

Exploration of The Seabed of Lake of Nemi, (Rome, Italy), From September 5, 2022, To December 5, 2022

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ABSTRACT

The exploration of Lake of Nemi (Rome, Italy) is one of the research projects of the Arco di Diana APS Association, which operates in the archaeological sector. Lake of Nemi is a natural lake of volcanic origin, which in ancient times was used by the first Italic populations, as a place to live and as a place of worship, and later by the ancient Romans, where they built temples and gigantic ships as real places of worship floats. The exploration work of the Arco di Diana APS Association had the aim of investigating the depths of the lake, and of

documenting any evidence of an ancient past in which man built important constructions. This study has as its object the archaeological exploration and research activity of the Arco di Diana APS Association, to verify the presence, or otherwise, of structures capable of suggesting the presence, in the lake, of archaeological finds of historical value.

Keywords: Archaeological Research, Italy, Lake of Nemi, Underwater Exploration, Underwater Research.

1 – METHOD AND DATA

The first exploratory research of Lake of Nemi (Rome, Italy) by submarine ROV started on 5 September 2022, with the researchers: Riccardo Bellucci, Daniele Cataldi, Settimio Tersigni, Giancarlo Valle and Marco Tudini (founding members of the Arco di Diana APS), when for the first time the Association used an underwater drone to scan the bottom of the lake. On that occasion the explorations concerned the bottom of the lake up to a depth of 7.7 meters (Fig. 1 and Fig. 2). As can be seen from the footage taken, the lake has a bottom full of silt and natural mud which hinders underwater exploration even with remotely piloted submersible systems. In this case the presence of

any ancient find has not been documented, but only natural material, such as algae, aquatic plants and the presence of tree trunks. The second exploration took place on the morning of 8 October 2022 (with the researchers: Riccardo Bellucci, Daniele Cataldi, Settimio Tersigni, Giancarlo Valle and Marco Tudini – founding members of the Arco di Diana APS Association), the exploration started from the South of the lake in correspondence and in the vicinity of the "Baia della Biscia nera", close to the ancient landslide of the rocky ridge that characterizes the area. The ROV was pushed to a depth of 14 meters and a distance of approximately 125 meters. This second exploratory scientific

expedition investigated the bottom of the lake, highlighting the presence of many boulders that had accumulated on the bottom, probably due to the continuous landslides that characterized this

area in the past. The seabed wall here is very steep and in some points the slope of 45° is abundantly exceeded (Fig. 4).



Fig. 1 – Taken on the seabed of Lake of Nemi, carried out by means of the underwater ROV of the Arco di Diana APS Association on 5 September 2022, in the northern area of the lake mirror, at a depth of less than one meter. Credits: Arco di Diana APS.



Fig. 2 – Taken on the seabed of Lake of Nemi, carried out by means of the underwater ROV of the Arco di Diana APS Association on 5 September 2022, in the northern area of the lake at a depth of 7.7 meters. Credits: Arco di Diana APS.

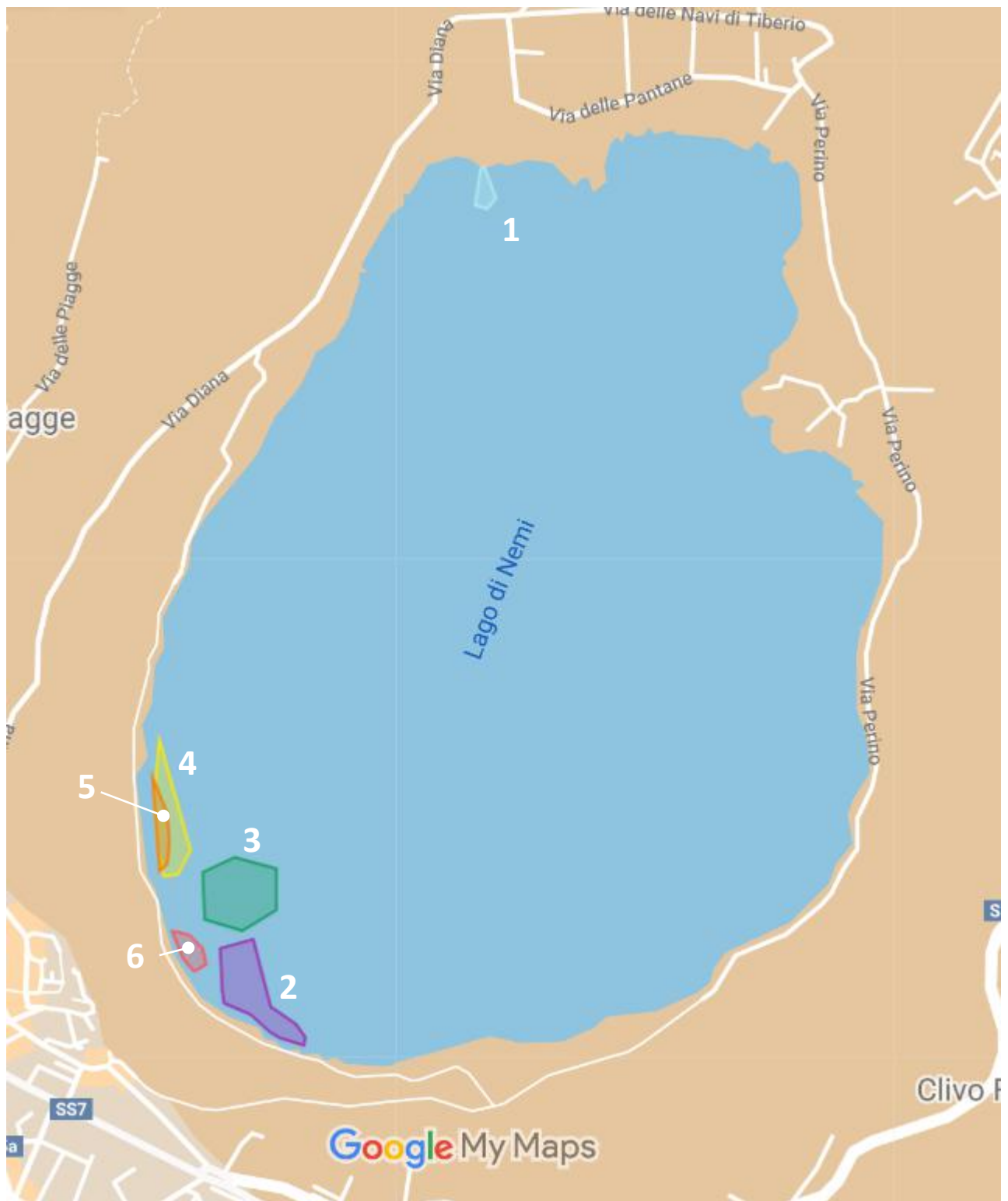


Fig. 3 – Lake of Nemi – Satellite localization of the points where the underwater explorations were carried out by means of the ROV by the Arco di Diana APS Association. 1: September 5, 2022; 2: October 8, 2022; 3: October 11, 2022; 4: November 29, 2022; 5: 30 November 2022; 6: December 5, 2022. Credits: Google Maps; Arco di

The presence of garbage that for many years has been accumulated on the bottom of the Lake by human action, was widely documented again on 8 October 2022, when the ROV, engaged in the

exploration of the bottom, recorded its presence (Fig. 5, Fig. 6, Fig. 7, Fig. 9, Fig. 10, Fig. 11). The garbage that is present only on the surface of the lake includes various types of waste:



Fig. 4 – Taken on the seabed of Lake of Nemi, carried out by means of the underwater ROV of the Arco di Diana APS Association on 8 October 2022, in the southern area of the lake at a depth of 4.3 meters. Credits: Arco di Diana APS.



Fig. 5 – Taken on the seabed of Lake of Nemi, carried out by means of the underwater ROV of the Arco di Diana APS Association on 8 October 2022, in the southern area of the lake at a depth of 9.6 metres. Credits: Arco di Diana APS.



Fig. 6 – Taken on the seabed of Lake of Nemi, carried out by means of the underwater ROV of the Arco di Diana APS Association on 8 October 2022, in the southern area of the lake at a depth of 12.3 meters. Credits: Arco di Diana APS.



Fig. 7 – Taken on the seabed of Lake of Nemi, carried out by means of the underwater ROV of the Arco di Diana APS Association on 8 October 2022, in the southern area of the lake at a depth of 3.8 meters. Credits: Arco di Diana APS.

- Cans;
- Plastic bottles;

- Lens used for fishing;
- Sheet metal;
- Plastic cups;
- Glass bottles;
- Aluminum foils;
- Truck and car tires;
- Shoes;
- Various metallic material;
- Plastic bags.

safety of diving due to the presence of a lens wire for fishing. Even the documentation of such waste has been part of the tasks of the Arco di Diana APS Association for years, which is dedicated to cleaning the seabed every year.

The presence of suspended silt and mud (Fig. 13 and Fig. 14) below the seabed, especially between 12 and 14 meters deep, in this area (South) did not allow for better investigation and exploration of the seabed marine, forcing the researchers engaged in the exploration, to reach a shallower depth, going up to the surface, although at this depth the seabed appears rather leveled (Fig. 8), with respect to the edge of the rocky landslide visible in the water at a shorter distance from the coast (Fig.4).

Garbage which, as visible in Fig. 4, Fig. 5, Fig. 6, Fig. 7, Fig. 9, Fig. 10, Fig. 11, also jeopardizes the



Fig. 8 – Taken on the seabed of Lake of Nemi, carried out by means of the underwater ROV of the Arco di Diana APS Association on 8 October 2022, in the southern area of the lake at a depth of 12 metres. Credits: Arco di Diana APS.

In this depth, the shots appear rather greenish, precisely because of the algae and micro-algae suspended in the water. The bottom is characterized by a lot of mud (Fig. 8), very loose, where the signs of sea currents are evident. At this depth the current has pushed the ROV without it being maneuvered, and this indicates a speed of the

currents on the bottom, of a certain speed (Fig. 8), the temperature in this point of the bottom reaches 17°C.

The presence of silt and suspended algae have been well documented by the underwater ROV, and this indicates that research in waters of this type is

extremely difficult and limited (Fig. 2 and Fig. 8). The presence of boulders and rocks of medium size, along the sloping area of the seabed (Fig. 12) in the southern area, has been well documented by

the ROV and has been able to confirm that, in the past, there was a large landslide which poured into the lake.



Fig. 9 – Taken on the seabed of Lake of Nemi, carried out by means of the underwater ROV of the Arco di Diana APS Association on 8 October 2022, in the southern area of the lake at a depth of 4.1 meters. Credits: Arco di Diana APS.



Fig. 10 – Taken on the seabed of Lake of Nemi, carried out by means of the underwater ROV of the Arco di Diana APS Association on 8 October 2022, in the southern area of the lake at a depth of 5.2 metres. Credits: Arco di Diana APS.



Fig. 11 – Taken on the seabed of Lake of Nemi, carried out by means of the underwater ROV of the Arco di Diana APS Association on 8 October 2022, in the southern area of the lake at a depth of 9.5 metres. Credits: Arco di Diana APS.



Fig. 12 – Taken on the seabed of Lake of Nemi, carried out by means of the underwater ROV of the Arco di Diana APS Association on 8 October 2022, in the southern area of the lake mirror at a depth of 7 meters. Credits: Arco di Diana APS.



Fig. 13 – Taken on the seabed of Lake of Nemi, carried out by means of the underwater ROV of the Arco di Diana APS Association on 8 October 2022, in the southern area of the lake at a depth of 14.5 meters. Credits: Arco di Diana APS.



Fig. 14 – Taken on the seabed of Lake of Nemi, carried out by means of the underwater ROV of the Arco di Diana APS Association on 8 October 2022, in the southern area of the lake at a depth of 11.4 meters. Credits: Arco di Diana APS.

The third underwater exploration carried out at Lake of Nemi took place on 11 October 2022 (with

the researchers: Riccardo Bellucci, Daniele Cataldi, Settimio Tersigni, Giancarlo Valle and Marco

Tudini – founding members of the Arco di Diana APS Association), and not without technical problems. On that occasion, the submarine ROV searched a specific area of the lake (area 3) as visible in Fig. 3, where the presence of an underwater phenomenon never detected near the lake was documented for the first time, i.e. the presence, 50 cm from the bottom of an area free

from suspended particles. The particles in suspension are detected from about 15 meters up to about 19.5 meters, and between the bottom of the lake and the area in which these particles are found, there is a thin laminar area which does not contain any, allowing an external view of the seabed, without particular visual problems.



Fig. 15 – Taken on the seabed of Lake of Nemi, carried out by means of the underwater ROV of the Arco di Diana APS Association on 11 October 2022, in the southern area of the lake at a depth of 18.7 meters. Credits: Arco di Diana APS.

Fig. 15 shows the presence of a thick layer of suspended particles, the thickness of which is about 5 meters (from about 15 meters deep). After that this area stops abruptly 50 cm from the bottom of the lake in area n.3 (Fig. 3) and the conditions become excellent for viewing the bottom of the lake (Fig. 16). In this grazing area it was possible to document, on 11 October 2022, the presence of a layer of silt about 4 cm thick.

The area at that point is almost flat although in the presence of some holes probably caused by marine animals.

In this context it was possible to document the thickness of this silt (Fig. 16), whose color is gray, while below this first layer the color tends towards

faded yellow (similar to tuff in color). In this phase of the research, some small dry branches and foliage were also observed, albeit rare, given that this area (area 3) is located quite far from the coast and therefore the presence of dry branches and foliage is infrequent.

Fig. 17 shows a schematic graph of the depth of the lake bottom, documented by the Arco di Diana APS Association on 11 October 2022. It highlights the presence of the "layer" free of suspended organic material with a thickness of approximately 50 cm, which separates the bottom of the lake from the area above, about 5 meters thick, where instead there is the "layer" characterized by suspended organic material.

These two layers are located in provintà, from about 15 meters and determine a clear decrease in the filtering sunlight, which makes the seabed almost completely dark.

In these areas (after 15 meters of depth) exploration is very difficult for the underwater

ROV, and in general for a diver engaged in diving.

Fig. 18 (8.5 meters deep), shows the presence of transparent water, albeit characterized by the presence of microscopic algae which make it greenish in color.



Fig. 16 – Taken on the seabed of Lake of Nemi, carried out by means of the underwater ROV of the Arco di Diana APS Association on 11 October 2022, in the southern area of the lake at a depth of 20.1 meters. Credits: Arco di Diana APS.

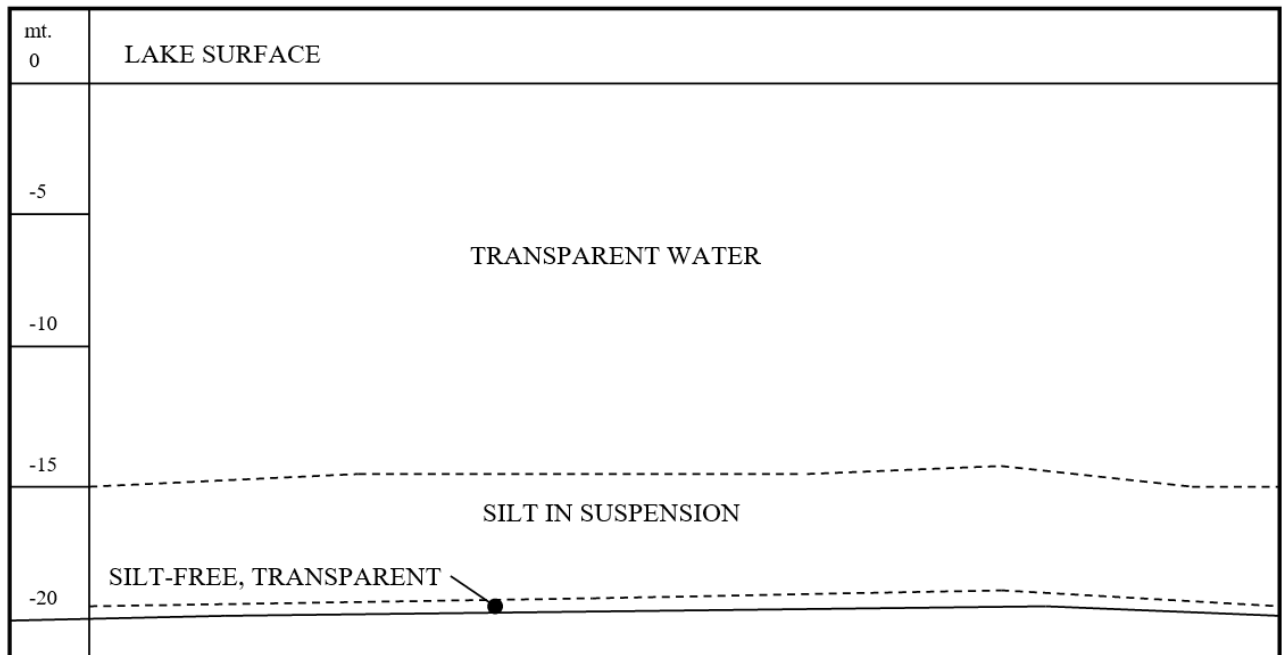


Fig. 17 – Diagram of the depth and characteristics of the water and seabed documented by the underwater exploration that took place on 11 October 2022, at Lake of Nemi. The area is no. 3. Credits: Arco di Diana APS.

The search carried out on 11 October 2022 was also assisted by the presence of some buoys installed by the group of researchers, to locate the

points where to carry out underwater searches (Fig. 18 - Fig. 19).

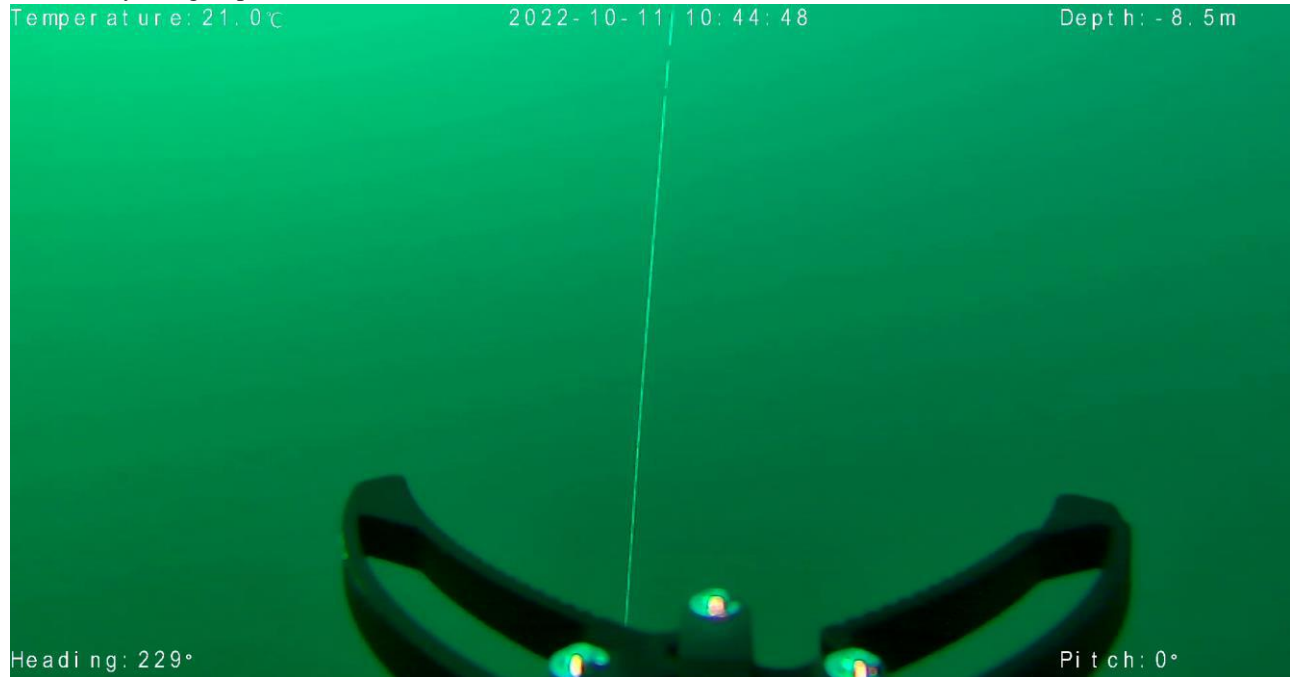


Fig. 18 – Taken on the seabed of Lake of Nemi, carried out by means of the underwater ROV of the Arco di Diana APS Association on 11 October 2022, in the southern area of the lake mirror at a depth of 8.5 metres. It highlights the presence of a nylon thread hooked to a floating buoy and to a lead weight, to better locate, under water, the search area on the bottom of the lake. Credits: Arco di Diana APS.



Fig. 19 – Taken on the seabed of Lake of Nemi, carried out by means of the underwater ROV of the Arco di Diana APS Association on 11 October 2022, in the southern area of the lake at a depth of 19.2 meters. It highlights the presence of a nylon thread hooked to a floating buoy and to a lead weight, to better locate, under water, the search area on the bottom of the lake. Credits: Arco di Diana APS.

illumination of the water visible from 8.5 m to 19.2 m in depth.

And as is clear, the presence of suspended organic material tends to darken the aquatic environment a lot, which filters a lot of the sun's rays coming from the aquatic surface.

This gives an idea of the difficulties that often make searches difficult even in calm waters such as those of small lakes of natural origin.

The fourth underwater exploration was organized on November 29, 2022, and during this research and exploration activity, some interesting points were identified where some large rocks from the ancient collapse of the lake wall were located (point 4 on the map visible in Fig.3).

In this case the documentation is very interesting.



Fig. 20 – Taken on the seabed of Lake of Nemi, carried out by means of the underwater ROV of the Arco di Diana APS Association on 29 November 2022, in the W-S-W area of the lake at a depth of 7.2 metres. It highlights the presence of many boulders positioned on the sloping seabed which indicates the presence, in the water, of the ancient landslide of the rocky ridge of the volcanic crater where the lake was later formed. Credits: Arco di Diana APS.

The area, object of research by the Arco di Diana APS association, on 29 November 2022, initially highlighted the presence of a large pointed boulder (Fig. 20), where there are also other smaller boulders, this indicates that the area is characterized by part of the landslide of ancient origin, generated by the adjacent rocky ridge.

In the same area, even if a little deeper, in an easterly direction, with respect to these rocky elements, some particular rocky elements have been highlighted and never observed before in the lake environment (Fig. 21, 22 and 23). These,

observed in detail by means of the ROV, are visible as rocks of an orange/yellow colour, covered by silt and slime in the upper part (deposit) and by the presence of some marine algae, but overall we speak of rocks of this particular colour. . In the area (precisely in point 4 visible on Fig. 3, these elements are very many and characterize the seabed in that point.

In this context, the Figs. 21, 22 and 23, document for the first time ever such "strange" rock formations, on which further studies should be carried out.



Fig. 21 – Taken on the seabed of Lake of Nemi, carried out by means of the underwater ROV of the Arco di Diana APS Association on 29 November 2022, in the W-S-W area of the lake at a depth of 10.4 metres. It highlights the presence of orange, yellow and red lithic structures, never observed before in the lake mirror. Credits: Arco di Diana APS.



Fig. 22 – Taken on the seabed of Lake of Nemi, carried out by means of the underwater ROV of the Arco di Diana APS Association on 29 November 2022, in the W-S-W area of the lake at a depth of 10.5 metres. It highlights the presence of orange, yellow and red lithic structures, never observed before in the lake mirror. Credits: Arco di Diana APS.



Fig. 23 – Taken on the seabed of Lake of Nemi, carried out by means of the underwater ROV of the Arco di Diana APS Association on 29 November 2022, in the W-S-W area of the lake at a depth of 10.2 meters. It highlights the presence of orange, yellow and red lithic structures, never observed before in the lake mirror. Credits: Arco di Diana APS.

The dive of 30 November 2022 (Fig. 24 and 25), was able to document the presence of what remains of an ancient round section pole, which the ROV

was able to hook and bring to the surface, for the completion of subsequent analyses.



Fig. 24 – Taken on the seabed of Lake of Nemi, carried out by means of the underwater ROV of the Arco di Diana APS Association on 30 November 2022, in the W-S-W area of the lake at a depth of 10.7 metres. It documents the recovery of an ancient wooden pole. Credits: Arco di Diana APS.



Fig. 25 – Taken on the seabed of Lake of Nemi, carried out by means of the underwater ROV of the Arco di Diana APS Association on 30 November 2022, in the W-S-W area of the lake at a depth of 10.7 metres. It documents the recovery of an ancient wooden pole, while it is being brought back to the surface. Credits: Arco di Diana APS.

On that date, and in that area located on the W-S-W side of the lake mirror (point n.5 in Fig. 3), the area of the ancient landslide that occurred in the past was also explored again, documenting the presence

of numerous rocks, shrubs and sediments located on the ridge of the W-S-W wall of the lake (Fig. 26 and 27).



Fig. 26 – Taken on the seabed of Lake of Nemi, carried out by means of the underwater ROV of the Arco di Diana APS Association on 30 November 2022, in the W-S-W area of the lake at a depth of 9 metres. It documents the presence of the ancient landslide of the edge of the volcanic crater. Credits: Arco di Diana APS.



Fig. 27 – Taken on the seabed of Lake of Nemi, carried out by means of the underwater ROV of the Arco di Diana APS Association on 30 November 2022, in the W-S-W area of the lake at a depth of 7.9 metres. It documents the presence of the ancient landslide of the edge of the volcanic crater. Credits: Arco di Diana APS.



Fig. 28 – Taken on the seabed of Lake of Nemi, carried out by means of the underwater ROV of the Arco di Diana APS Association on 30 November 2022, in the W-S-W area of the lake at a depth of 8.2 meters at 120 meters from the dive point. It documents the presence of what appears to be a wooden pole with a diameter of about 30 cm, and characterized by a groove, near a large boulder. Credits: Arco di Diana APS.

Another interesting find, documented on the morning of November 30, 2022, was that which occurred 120 meters away from the point where the ROV was launched into the water, i.e. the location

at a depth of 8.2 meters of what appears to be a squared wood, just as visible in Fig. 28. In this case the shape of the wooden pole could suggest some kind of use.



Fig. 29 – Taken on the seabed of Lake of Nemi, carried out by means of the underwater ROV of the Arco di Diana APS Association on 30 November 2022, in the W-S-W area of the lake at a depth of 8.2 meters at 120 meters from the dive point. It documents the presence of what appears to be a wooden pole with a diameter of about 30 cm, and characterized by a groove, near a large boulder. Credits: Arco di Diana APS.

Fig. 27 shows a particularly green color of the water and a low luminosity of the environment at a depth of 7.9 metres, a characteristic which limited and complicated the underwater search on 30 November 2022. The same difficult conditions for the exploration of the fondache that the researchers of the Arco di Diana APS Association had encountered on November 29, 2022 (Fig. 20) at a depth of 7.4 meters.

On 5 December 2022, the sixth documentary expedition was carried out with the submarine ROV, this time from a point located in the W-S-W area of the shore of Lake of Nemi, but further South (point 6, visible on Fig. 3). The ROV was pushed to a maximum distance of approximately 70 meters and to a maximum depth of 12 meters. During the research, the ROV identified a series of wooden poles of ancient origin, adhered to the bottom of the steep wall, characterized by an

ancient landslide of the lake, the same landslide that has been documented in other explorations, and exactly that of 29 and November 30, 2022. On December 5, 2022 it was however possible to document these poles (Fig. 30, 31 and 32). The localization of these piles adhered to the bottom of the landslide below the water level, documents how the area is characterized by a human construct, built in ancient times, as they documented in ancient times [1], this clearly indicated that there was facing an area that once must have been above the waters of the lake and which the ancient landslide had moved above the water, spreading the soil present on the banks of the lake itself. The presence of these wooden posts confirmed that the research point retained evidence of an ancient past and that the landslide, moved in water by at least 20 meters from the point where the posts were located, demonstrated how the rock mass precipitated by wall of Lake of Nemi, at this point,

had drastically deformed the ancient soil, filling it with debris, boulders and ancient shrubs, visible under the lake surface.



Fig. 30 – Taken on the seabed of Lake of Nemi, carried out by means of the underwater ROV of the Arco di Diana APS Association on 5 December 2022, in the W-S-W area of the lake at a depth of 7.5 meters at 40 meters from the diving point. It documents the presence of what appears to be a wooden pole with a diameter of about 12 cm. Credits: Arco di Diana APS.



Fig. 31 – Taken on the seabed of Lake of Nemi, carried out by means of the underwater ROV of the Arco di Diana APS Association on 5 December 2022, in the W-S-W area of the lake at a depth of 6.6 meters at 50 meters from the diving point. It documents the presence of what appears to be a wooden pole with a diameter of about 10 cm. Credits: Arco di Diana APS.



Fig. 32 – Taken on the seabed of Lake of Nemi, carried out by means of the underwater ROV of the Arco di Diana APS Association on 5 December 2022, in the W-S-W area of the lake at a depth of 7.2 meters at 45 meters from the diving point. It documents the presence of what appears to be a wooden pole with a diameter of about 12 cm. Credits: Arco di Diana APS.

The number of piles located and documented on the morning of December 5, 2022 was three, and the most protruding one was documented in Fig. 32.

2 – DISCUSSION

The archaeological research carried out at Lake of Nemi has provided interesting indications relating to the seabed, the presence of rocks and landslides of ancient origin on the southern side of the lake, an area in which part of the presence of an ancient wharf has been documented time it must have been on the shore of the lake and then, due to a landslide that occurred in the past, it was partly buried and moved below the water level. Underwater exports have managed to document part of the poles that

served to contain this quay, as is evident in Figs. 30, 31 and 32.

This indicates that in this point (point 6 of Fig. 3) there could be the rest of the structure of the quay today submerged and disfigured in its morphology by the ancient landslide, characterized by huge blocks of lava rock, detached from the southern wall of Lake of Nemi, as documented by the research team.

3 – CONCLUSIONS

The historical data concerning Lake Nemi speak of a vast archaeological area in which ancient port structures are located, such as docks and other human constructs [2] [3] [4]. The presence of these departments, still present in the area, has prompted the Arco di Diana APS Association to carry out

explorations of the bottom of the lake to try to identify part of the quay identified in ancient times in the southern portion of the lake, but disappeared due to an ancient landslide of the rocky ridge of the lake.

The research carried out by the Arco di Diana APS Association managed to document, albeit partially, the presence of wooden structures (poles) which are probably referable to the ancient wooden structure of the quay of Roman origin, or in any case ancient. This structure and in general what remains of it, is today submerged and located in the southern portion of Lake of Nemi at a depth of several meters (between 6.6 m and 7.5 m). The exploratory work carried out thanks to a wire-controlled ROV also managed to document the presence of garbage, present in large quantities in the lake, especially close to the shallow seabed, and what is the structure of the lake's waters in relation to its transparency and its characteristics related to visibility. It can be seen that up to 15 meters, the water still appears clear even if it has a certain lack of sunlight, after 15 meters a massive quantity of particles and natural dust in suspension is observed

which greatly alters the visibility of the seabed, it is visible only in a "window" of about 50 cm, at a depth of 20 meters. This means that documenting the bottom of the lake with divers is extremely dangerous and inconsistent, given the amount of dust that would be raised and which would totally prevent vision in the water. The underwater ROV approach was therefore a wise and useful choice, without which it would not have been possible to document the characteristics of the lake and the located objects. The research in this place requires further study, in order to better document the presence of the quay of ancient origin which once must have encircled the lake at this point of the lake. In this case, the structures referable to this archaeological subject are all positioned on a seabed sloping, or on the steep wall caused by the landslide.

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