

# Strategies to Reduce the Incidental Capture of Marine Mammals and Other Species in Fisheries

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**Abstract:** *Catching unwanted species or individuals has been a cause of inconvenience, loss of income, and even danger to fishermen for thousands of years. However, increases in human population, industrialization of many fisheries, full utilization or overexploitation of most marine living resources, and a growing awareness of the potential ecological impacts of the problem have brought the issue of bycatch to the forefront of fisheries science. A recent review (Alverson et al. 1994) gives an idea of the magnitude of the problem for different types of gear and regions. That study also shows that reliable data are scarce or nonexistent for most fisheries and that problems are apparent for those that are closely monitored. Increased data collection is needed to identify the problems, diagnose the causes, and search for solutions.*

*Bycatch problems have specific characteristics for each gear type, fishery, habitat, etc., but there are some aspects that are the same for all of them. One of the objectives of this paper is to describe these basic features and the ways that solutions to bycatch problems can be sought. In addition, this paper suggests a classification of bycatch and shows how different approaches to solutions apply to different classes. Another subject of this paper will be a general characterization of the strategies that can be used to mitigate the problem of bycatch.*

"Bycatches" were defined by the participants at the National Industry Bycatch Workshop held in Newport, Oregon, as "that portion of the catch returned to the sea as a result of economic, legal, or personal considerations, plus the retained catch of nontargeted species (McCaughran, 1992)." That definition is confusing because it mixes what is waste with what is an additional source of income to the fishery. The catch of nontargeted species may be desirable to the fishermen: These species may have prices similar to or higher than the target species, as would be the case if a group of swordfish were caught in a net of sardines. This bycatch may be quite beneficial economically, while throwing fish back into the ocean usually isn't, and therefore is not desirable.

A set of definitions for bycatches and discards was produced at the Oregon workshop; however, none of the schemes proposed has been accepted by the majority of authors dealing with the subject. The following set of definitions is proposed as being clearer than the previous ones.

- Capture - all that is physically retained inside the net or in any other type of gear

- Catch - the fraction of the capture that is retained, usually because it has economic value, but occasionally for legal reasons. It can be subdivided into target catch—the species that

was the primary objective of the operation—and nontarget catch, which is other species

- Bycatch - the fraction of the capture that is returned to the sea dead or injured to an extent that death is the most likely outcome

- Release - the fraction of the capture that is returned to the sea alive, and in a condition such that survival is expected

- Marketable catch - the fraction of the catch that the fishermen can sell

- Reject - the fraction of the catch that is rejected by the buyers, and is discarded in or near the port

- Yield - the fraction of the marketable catch that reaches the consumers

- Processing waste - the fraction of the marketable catch lost during the elaboration, preparation, transportation, packaging, etc. of the fish

## Classification of bycatches

Not all bycatch situations are equally important from the ecological point of view. The fishermen may or may not have some control on the level of bycatch. In general, most bycatch situations can be classified into some basic types, based on different criteria. Bycatch may be classified:

- a) According to the spatial pattern of the bycatches (concentrated or diffuse): Some bycatches occur in well-defined areas of a fishery—examples include most migratory species and species with small ranges; others occur throughout the fishing grounds

- b) According to the temporal stratification of the bycatches (seasonal or continuous): The bycatch can be seasonal, as during migration or nesting seasons,

or it can occur year-round, among species that are continuously present in the fishery

c) According to the level of impact, which creates the following subclassifications:

- Critical bycatches - those affecting a species in danger of extinction

- Nonsustainable bycatches - those that cause a decline in the abundance of a species, and if continued over time, could lead to the endangerment of the species, although there is no imminent threat of extinction

- Sustainable bycatches - those that a population can sustain without declining in abundance

- Biologically insignificant bycatches - sustainable bycatches whose magnitude is such that they practically have no impact on abundance

- Ecosystem-level impacts - bycatches that affect a large variety of species in an ecosystem, rather than a main species or group of species

- Charismatic bycatches - bycatches of species that are especially valued by a society because of religion, superstition, or the attribution of a human-like moral standing. The response of the public to these bycatches is frequently disproportionate to the biological impact

d) According to the frequency of occurrence (rare or common)

e) According to the level of control fishermen have (controllable or uncontrollable): There are many different levels of control. The bycatch level in more passive gear, such as gill nets or longlines, can be controlled, at least in part, by the configuration of the gear and location and form of deployment. Trawl hauls can be aborted under certain circumstances, thus reducing the

bycatch. But there is a continuum of control levels, and the degree of control of the bycatch in a fishery will indicate whether training programs for fishermen can be effective.

f) According to the degree of predictability (predictable or unpredictable): Bycatches, such as those of rare species, tend to be unpredictable because our databases are insufficient to describe their distribution in a quantitative way. Species with highly variable recruitment may show up in the bycatches at very different levels in different years. Or the behavior or ecology of a species may be modified by some external factors, for example, flooding, or El Niño.

g) According to the ecological origin of the bycatch (associated species or random encounters): The species that constitute the bycatch of a fishery may be caught because they are associated in some way with the target species. Or there may be a "chance" bycatch of individuals that happened to be in the area enclosed by the net or that wandered into the net during its deployment. This is possibly the most important classification, because the presence or absence of an ecological link may suggest different ways of dealing with the problem.

### ***Some basic strategies to mitigate bycatch problems***

Given that the total bycatch is the product of the total effort times the average bycatch per unit of effort (BPUE), there are two ways to mitigate bycatch problems—reduce effort or reduce the BPUE.

Reducing effort results in negative impacts on the fisheries, unless a type of gear is replaced by a more benign one. Reducing

BPUE is a more desirable solution: It allows the continuation of the fishing activity while reducing the negative impacts. It can be achieved through technology, education, regulation, etc. Observer programs are very important for identifying the causes of incidental mortality, and this information makes it possible to develop the research and education programs needed to mitigate the problem.

There are several lines of defense to reduce BPUE:

A) Actions to reduce incidental captures

*First line of defense* - Decisions by fishermen or regulations concerning gear, areas, and seasons: Before deploying the net or other type of gear, fishermen make many decisions that may affect the bycatch. They may choose to avoid some areas or seasons with high bycatch rates; they may modify or change the type of fishing gear used to reduce the incidental captures of nontarget species. Alternatively, regulations may be passed making some of those choices mandatory, or banning some gears, areas, etc.

*Second line* - Decisions by fishermen or regulations concerning deployment conditions: When the gear is being deployed, another set of choices (or regulations) can come into play. The time of day, the duration of the deployment, the fishing depth, the position with respect to currents or other oceanographic or topographic features, are all factors that may affect bycatches.

B) Actions to increase the release of bycatch

*Third line* - Release from the net (procedures and equipment): In the eastern Pacific, a procedure called backdown is used to get dolphins out of nets. In the western North Atlantic, techniques have been developed to

release whales caught in gill nets. The Turtle Excluder Devices release sea turtles from inside trawls.

*Fourth Line* - Release from the deck (procedures and equipment): It may be possible to change some of the conditions prevailing on deck, such as shade, temperature, or running water, to reduce the negative effects of the capture on survival, or to develop equipment to facilitate the handling of the animals, reducing injuries or traumas.

C) Actions to turn the bycatch into catch

*Fifth Line* - Utilization: Once an individual caught incidentally is dead, it can either be returned to the sea or utilized. From the ecological point of view, utilization may be wiser in some cases. Given that the ecological costs of fishing have already been incurred—fuel consumption, pollution, bycatches, damage to the habitat, etc.—the protein or any other product extracted from the bycatch may replace other alternative sources of the same product and reduce the ecological impact of the other exploitation.

## Conclusions

The strategies to mitigate bycatch problems are determined by the statistically simple nature of those problems. With only two "levers" available, the solutions will have to be sought in one of them. The options available are quite diverse, and further technological and scientific developments will add more. Scientists must work to identify the factors that cause high bycatches, such as environmental conditions, including currents and turbidity; gear characteristics and "behavior;" and behavior and ecology of the species involved. This knowledge must be transferred to the fishermen to improve their decision-making processes.

The lines of defense identified here provide a wide range of possibilities for mitigating bycatch problems. Bycatches result from a combination of environmental, biological, ecological, and gear factors. It is vital to identify them, and to assess their relative importance if measures needed to mitigate the problems are to be undertaken.

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