Sustainable Seafood Identification

Wild Fishing Methods Review

At REEF Scuba we believe that the best choice for the health of the ocean is to not consume fish or ocean life. That being said, if you are one of the many people who are not ready to take that step, or if you depend on seafood as a core part of your nutrition, we're here to help you identify seafood options and fishing methods which are more sustainable.

Table Of Contents

Introduction: Identifying Sustainable Seafood

There are several methods of identifying sustainable fishing practices in Mexico, including the following:

1. **Using Marine Stewardship Council (MSC) and Aquaculture Stewardship Council (ASC) Certification:**
   You can find ASC certified farms here and MSC certified suppliers here.
   - Cost, however, is a major barrier to certification in Mexico specifically and there also aren't a vast number of certified suppliers available.
   - In addition, certification and eco-labels are often criticised, read more at How Sustainable Is Sustainable Fishing Really?.
2. **Using Seafood Rating systems already in place:**
   - Ocean Wise Seafood Search Function and Ocean Wise Seafood Master List *
   - Seafood Watch *
   - EDF Seafood Selector *
   - Good Fish Guide by the Marine Conservation Society MCS *(NOT to be confused with Marine Stewardship Council MSC)*

It is also possible to search for Fishery Improvement Projects (FIPs) happening in and around Mexico through the FIP Directory. This tool allows the user to identify FIPs happening in Mexico and view what progress has been made towards sustainability of the fishery, although it doesn't directly identify guaranteed sustainable suppliers. Nevertheless, it is a useful tool for periodic monitoring.

Of the above suggestions, we believe that using the **Ocean Wise Seafood Master** List would be best for REEF Scuba's sustainable seafood mobile application. The Ocean Wise Master List is comprehensive, publicly available and undergoes regular monthly review. It also details whether any eco-certifications have been awarded to the named fishery, including MSC certification. Therefore, we believe that if filtered specifically for Mexico and edited to meet a more rigorous definition of sustainability, the list provides one of the most useful tools upon which to base REEF Scuba's mobile application.

One criterion upon which we believe the list should be filtered is by fishing practice since Ocean Wise deem some controversial fishing methods, such as trawling, to be acceptable/sustainable under certain circumstances. Of course, fishing method alone cannot be used to quantify sustainability and other factors, such as stock level and species vulnerability, should still be considered alongside the method of capture. It's always worth remembering that a sustainable method of fishing cannot still be considered sustainable when used to target vulnerable or rare species.

Nevertheless, the remainder of this document aims to provide an overview of the different fishing methods referenced in the Ocean Wise Seafood Master List and the extent to which we believe they should be considered sustainable. *(* Ocean Wise Seafood, Seafood Watch and the EDF Seafood Selector each provide ratings in partnership with Monterey Bay Aquarium. You can read more about Ocean Wise's scoring methodology here.)*

The following provides a list of all wild fishing methods referenced in the Ocean Wise Seafood Master List, a more in-depth discussion of their sustainability follows:

1.0 Trawls

- Midwater/Pelagic Trawls:
  - *Pair Trawls*
  - *Skimmer Trawls*
- Bottom/Demersal Trawls:
  - *Beam Trawls*
  - *Otter Trawls*
  - *Shrimp Trawls*

2.0 Hooks and Lines:

- Handlines and Pole-and-Lines
- Trolling Lines
- Vertical Lines
  - *Jigs*
- Handlines
- Longlines
  - *Demersal/Deep-set*
  - *Pelagic/Shallow Set*

3.0 Gillnets and Entangling Nets:

- Drifting Gillnets
- Anchored Gillnets
- Encircling Nets

4.0 Surrounding Nets:

- Seine Nets:
  - *Purse Seins*
  - *Danish Seins*
  - *Beach Seines*
  - *Pair Seins*

5.0 Traps:

- Fyke Nets, Pound Nets, Stow Nets or Trap Nets (Set Nets)
- Crab Rings
- Lobster Pots

6.0 Dredges:

- Vessel Towed Dredges
- Mechanized Dredges and Harvesting Machines

- Hand Dredges

7.0 Buoy Gear
8.0 Lift Nets
9.0 Falling Gear

- Cast Nets

10.0 Miscellaneous Gear

- Diving
- Hand Implements
  - *Harpoons*
- Scoop Nets or Dip Nets

Sustainability of Fishing Methods Review

1.0 Trawling

Trawling is a fishing technique which consists of dragging a net through the ocean behind one or more boats (Lemasson et al., 2020). Trawling can be divided into two main types: bottom/demersal trawling and midwater/pelagic trawling. Bottom trawling targets bottom-living species/fish and involves towing a weighted trawl net along the seafloor, capturing everything in its path. Midwater/pelagic trawling conversely targets species living in the mid-upper water column and unlike bottom trawling, does not disturb the seafloor (Marine Stewardship Council., 2022). Further sub-types of trawling include:

- Bottom/Demersal Trawls:
  - Otter Trawls
  - Shrimp Trawls
  - Beam Trawls
- Midwater/Pelagic Trawls:
  - Pair Trawls
  - Skimmer Trawls

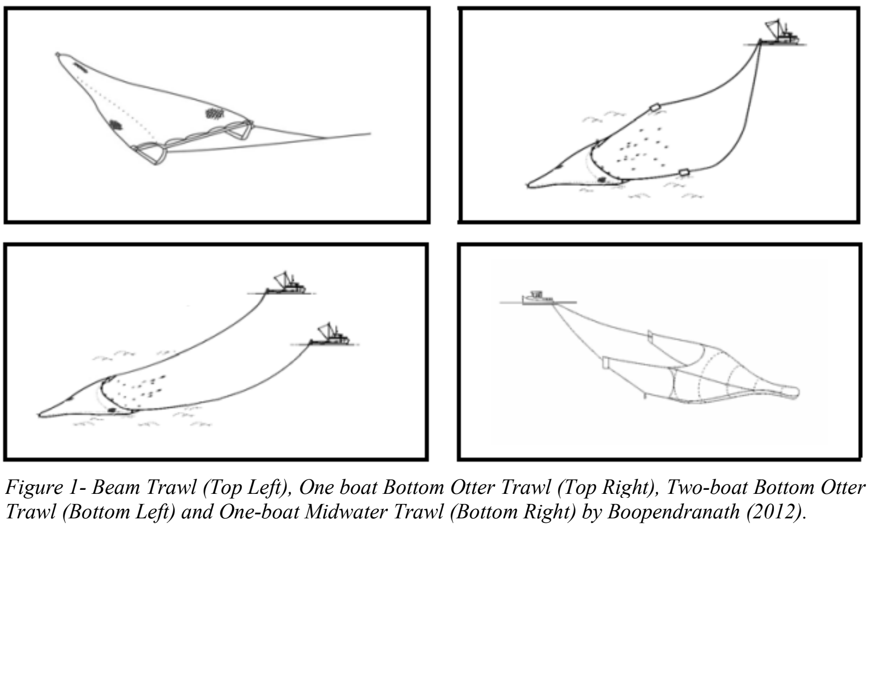


Figure 1- Beam Trawl (Top Left), One boat Bottom Otter Trawl (Top Right), Two-boat Bottom Otter Trawl (Bottom Left) and One-boat Midwater Trawl (Bottom Right) by Boopendranath (2012).

1.1 Environmental Issues of Trawling

- **Seafloor damage**- Bottom trawling causes direct impacts on the seafloor by disrupting sediment, overturning boulders and imprinting scars on the seabed through the repetitive passage of trawling gear across the same area over long periods of time (Oberle, Puig and Martin., 2018). Bottom trawling causes direct, substantial and potentially irreversible physical damage to seafloor habitats and has been likened to forest clear cutting (Watling and Norse., 1998). Fragile-bodied marine fauna, such as Sea Anemones, Sponges and Urchins, are destroyed through bottom-trawling and many species of corals which are specialized to grow on the ocean floor are also uprooted and destroyed by bottom-trawling (Sen Nag., 2018). The bottom trawl net is also known to remove excess seabed-vegetation, exposing organisms to predation which therefore directly effects species composition on the seafloor (Kumar and Deepthi., 2006).
- **Bycatch-** Bottom trawling is known to result in large volumes of by-catch as the nets do not distinguish between species, and therefore many species of fish, marine invertebrates, marine mammals, reptiles, and even seabirds are caught unintentionally. In the Gulf of Mexico, for instance, it has been estimated that for every pound of shrimp caught, between four and ten pounds of other marine resources are discarded. Trawling also contributes to over-fishing as the intensity of operations can rapidly deplete fish stocks, making it an unsustainable method of fishing (Stiles et al., 2010).

It is arguable that mid-water/pelagic trawling is better (more sustainable) than bottom trawling as these trawls do not come into contact with the seabed and are therefore not associated with seafloor destruction (Moran and Stephenson., 2000). However, they may still unintentionally catch large volumes of non-target or even vulnerable species at an unsustainable rate and therefore should not be considered a perfect/vastly superior method. Overall, we believe that all forms of trawling should be considered unsustainable.

2.0 Hook-and-Line

Hook and line is a fishing method which utilizes baited hooks suspended in water by fishing line. There are several types of hook-and-line fishing, including:

- Handlines
- Pole-and-Lines
- Trolling Lines
- Vertical Lines:
  - Jigging
- Longlines (both drifting and set):
  - Demersal/Deep-Set
  - Pelagic/Shallow Set

Handlines and pole-and-lines are both similar fishing methods whereby bait is attached to a hook at the end of a line and suspended in water to capture individual fish. Handlines do not have a pole/rod whereas pole-and-lines do. Trolling is instead a method of fishing whereby multiple fishing lines with attached lures are towed behind a vessel as it moves through the water. Longlines and vertical lines are both similar fishing methods in which a series of baited hooks run at intervals along one mainline. They can be either set (stationary) or drifting (allowed to move with the current). Vertical lines run from the water surface down to the seafloor whereas longlines run horizontally either suspended in the water column (pelagic/shallow set) or close to the seafloor (demersal/deep-set) (Boopendranath., 2012). Jigging is a specific fishing method used to capture squid whereby a vertical line is jerked up and down.

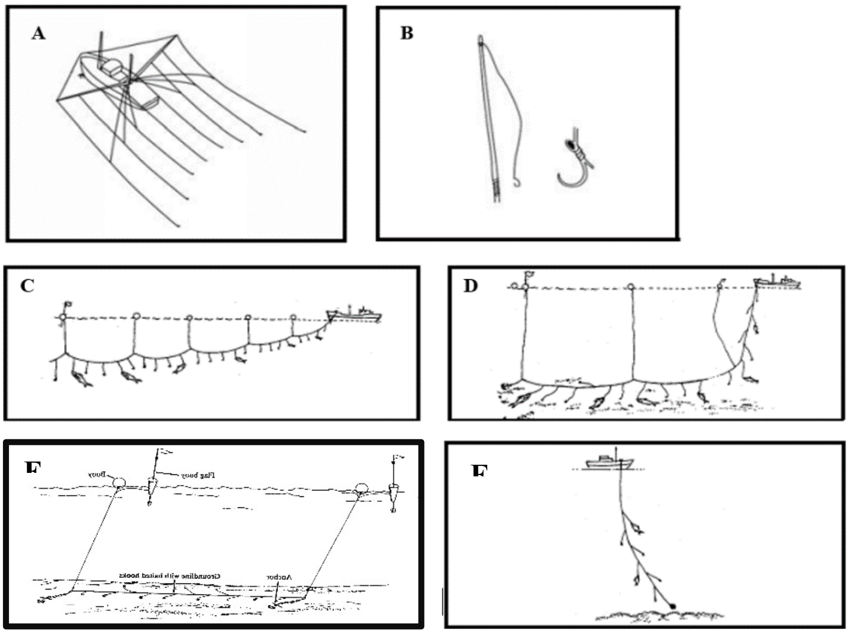


Figure 2- A: Trolling, B: Pole-and-Line, C: Drifting Long Line, D: Drifting Demersal Longline, E: Set Demersal Longline and F: Vertical Longline by Boopendranath (2012) and NOAA Fisheries.

2.1 Environmental Issues of Hook-and-Line

Studies have identified hook-and-line as having one of the lowest environmental impacts out of all commercial fishing methods (Morgan and Chuenpagdee., 2003). However, there are major issues with some of the sub-categories of hook-and-line, including:

- **Bycatch of sharks and turtles**– pelagic and demersal longlines have been associated with increased by-catch, particularly of sharks and turtles (Burgoni et al., 2008; Petersen, Nel and Underhill., 2008; Afonso et al., 2012). For a pelagic longline fishery targeting swordfish and tuna in the southwestern equatorial Atlantic, for instance, 53% of the catch was classified as bycatch and sharks constituted 45% of this (Afonso et al., 2012). Burgoni et al (2008) also reported a bycatch rate of 1.08 turtles per 1000 surface longline hooks for a fishing fleet in Brazil.
- **By-catch of seabirds-** some forms of hook-and-line are linked to increased bycatch of seabirds, including endangered albatrosses. For instance, Burgoni et al (2008) report a bycatch rate of 0.15 birds/1000 hooks for surface longlines, 0.41 birds/day for slow trolling and 0.61 birds/day for handlining.

Overall, some forms of hook-and-line should be considered sustainable, with the exception of pelagic longlines which we believe should be classified as unsustainable due to their high bycatch. Demersal longlines and trolling should also both be treated with extreme caution and not considered sustainable.

3.0 Gillnets and Entangling Nets

Gillnets are curtains of netting which hang in the water column. Mesh sizes of the gillnets are designed to allow certain fish to pass their head through the netting but not their body; their gills become caught in the mesh, therefore trapping them (NOAA Fisheries., 2021; Marine Stewardship Council., 2022). There are three main types of gillnet/entangling net: drifting gillnets, anchored gillnets and encircling nets. Drifting gillnets are held in places by floats and allowed to drift freely near the water surface with or without a boat; anchored gillnets are instead attached to the seafloor with weights at the bottom and floats holding up the top. Encircling nets are gillnets which are deployed around a school of fish; the circular net is slowly closed until the species enclosed within it are fully captured (Fonteyne and Jung., 2019; Goodfish., 2022).

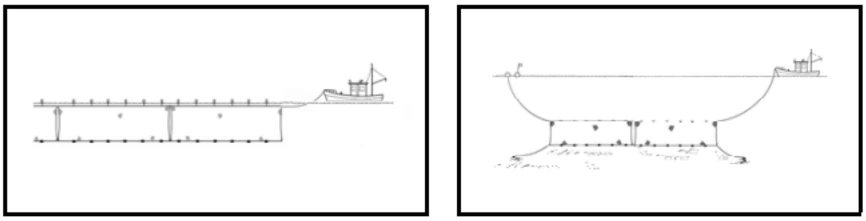


Figure 3- Drift Gill Net (Left) and Anchored, Bottom Set Gill Net (Right) by Boopendranath (2012).

3.1 Environmental Issues of Gillnets and Entangling Nets

There main environmental issues associated with gillnets are:

- **Bycatch** –Shester and Micheli (2011) found that gillnets have high bycatch and discard rates of unwanted and potentially vulnerable species. Anchored gillnets in their study, for instance, had a mean discard (bycatch) rate of 34.3% by weight which is higher than the average discard rate for all other fishing gear detailed in the FAO discard database, when excluding trawls (Kelleher., 2005).
    - Gillnets are also known to unintentionally ensnare and asphyxiate cetaceans which are high intelligent and sentient beings. Cetaceans which escape can suffer physical injuries and also often display behaviour alterations which reduce their long-term survival rate (Dolman and Moore., 2017). Between 1950 and 2018, 4.1 million small cetaceans were caught by pelagic drift gillnets, raising concerns over animal cruelty (Anderson et al., 2020).
- **Seafloor damage**- Shester and Micheli (2011) also state that some of the gillnets in their study contacted the seafloor, damaging habitat-forming species such as Eisenia 25% of

the time and fully removing them 45% of the time. The study authors suggest that gillnets may also damage other species of kelps, sponges, and corals.

- **Ghost fishing** - a phenomenon in which lost nets continue capturing marine species even after they have been abandoned (Brown and Macfayden., 2007). Although difficult to accurately estimate, it has been reported that lost gillnets have a capture rate of 92.8 fish per 100 m^2 of netting and can continue to fish for around 142 days (Nakashima and Matsuoka., 2004; Gilman et al., 2016).

As a result of the points highlighted above, we do not believe that any form of gillnet fishing should be considered sustainable.

4.0 Surrounding/Seine Nets

Surrounding nets are large walls of netting set for capturing fish both from the sides and from underneath, therefore preventing them from escaping by diving downwards (FAO., 2022b). There are multiple types of surrounding net, categorised as follows:

- Purse Seines
- Danish Seines
- Beach Seines
- Pair Seines

Purse seines are the most common type of surrounding net and involve a net being placed around a pre-located school of fish near to the ocean surface. In a purse seine, the top of the net is floated at the ocean's surface and the bottom is weighted. When the fish are enclosed inside the net, the bottom can be drawn closed, capturing the fish inside. Danish seines are similar to purse seines, but instead target fish species found on the ocean floor (Australian Fisheries Management Authority., 2022). In contrast, beach seines are nets shot by hand or from a small boat in a semi-circular shape which are then drawn closed and pulled ashore (Seafish., 2022a).

Pair seines are slightly different from the methods previously mentioned and are actually an alternate name for pair trawls. In this fishing method, a net is towed by two boats simultaneously along the seafloor, one boat towing each side of the trawl. The gear and way of operating a pair seine differs very little from a pair trawl except that the pair seine has a much greater length of rope and wire on the seabed which covers a much larger area (Seafish., 2022b).

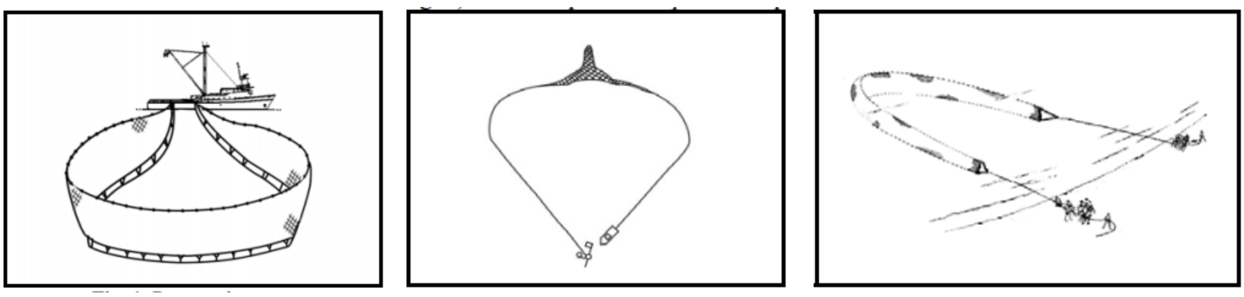


Figure 4- Purse Seine (Far Left), Danish Seine (Middle and Beach Seine (Far Right) by Boopendranath (2012).

4.1 Environmental Issues of Surrounding Seine Nets

- **Bycatch -** the main issue associated with seine nets is bycatch, although the rate is thought to be lower than with other fishing methods, making it more sustainable. Amande et al (2012), for instance, estimated an overall ratio of bycatch vs. tuna landings to be 4.7% in the Indian Ocean, dominated by juveniles of skipjack tuna. Hall and Roman (2013) report a similar bycatch rate of between 1-5% but highlight that seine nets may also capture sharks and sea turtles in small quantities. In some countries, purse seine nets may be set around a Fish Aggregating Devices (FADs). These attract large volumes of fish and significantly increase bycatch rates. Careful distinction should therefore be made between regular seine nets and unsustainable seine nets which employ FADs (Amande et al., 2012; Australian Fisheries Management Authority., 2022).
- **Disturbance of fish spawning grounds**- beach seines are generally sustainable due to their small scale, however, there is a small chance of them disturbing the spawning grounds of fish species which use shallow inshore waters as their nursery grounds (Seafish., 2022). Overall, though, this risk is low.
- **Major environmental issues associated with pair seines**- pair seines are different from the other methods of surrounding seine net and encounter similar environmental issues to those discussed in *part 1.1*. As such, they should not be considered a sustainable method. \

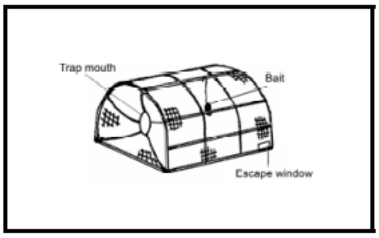
In summary, Purse, Danish and Beach Seines can be considered potentially sustainable when Fish Aggregating Devices (FADs) are not employed, although the method as a whole should be treated with caution due to the discussed bycatch rates above. Pair seines, however, should not be considered at all sustainable.

5.0 Traps

Fishing traps are static cages or nets which are designed to steer or lure fish/shellfish into them and then prevent them from exiting (Mindset Co., 2022). The following are all forms of fishing traps:

- Fyke Nets, Pound Nets, Stow Nets or Trap Nets (Set Nets)
- Lobster Pots
- Crab Rings

Fyke and Pound nets are both types of large, fixed nets which are anchored to the seabed. Pots are instead much smaller traps which resemble a basket or crate attached to a rope; they are typically used to catch crustaceans such as lobsters and crabs (Marine Stewardship Council., 2022). Crab rings are very similar to pots, although as the name implies, designed specifically to catch crabs.



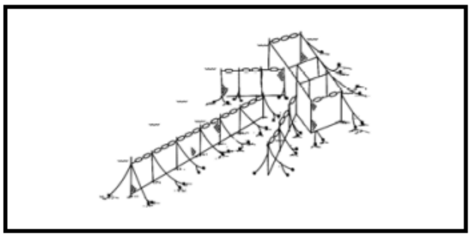


Figure 5- Lobster Pot (Left) and Type of Set Net (Right) by Boopendranath (2012).

5.1 Environmental Impact of Traps

- **Ghost Fishing**- ghost fishing by derelict or lost traps for crabs and lobsters is well known and extensively reported (Kopp et al., 2020; Stevens., 2021). Despite this, the use of fish traps should still be considered as sustainable due to the benefits previously discussed and especially when compared to other capture methods.

Otherwise, there are very few environmental impacts associated with traps. Most traps are designed so that undersized fish can escape, reducing the risk of catching juvenile fish or other smaller fish species (Mindet co.,2022). Similarly, bycatch of unwanted species is low compared to mobile gear. Shester and Micheli (2011), for instance, report bycatch rates using traps to be as low as 0.11%, and due to the design of many traps, any unwanted species which are unintentionally captured can generally be released unharmed anyway (Stevens., 2021; Seafish., 2022c). Seabed damage by traps is also thought to be low (Kopp et al., 2020). Overall, all forms of trapping should be considered sustainable.

6.0 Dredges

Dredging is a similar form of fishing to trawling and involves dragging large, metal framed baskets with rakes along the seabed to collect and capture shellfish such as Scallops (Sustain., 2022). There are three main types of dredging:

- Vessel Towed Dredges
- Mechanized Dredges/Harvesting Machines
- Hand Dredges

Vessel towed dredges involve a boat towing multiple dredge baskets along the seafloor whereas hand dredges are operated on a smaller scale by individuals on foot pulling a rake through shallow sandy sediments (Gaspar et al., 2013). Mechanised dredges, including suction dredges, are more powerful and dig shellfish out of sediment by means of powerful underwater jets. The catch is then transferred to a boat, sometimes by conveyor belt or suction pump (FAO., 2022a).

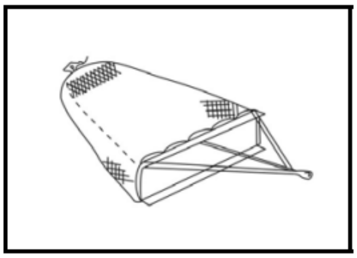


Figure 6- Dredge Frame by Boopendranath (2012).

6.1 Environmental Impact of Dredges

There are many environmental impacts associated with dredging, including:

- **Seabed and habitat damage-** damage and disturbance to the seabed, as well as bottom living marine species, can occur when dredging gear is towed and raked along the ocean floor (Gilkinson et al., 2003). However, many researchers report limited long-term effects of dredging despite dramatic immediate effects (Hall, Basford and Robertson., 1990). For instance, Tuck et al (2000) report limited physical evidence of dredging on the seafloor after 11 weeks as well as limited to no effects on infauna and epifauna.
- **Bycatch-** bycatch is also an issue associated with dredging. Urra et al (2017) for instance, found that for a mechanised dredging fleet targeting the Wedge Clam (*Donax trunculus*) in the northern Alboran Sea (southern Spain), approximately 42% of the catch was discarded. Of these discarded individuals, 3.4% displayed intermediate damage and 11.6% displayed severe damaged. Hand dredging may however lead to slightly lower rates of bycatch. In Southern Portugal for instance, hand-dredged Wedge Clam bycatch rates ranged from 13.1-32.0% and damage rates were lower at 1.3–2.6% (Nicolau et al., 2021).

Overall, although perhaps not as environmentally damaging as trawling, dredging should still not be considered a fully sustainable method due to the issues raised above.

7.0 Buoy Gear

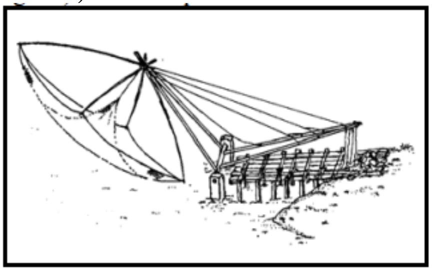
Buoy gear is a slightly newer fishing technique developed specifically to target swordfish as a result of high bycatch rates observed when using alternate techniques. A floating buoy is attached to a fishing line which contains one or more baited hooks. The buoy is continually monitored so that when a fish is hooked, the buoy is pulled down which signals to the fisher to check the catch (Sepulveda, Aalbers and Heberer., 2014).

7.1 Environmental Impacts of Buoy Gear

Buoy gear has been specifically designed to reduce the environmental impacts associated with other methods of swordfish fishing and research suggests that it is a more sustainable method. In one report, bycatch rates were stated to be 8%, with a 93% survival rate of the unintentionally caught species, suggesting that the method is mostly sustainable, especially when compared to traditional swordfish capturing methods including pelagic longlining (Romanov et al., 2013).

8.0 Lift Nets

Lift nets are open net bags or panels used in combination with bait or light which are submerged underwater and left for a set amount of time before being lifted from the water to capture the attracted fish. They can be operated by hand from the shore or from a boat (FAO., 2022c).



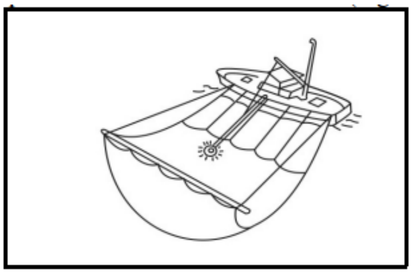


Figure 7- Shore/hand operated lift net (left) and boat-operated lift net (right) by Boopendranath (2012).

8.1 Environmental Impacts of Lift Nets

There is little information available on the environmental impact of lift nets, however, it is presumed that due to their small scale, the impacts should be low. That said, as with all small nets, it is possible that fish of all sizes and species could be unintentionally captured as the nets are not selective (Wiyono et al., 2006; Ramesan, Pravin and Meenakumari., 2009). Therefore, this method should be treated with caution and further research may be required to provide a definitive conclusion as to its sustainability.

9.0 Falling Gear

Falling gear is a method of fishing whereby a net is thrown by hand over fish swimming near to the water surface. Cast nets are a specific type of falling gear composed of a circular net with weights sewn around its edge which are thrown to capture fish (Boopendranath., 2012). Not enough information is known at the time of writing to provide a definitive conclusion as to this fishing method's sustainability, although it is presumed to be sustainable due to its small-scale and specificity resulting in supposed low bycatch.

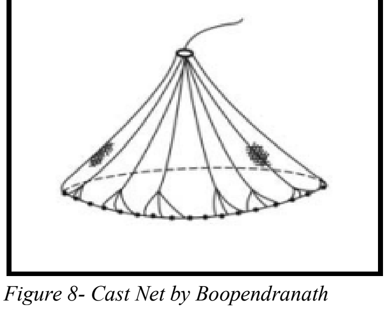


Figure 8- Cast Net by Boopendranath (2012).

10.0 Miscellaneous Gear

The following fishing methods are all classified as ‘miscellaneous gear’. Each of these methods targets individual fish and therefore has limited to zero bycatch. All methods should be considered sustainable:

- **Diving-** a method of gathering sea creatures by hand with or without SCUBA equipment.
- **Hand Implements-** collecting species either by hand or using hand operated tools.
    - **Harpoons-** throwing or shooting a sharp, pointed pole attached to a retrieval line at individual fish.
- **Scoop nets or dip nets-** a hand operated open net bag used to scoop individual fish from the water.

Summary of Fishing Methods

As previously stated, it’s worth remembering that a sustainable fishing method alone does not guarantee sustainably sourced seafood; other factors including stock level and species vulnerability must still be used in conjunction with fishing method to ensure minimal environmental impact. Nevertheless, based upon the above research, we believe that the fishing methods outlined in this document should be categorised as follows:

Sustainable:

- Hook and Line:
    - Handlines and Pole-and-Lines
    - Vertical Lines
        - *Jigs*
- Traps:
    - Fyke Nets, Pound Nets, Stow Nets or Trap Nets
    - Crab Rings
    - Lobster Pots
- Miscellaneous Gear
    - Diving
    - Hand Implements
        - *Harpoons*

Potentially Unsustainable (Treat with Caution)

- Dredging:
    - Hand Dredges
- Hook-and-Line:
    - Trolling

    - Longlines:
        - Demersal/Deep-set
- Surrounding Nets:
    - Seine Nets (without FADs):
        - *Purse Seins*
        - *Danish Seins*
        - *Beach Seines*

Unsustainable:

- Hook-and-Line:
    - Longlines
        - *Pelagic/Shallow-set*
- Trawls:
    - Midwater/Pelagic Trawls:
        - *Pair Trawls*
        - *Skimmer Trawls*
    - Bottom/Demersal Trawls:
        - *Beam Trawls*
        - *Otter Trawls*
        - *Shrimp Trawls*
- Gillnets and Entangling Nets:
    - Drifting Gillnets
    - Anchored Gillnets
    - Encircling Nets
- Dredges:
    - Vessel Towed Dredges
    - Mechanized Dredges and Harvesting Machines
- Surrounding Nets:
    - Seine Nets (with FADs):
        - *Purse Seins*
        - *Danish Seins*
        - *Beach Seines*
        - *Pair Seins*

More Research Required:

- Buoy Gear
- Lift Nets
- Falling Gear
    - Cast Nets

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