



Diving Safe

UNDERWATER SEARCH METHODS

An overview

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Introduction

One of the most common activities for a professional diver is to search for something on the bottom. It could be a lost item, some artificial structure, or some specific natural feature to investigate.

The main problem for any underwater search is that visibility is always limited, even under the most favorable conditions. On land, on a good day, we can talk of miles of visibility; submerged, the visibility is never more than a few dozen feet.

Another issue when operating below the surface is knowing the proper position or the positions of the items we seek. GPS systems do not work underwater, and acoustic position systems are complex to manage and expensive. The divers, therefore, have to rely on dead-reckoning, using a compass to determine direction and other methods to measure distance. For short paths, metered lines can be used with reasonable accuracy. Only an estimate can be done for longer distances, for example, counting the kicks or considering the swimming time.

Finally, gas availability and decompression limits inevitably reduce the time available for the search.

Despite all these limitations, it is possible to obtain good results when appropriate techniques are used by trained and experienced diving teams.

The following paragraphs describe some of the most common and effective search procedures.

Always remember that the safety of the divers comes first. Never jeopardize the wellness of the divers to conduct any search.



Search methods

All search methods share some common elements (1):

- Identify a starting point. This will be marked, and its coordinates will be recorded.
- Cover a known area.
- Identify the endpoint. This will be marked, and its coordinates will be recorded.
- Partial overlapping of search areas. This should ensure that no area will be skipped.

Different methods can be used depending on the area's dimensions to be searched for and the typology of the object to be located.

The location of the lost item is affected by multiple uncertainties. First, the logged position is often inaccurate; current, wind, and waves also affect the sinking pattern (1).

Circular search.

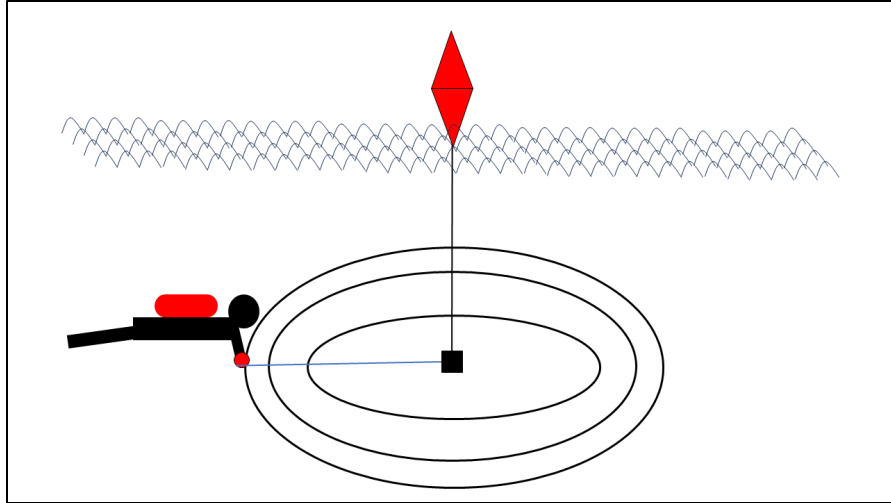
It is used for limited areas. Progressively larger circular areas are searched starting from a shot-line anchor. A reference marker line can be deployed first (downstream of any current) and used by the divers to identify the end of each circular pattern (1).

Multiple circular searches can be used to cover a larger area. In this case, the patterns should partially overlap (2).

A circular pattern can be used by a tethered diver under the ice. In this case, the diver will start the search at the maximum radius and progressively be pulled by the tender closer to the entrance hole (1).

Some potential issues when conducting this kind of search include entanglement of the divers and leaving areas not searched (3).

During the circular search, a diver will be at the foremost extreme of the radius, generally, the diver who holds the reel; the other diver can stay at the center of the search area or follow the buddy located halfway along the line. Visibility, seafloor composition, and the object's dimensions will dictate the divers' best position.

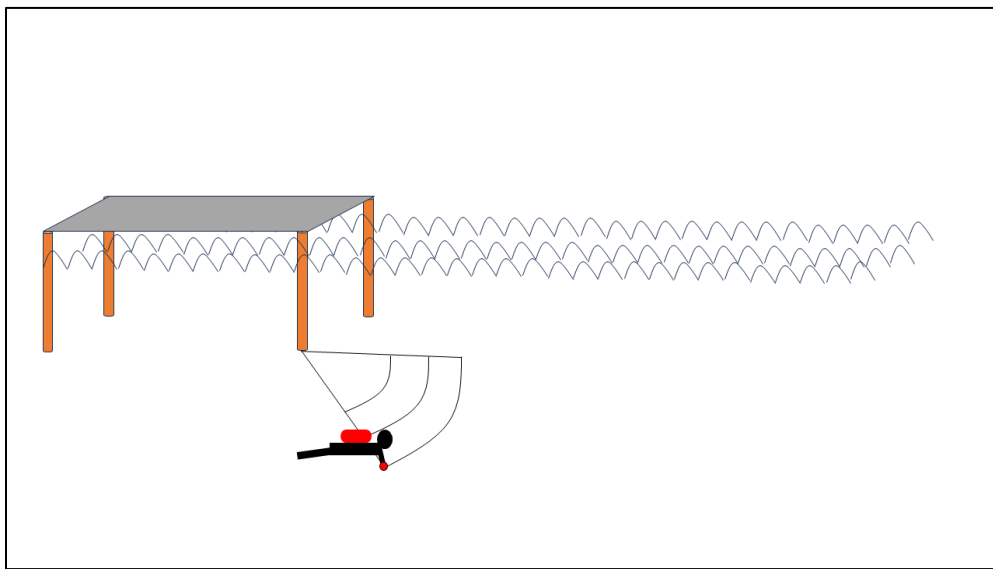


Circular search pattern.

Sweep/arch search.

This system works well in areas such as the end of a jetty or pier. The diver is tethered and starts the search from the far away limit of the search area. The tender progressively pulls back the diver, who will cover circular sectors. Multiple zones can be searched simultaneously using more divers (3).

The sweep search is suitable for areas of limited dimensions and no current or tangling hazards (1).



Arch search pattern.

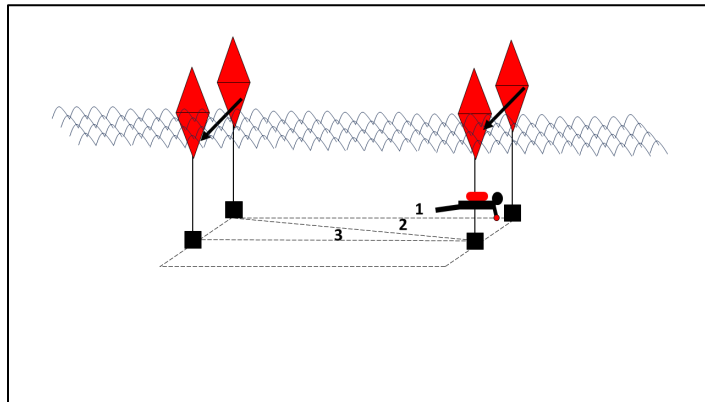
Jackstay search.

This search pattern is suitable for a rectangular area to be investigated by two divers working as a team.

Two buoys are deployed, connected on the bottom by a groundline. The divers descend along one of the shot lines and follow the groundline to the other buoy. The anchor of the buoy is then moved forward in the search area. The divers swim back along the groundline and move the first anchor forward. The path is repeated until the whole area has been searched (1).

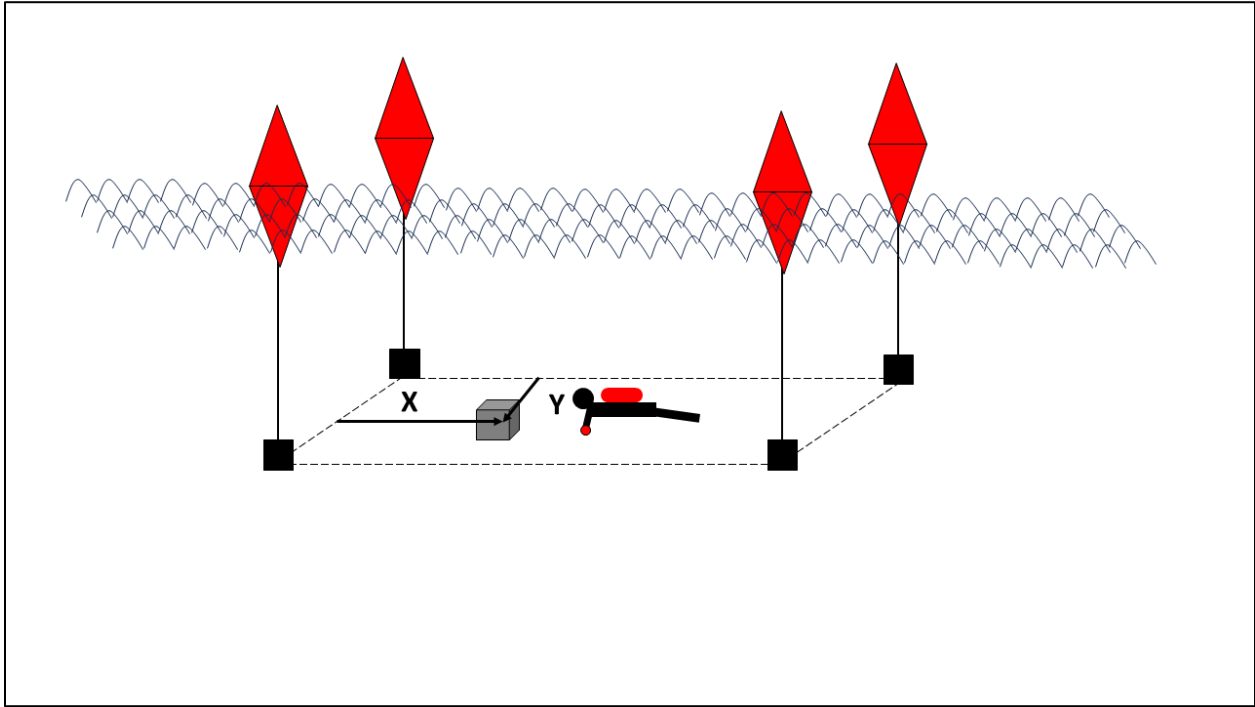
The groundline length should be no more than 125 ft, and the anchors should be around 25 lb. each. If current is present, the line should be moved upstream. In this way, any silt will be pushed away from the area to be searched (3).

The end of the search area can be marked using two further buoys connected by a groundline. This way, the divers will know when the whole area has been searched. If a team of four divers is available, they could move both groundlines simultaneously (2). If a current is present, only two divers should be used to avoid silt from upstream being flushed towards the downstream team.



Jackstay search pattern.

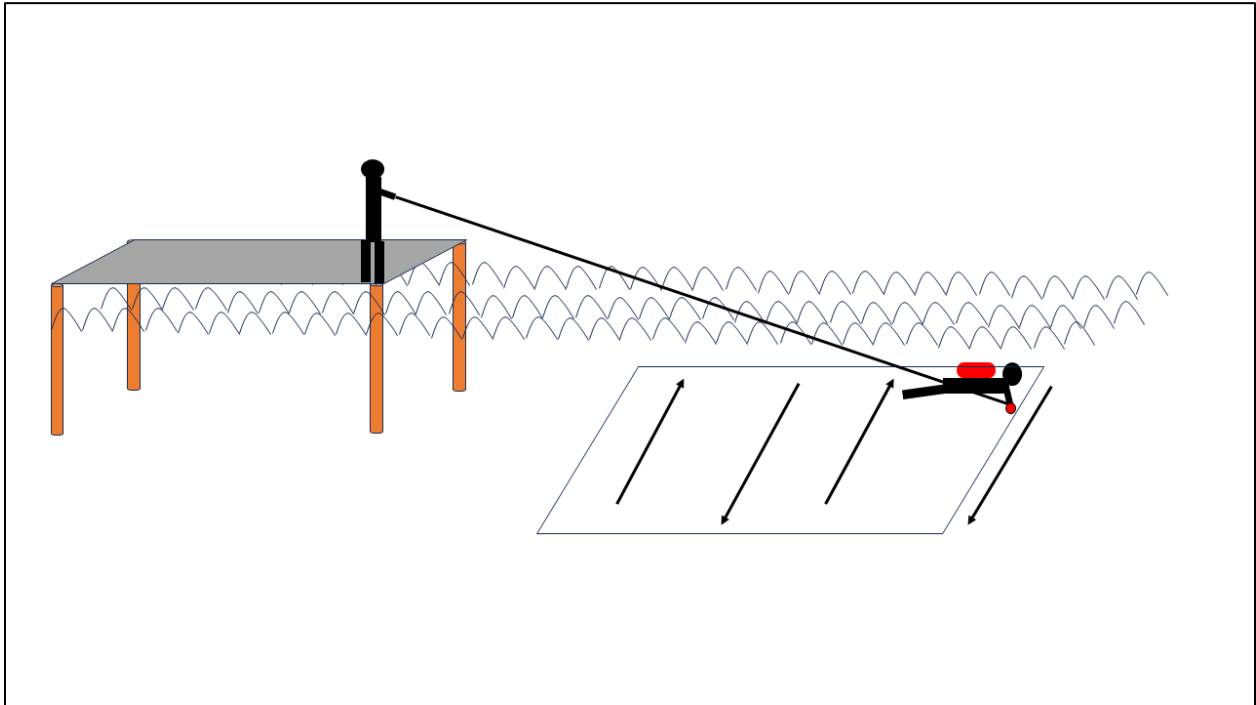
A variation of this search pattern uses two parallel lines defining the area to be searched. The diver then swims from one line to another along an orthogonal path marked by a metered line. If an object is located, its position can be identified by two coordinates, “x” and “y,” referred to as the metered line and the groundline (4).



Coordinates search pattern.

Box search.

In this case, the diver is tethered, and the tender walks along a straight line, guiding the diver along rectangular search areas. Two divers with two tenders can be deployed at the same time to search along two contiguous boxes (3).



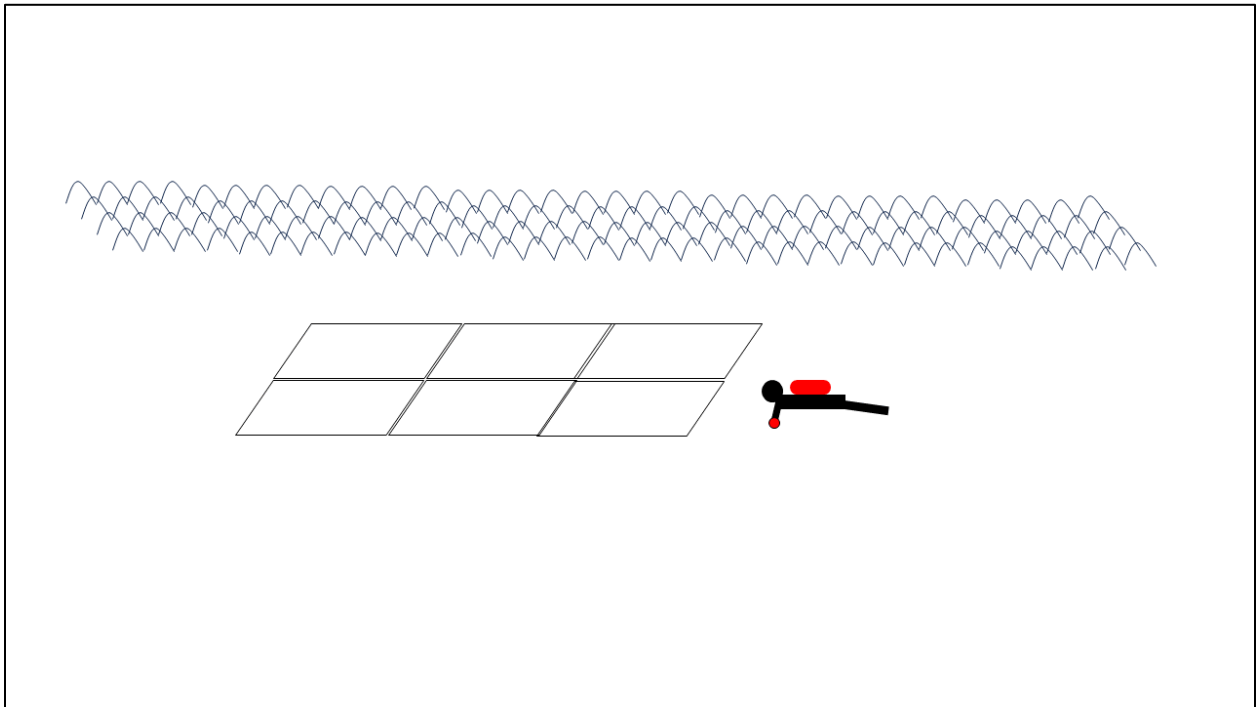
Box search pattern.

Grids and quadrants.

An underwater grid can be deployed for more detailed surveys. The area is divided into sectors by lines or rigid poles. It is time-consuming and usually used only for specific searches such as archaeological surveys (5).

This method is suitable when searching for very small items. A square frame is placed on the seafloor at the starting point of the area to be searched. The frame is then flipped along one of its sides to the next sector to be searched. It is essential to cover the whole area, avoiding “jumping” a sector (3).

Sometimes, this method also includes “sifting.” If the bottom is soft and the object to search is very small, then it is necessary to use a screen to sift through the area. It is good practice to mark the limits of the search area with weighted ropes or a rigid grid (2).



Grid search pattern.



Tow search.

A tow search can be the fastest solution for covering large areas compared to any other method.

Towing divers requires a skilled and experienced crew. The divers must be able to control their depth to avoid barotrauma. They must also be able to disconnect from the towing line quickly. The boat's personnel must be aware of the divers' position, mainly in relation to the propellers (1).

The diver can use a plane board or a weight on the bottom to control the operative depth (2).

The towing speed should be slow, never exceeding 1 to 2 knots. The towline should have a length of about 200 ft and be weighted with about 75 lb. The length-to-deep ratio of the towline can be as much as 10:1. If a weight is used, this ratio can be reduced to about 4:1. A return line of about 50 ft can be connected to the towline to allow the divers to temporarily search and then return to the tow (1).

References

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