermediate levels up and from intermediate levels down.

Cumulative and Synergistic impacts

The cumulative or synergistic contributions of top down and bottom up effects on ecosystem can be difficult to detect (Micheli, 1999) and equally less severe into individual (Boesch et al., 2001). The concerns like fishing, pollution, climate change, eutrophication, and disease would add the affects of intensive aquaculture for reflection in the situation of cumulative impacts. It has resulted in significant loss of habitat in many developing nations (Naylor et al., 2001). This should serve as warning to heed as aquaculture develops in the world.

Reduced Reproductive potential of Population

Fishing not only alters the abundance of stocks, but it also effects the age of first maturity, size structure, sex ratio and genetic makeup of the population. So the way we fishing has been reduction in the mean fecundity across all age groups and often disappearance of the largest, most fecund individuals. Larger fish produce far more eggs than smaller fish, demonstrating an exponential rather linear relationship between fecundity and size.

The most of truncated age structure is worsened in hermaphrodite species. For instance grouper & sea bass changes sex from female to male & male to female respectively when they reach a certain age and size. So declining male to female ratio as through it represents complete loss of the larger size classes of a much more significant loss of an entire sex.

Depensation

It has been observed that the per capita reproduction declines significantly when the population size of a species falls below a critical level and the phenomenon is known as despensation (Dayton et al., 2002). The less mobile species as more vulnerable to depensation (Stoner and Ray Culp, 2000). These animals stop reproducing when the density declines below a critical limit. The warm temperate or tropical species that change sex and are fished while spawning are more likely to exhibit depensation. In addition, ecosystem relationships may play a role in depensation. (Walters and of Depenstion occurrs because of fishery induced food shift. In this case, declines in abundance of top level predators lead to increased abundance of forage species, which are intermediate level predators. When they are no longer cropped by predation, the forage populations prey upon the juveniles of their predators (Kitchell 2001).The result is decreased juvenile survival, which drives down top level predator populations further.

Bycatch.

Improved gear and technology continue to improve the effectiveness of the fisheries, and there have been coincident improvements designed to reduce bycatch. Yet these efforts to reduce bycatch are positioned with many technical innovations such as beam trawl, paired trawling, gillnets etc. That also much increases the overall catch and cause secondary damage.

By-catch is the portion of the catch that is not the target species. These are either kept to be sold or discarded. In some instances the discarded portion is known as discards. Bycatch fundamentally results from the limited selectivity of fishing gear (Alverson, 1998). It is mostly occurs in active fishing gear. It also occurs in gear that is lost at sea but continues to fish unintended. Marine species whose reproductively or foraging behaviors bring them in contact with fishers are particularly vulnerable. These include sea turtle that nest on beach close to shrimping grounds, and seabirds, marine mammals, sharks, and rays and other species that share the same prey and feeding grounds as the targeted populations. Species with low reproductive rates suffer the greatest population level consequences of bycatch mortality. Seabirds, marine mammals, sea turtles, most sharks and rays, and some long lived finfish all fall into this category. Other species that are attracted to vessels to scavenge discards are often accidentally caught as well.

Habitat Disturbance and Alteration

Habitat loss is the primary factor responsible for the rapid rate of species extinctions and the global decline in biodiversity

that has witnessed in the past one hundred years. This section address ecological consequences associated with the effects of fishing on marine habitats. Marine fishing practices have both temporary and long term effects on habitat, which can lead to impacts on species diversity, population size, and the ability of a population to replenish. (Northridge, 1991) reviewed bottom fisheries that have destroyed *Zostera* beds and saltmarsh vegetation horse mussels beds and their extensive associated invertebrate community, as well as many types of mollusc, crustacean and echinoderm dominated communities. The habitat features associated with the bottom, for instance, the rocks, ledges, sponge gardens, and shell fish beds can significantly and positively influence growth and survivorship of juveniles fishes, often because of reduced risk of predation (Lindholm et al., 1999). Reduction in these features, whether by fishing or other means, can have devastating effect on populations, biodiversity and ecosystem (Sainsbury, 1988).

Conclusion

Fishing exerts a profound effect on all almost components of associated communities and ecosystems. The most sensitive components are rare habitats that serve as nurseries and species with low reproductive rates. It appears as though most continental shelf and coastal habitats are already heavily disturbed by fishing impacts of many types.

We need to manage fisheries by redefining the objectives, overhauling the methods, and embracing the inherent uncertainty and unpredictability in marine ecosystems. This is a accomplished by developing a flexible decision making frame work that rapidly incorporates new knowledge and provides some level of insurance for unpredictable and uncontrollable events. Collapsing fisheries, wasteful bycatch and habitat destruction have drawn the attention of fishers, scientists, Conservationists', and the public, and led to intense analysis of the science of fishery management (Conover et al. 2000) .Habitat lost is not easily (or inexpensively) regained. Species disappearances are irreversible. The government's obligation to protect natural resources is overlooked & ignored, because of political pressure to protect industry. The result is complete disconnect between the problem identified by science and the regulations intended to solve it. We must also hold concerned department responsible when there is inaction. Otherwise, a sustained fishery is unbelievable.

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