

# Artificial Reefs in Florida 101: Effects on Fishers (and Divers)—Part 3 of an Artificial Reef Series<sup>1</sup>

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## Artificial Reefs in Florida 101—why this publication?

Coastal managers and practitioners increasingly place artificial reefs in marine waters. Artificial reefs are expensive to deploy but they are much more expensive to remove. This makes them relatively permanent habitat alterations. These long-lasting habitat alterations have measurable effects on fish, fishers, divers, fisheries, and the overall marine ecosystem and connected human socioeconomic system. It is critical to understand how artificial reefs “work” to make good decisions about how many artificial reefs to place in the future and where they should go. While scientists have researched many aspects of artificial reefs, this information is not always summarized and explained to the public. To address this we designed a 4-part series called Artificial Reefs 101:

- Part 1 describes why artificial reefs are built.
- Part 2 describes how artificial reefs affect fish ecology.
- Part 3 describes how artificial reefs affect users, mostly focusing on fishers.

- Part 4 describes how the overall fishery system (both fish and fishers) is affected by artificial reefs.

The Artificial Reefs 101 series is intended to provide a general overview for users seeking to better understand artificial reefs in Florida. It also gives some additional details and references for those wishing to dive deeper into the science. The Artificial Reefs 101 series compliments existing publications about specific aspects of artificial reefs, such as how they are implemented (FA231), and the economic benefits of artificial reefs (FE649). There is also additional information available through the *Florida Master Naturalist Program* in the *Marine Habitat Restoration Course*.

In Part 3 (this publication), we describe some of the ways that artificial reefs affect the people using them, specifically fishers and divers. Part I (*Why Are They Built?*) showed that one of the main reasons why artificial reefs are deployed is to enhance coastal recreational opportunities, especially fishing. Below, we describe the specific ways that scientists think artificial reefs affect fishers and divers. First, we cover the direct effects of artificial reefs on fishers and divers (in this publication, “divers” refers to recreational divers who are *not* spearfishing). Then we describe how these direct

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effects may lead to other indirect effects, especially changes in fisher/diver behaviors. These behaviors include things like choosing where, how much, and what species to target when they fish, and are important to consider because they in turn affect things like harvest rates of fish and economic effects of artificial reefs. This resource should help the public understand more about the effects of artificial reefs and provide background information to decision-makers including local officials, management agency personnel, and Extension agents.

## How do artificial reefs affect fishers?

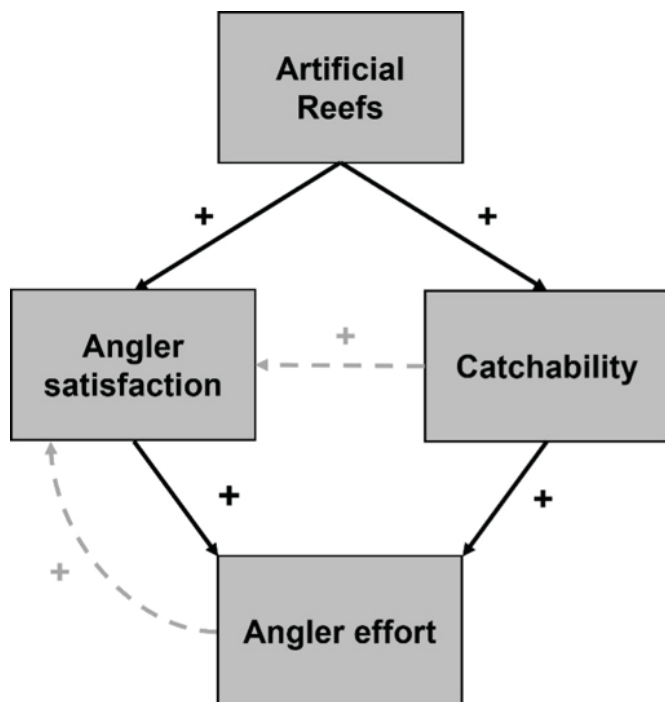


Figure 1. The three ways artificial reefs can affect fishers. Solid lines describe “direct” effects, and dashed gray lines describe “indirect” effects. The plus sign means that there is a positive effect. Artificial reefs can increase catchability and satisfaction directly. It is expected that artificial reefs will initially increase catchability and angler satisfaction, which will then affect effort. If effort increases, then anglers will likely be more satisfied with their fishing experience (indirectly).

Credits: Lisa Chong, UF/IFAS

### Direct Effects

There are at least two ways that artificial reefs can directly affect fishers (Figure 1). The first is by affecting how efficient they are at finding and catching fish. Fisheries scientists refer to this as “catchability.” Catchability essentially describes how effective a unit of effort is at catching fish, and catchability is used to connect fishing effort to number of fish caught. Greater catchability means one unit of fishing effort (like a single fishing trip for a single person) will

have more catch, and lower catchability means less catch for the same amount of effort. Artificial reefs are thought to influence catchability in two ways. The first and most direct way is that artificial reefs are often easy for fishers to find. Artificial reef GPS coordinates are, in general, publicly available; additionally, the structures may be marked with buoys or otherwise visible from above water, or, because they are generally taller than natural reefs, the structures may be easier to locate on bottom imaging machines (sometimes called “fish finders,” “bottom machines,” or “side scan sonar”). Finding good bottom structure faster should help anglers catch more fish more quickly, or it may help them catch species of fish that would otherwise be hard to find (Figure 2). A similar thing may occur with recreational divers, who generally focus their dives around physical structures as opposed to bare bottom. Artificial reefs may make it easier for divers to spend more time underwater, and less time looking for good dive sites.



Figure 2. Artificial reefs can often improve catch rates, decrease time searching for productive fishing spots, or both. Credits: Angela Collins, UF/IFAS

The second way artificial reefs affect fisher catchability depends on how artificial reefs affect fish. Artificial reefs often attract a lot of smaller forage fish, which attract larger fish species that fishers want to catch. For example, large vertical structures often associated with artificial reefs seem to attract more red snapper and greater amberjack than surrounding lower-relief natural reefs (Collins et al. 2015; Karnauskas et al. 2017). This translates to greater concentrations of fish on artificial reefs that often result in greater catch rates for fishers. Together these features mean artificial reefs will probably increase fisher catchability, possibly by a lot. For example, Karnauskas et al. (2017) found that red snapper catch rates are about 20 times higher on artificial reefs than on natural reefs. There have not been many studies that tested how artificial reefs change catchability, but the fact that the same reefs remain popular with fishers through time also suggests artificial reefs increase

catchability. While catchability does not exactly apply to divers, it is also true that divers often expect to see greater numbers, sizes, or diversities of fish around artificial reefs and other large structures such as airplanes and ships.

The presence of artificial reefs can affect fishers and their satisfaction. One way this might occur is if the fishers themselves are involved in the implementation of the artificial reef. This could be by working to place the reef or talking to local leaders and fisheries managers to encourage artificial reef deployment. Very little research has focused on this, though several papers and reports describe how artificial reefs are usually popular with fishers and divers (Lindberg and Seaman 2011). Many fishers also think that artificial reefs attract popular sport fishes, that they produce more fish by providing more habitat (Schuett et al. 2016), or that more artificial reefs will help spread out the fishing effort and reduce boat crowding at local reefs. In all, it is likely that artificial reefs tend to result in at least initially more satisfied fishers or divers. More satisfied fishers or divers translates to increased benefits to society, which is counted as economic value.

## Indirect Effects

Artificial reefs can also affect fishers by changing fishing effort. Fishing effort describes the number of fishing trips in a given time period. Usually effort is described for a calendar year, but it can also be broken down by month, season, or location. Artificial reefs might increase overall fishing effort by encouraging people to fish who otherwise would not have known fishing “spots,” and who might not be willing to search for spots on their own. Or it might increase fishing effort on specific popular species like red snapper by making them easier to find and encouraging people to fish for these species instead of something else (like pelagics or inshore fish). The few studies measuring effort seem to show that artificial reefs do increase fishing effort (Keller et al. 2016; Simard et al. 2016). For example in Australia, Keller et al. (2016) found that effort intensity at artificial reefs was 12 times more than at other estuarine fisheries in the area. As fishing effort and trips increase, the demand for more artificial reefs could also increase, especially if they provide better fishing benefits such as providing new areas for fishing. If artificial reefs cause an increase in the number of fishing or diving trips made to an area, it will affect the local economy. All else being equal, more fishing/diving trips will mean more consumer spending on trip supplies like ice, fuel, food, etc. This translates to greater market activity—things like sales revenue, total economic output, and even jobs. When evaluated, artificial reefs do seem to have a positive effect on the local economy (Huth et al.

2014), which is covered in more detail in [FE649](#). Together, this all means that we should generally expect that artificial reefs will, at least initially, increase not only fisher and diver satisfaction, but likely also catchability, trips made, and the local economic activity.

The reason it is so important to understand how artificial reefs affect catchability and fishing effort is that effort times catchability equals fishing mortality. That means that if catchability, effort, or both increase, then fishing mortality will increase as well. In turn, that means that if artificial reefs didn’t increase the fish populations, artificial reefs would probably increase the proportion of fish harvested per year (this is called the harvest rate). At first that would mean greater catch rates and more fishing trips, but eventually it would negatively affect the fish population. Again, this would occur any time artificial reefs increase fishing mortality more than they increase fish populations. More details on the net effects of artificial reefs will be described in the fourth publication in the Artificial Reefs 101 series.

## Effects on Divers

It is first important to define that when we are describing the effects of artificial reefs on divers, we are referring to non-spearfishing divers who want to observe fish rather than harvest them. This makes a huge difference in terms of the way that divers may affect the overall fish population, but we would expect the way divers are affected by reefs to be similar to the way fishers are affected by them. Divers may be directly more satisfied that artificial reefs exist, and this would lead to more diving trips. The idea of “catch-ability” does not directly apply to divers, who aren’t seeking to catch fish. But artificial reefs that aggregate numbers, species, or sizes of fish or other marine life may well increase how often divers see interesting things underwater. Many divers prefer sunken vessels because of high densities of fishes and the aesthetic qualities from the structures (Murray and Betz 1994). Recent efforts to create artificial reefs that promote underwater art or serve as memorials to be visited are also gaining support in many areas (e.g., [1000 mermaids](#), [Eternal Reefs](#)). If artificial reefs are deployed to create a “destination dive,” or to increase the number of interesting things divers see, we would again expect the new reefs to lead to increased satisfaction, probably greater numbers of dive trips, and, thus, a positive effect on local market activity (Wallmo et al. 2021).

Conflict between divers and fishers at artificial reefs could arise from crowding and from the effects of fishing on fish (Sutton and Bushnell 2008). Too many people diving or

fishing could decrease the natural aesthetics of the diving site, or if fish bear obvious injuries (such as from spears) they may be less attractive for non-fishing divers and fishers alike (Brock 1994). Fishers are also affected by crowding at artificial reefs in general, but they are especially unlikely to fish a reef with divers in the water—both for the safety of the divers and because divers tend to cause fish to be more cautious and less willing to bite fishers' hooks. Similarly, divers may not want to enter the water if fishers are actively retrieving lines and hooks that could snag them or their gear. Too many fishers and divers using the same spaces can cause some on-water conflict on popular artificial reefs. Common courtesy (i.e., yielding to the first user of the reef) can avoid this, but common courtesy is not always followed. In general, however, fishers and divers tend to stay away from each other. Some well-known artificial structures are primarily used by scuba divers (e.g., [USS Oriskany](#)) rather than fishers, and may help entice divers away from the more popular fishing spots. Similarly, many other artificial reefs have been placed in areas where diving is less common.

## Summary

Artificial reefs can affect fishers by changing how effective they are at fishing (catchability), how much they fish (effort), and how content they are with the fishery and their fishing experience (satisfaction). Artificial reefs can also affect diving experiences by providing a unique underwater visual experience and/or by increasing the amount and diversity of species encountered on a trip, which affects diver satisfaction. If artificial reefs do attract and aggregate fish, it is likely that catchability will increase because fishers can target these aggregations and catch more fish. Effort will also increase because fishers will know that these artificial reefs will have more fish, and they may increase the number of trips or spend more time there. Effort may also increase simply because locations of artificial reefs are published, and therefore they are easier to locate than unpublished natural bottom habitat. Artificial reefs may increase fishers' and divers' satisfaction if they catch more fish or see more fish at these sites. If artificial reefs can increase catch rates through increased catchability and effort, that may translate to greater economic impacts and contributions to nearby coastal communities.

However, research is increasingly showing that some artificial reefs may eventually lead to greater fishing mortality. If it is actually the case that artificial reefs are attracting fish and fishers at high and unsustainable levels without leading to increased fish populations (production), then artificial reefs will become ecological traps that increase fishing mortality (Lindberg 1997; Lindberg and Seaman

2011). Conditions could also become unsustainable if artificial reefs do enhance biological production but the enhancement is not large enough to offset the increase in fishing mortality the reefs cause with greater catchability and/or fishing effort. It is possible for artificial reefs to have a net negative effect on fish populations (from increased harvest) and still be desirable to society because of the increased value or market activity they generate. What is also possible, however, and what would be particularly problematic, is a situation in which artificial reefs increase fishing mortality on a species near overfishing limits. In this scenario, the greater harvest the artificial reefs allow could trigger harsher restrictions like shorter recreational harvest seasons. This scenario would cause “losses” to all the “actors” involved: the fish populations, the recreational fishers, the managers, and probably even the local economy that is only tangentially related to fishing. All this makes it important to understand how fishers and divers use the reefs and how their behaviors can affect fish populations. The next publication and [part four of this series](#) will describe potential total effects of artificial reefs on fisheries, including effects on both fish and fishers.

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