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RESEARCH

Animas de la Victoria Wreck Site, Espiritu Santo Bay, Mexico: First Hypothesis About the Intriguing Context of an Eighteenth-Century Nautical Accident

Helena Barba-Meinecke[1] · **Josué Guzmán**[1] · **Josefa Martí-Solano**[2] · **Fabrizio Ciacchella**[3]

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Abstract
Semi-hidden among the reef labyrinth of the Espiritu Santo Bay mouth, off the Mexican Caribbean coast, the *Animas de la Victoria* wreck site is beginning to raise interesting topics about its condition, origin, and history. Nineteen iron cannons, four admiralty anchors, and a few other materials lie scattered over a large, shallow area close to the reef crest, evidence of the nautical accident of an apparently mid-eighteenth-century or a little later, lightly armed, non-military, medium-sized ship. Curiously, the site is located far from any Spanish port or even from any primary European sailing route in the Yucatan Channel. This paper presents the outcomes of the first research stage, focused on determining the wreck site' chronology and cultural provenance, based on the morphological analysis of anchors and ordnance, and on interpreting the nautical accident (site formation process) according to the context deposition pattern. Oceanological data and historical studies have been crucial sources of information, converging to form a comprehensive initial understanding of the site and its circumstances.

Keywords Shipwreck · Underwater archaeology · Yucatan · Anchor · Cannon

✉ Helena Barba-Meinecke
helena_barba@inah.gob.mx

Josué Guzmán
josue.guzman.ts@gmail.com

Josefa Martí-Solano
jomarsol@gmail.com

Fabrizio Ciacchella
fabriziociacchella@gmail.com

[1] Subdirección de Arqueología Subacuática (SAS), Instituto Nacional de Antropología e Historia (INAH), Mexico City, Mexico

[2] Centro de Arqueología Subacuática (CAS), Instituto Andaluz del Patrimonio Histórico (IAPH), Cadiz, Spain

[3] Laboratorio di Storia Marittima e Navale, Università di Genova, Genoa, Italy

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Introduction

Archaeology of nautical accidents is rarely a simple task. In some cases, the scarcity of available material remains makes understanding them difficult, necessitating the utilization of all available resources and data to unravel the story of the events with the greatest possible scientific certainty. This is precisely the case of the *Ánimas de la Victoria* (ADLV) shipwreck, an intriguing context located off the coast of Mexico in the Caribbean.

This shipwreck is located at the entrance to Espiritu Santo Bay, in a dangerous area of the Mesoamerican Reef System (MRBS) on the eastern coast of the Yucatán Peninsula. Its waters have been crossed by diverse societies, at the confluence of different geopolitical spheres. Since the Late Preclassic period (350 BC–250 AD), and especially during the Postclassic period (950–1550 AD), Mayan groups developed an intense maritime trade (Romero Rivera 1991, 1998; McKillop 2010). During the Contact period, the testimonies recovered from the fourth voyage (1502) of Christopher Columbus (Colón 1984, pp. 92–93) and the 1517 expedition by Francisco Hernández de Córdoba (Díaz del Castillo 2016, p. 79), are a valuable source of ethnohistorical information on the sighting of Mayan canoes (monoxyla vessels) between the Gulf of Honduras and the eastern coast of Yucatán. After the European arrival and the establishment of the Spanish dominion, the Caribbean (including the east coast of Yucatán) became a geopolitical maritime scenario where Western European colonial powers struggled for control over sea routes and strategic territories to access the New World resources and markets. Myriads of merchant ships and military vessels sailed the Caribbean and the Gulf of Mexico for three centuries, expanding geographical and nautical knowledge, transporting goods, persons, ideas, and diseases between continents and islands, fighting among them and connecting cultures irreversibly… some of them wrecked along the coasts or in the ports and rivers of the New World.

The ADLV wreck site, archaeologically explored and recorded in 2009 by the Subdirección de Arqueología Subacuática—SAS—(Vice directorate of Underwater Archaeology) of Mexico National Institute for Anthropology and History (INAH), is a testimony of the intense maritime dynamics and geopolitical processes that shaped the Caribbean and the Americas between the sixteenth and nineteenth centuries. Given its research potential, in 2022, an international team of researchers carried out a fieldwork campaign, coordinated by the SAS, Yucatan Peninsula Office, aiming to gather solid data to increase our understanding of the nautical accident and the historical-cultural context within which the ill-fated vessel was part (Barba-Meinecke 2020, 2023).

Anchors and ordnance, the most visible elements of the site, were the object of detailed documentation and critical analysis, cross-checking sources and documents in order to identify historic models, technological and social implications, historical, and nautical possibilities. The initial results of this analysis, if at an initial stage, are presented in this paper as a hypothetical interpretation.

The final aim of this research is to study the wreck as a multiplicity of converging agents and factors, condensed in a historical-cultural event; it is necessary to understand the environmental settings, the maritime factors, the people linked to the ship and to the crew, the social, economic, and political processes they were involved in, the belief systems they professed, as well as the nautical maneuvers (successful or not) they tried.

Wreck Location

The *Animas de la Victoria* (ADLV) wreck site is located in Espiritu Santo Bay, on the Caribbean coast of the Yucatan Peninsula, Mexico, in the south-central part of the state of Quintana Roo. It is situated within the area that was declared the Sian Ka'an Biosphere Reserve (D.O.F. 1986), later appointed as a World Heritage Site (UNESCO 2001) (Fig. 1).

The north–south reef barriers (part of the MRBS) almost close the mouth of Espiritu Santo Bay. The ADLV wreck is located in the northern sector, practically over the reef breakers, 2.3 nm (4.25 km) from the coast, in front of the fishing camp called "La Victoria". The remote location of this area, along with the absence of inhabited regions and roads (the nearest settlement is Punta Herrero, a small fishing village 6 nautical miles [11.11 km] to the south), has favored the preservation of both the underwater natural environment and archaeological context.

The Yucatan Channel: Currents, Winds, and Cartography

Several maritime factors of the Yucatan Channel area, including oceanic currents, prevailing winds, and hydrometeorological phenomena, have converged to cause many nautical accidents in this region over time.

The Yucatan Channel is a 105.83 nm (196 km) wide, 2040 m deep sea passage between Cuba (Cape San Antonio) and the Yucatan Peninsula (Isla Mujeres), a funnel where the

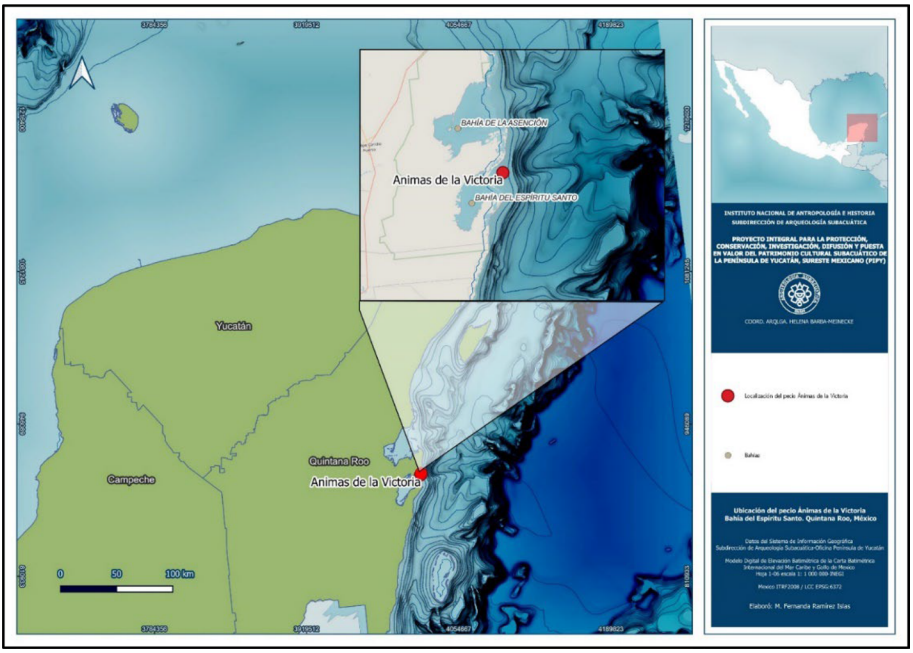

Fig. 1 Map showing the location of the *Ánimas de la Victoria* (ADLV) shipwreck, Quintana Roo, Mexico SAS-INAH Archive, 2023. Prepared by Fernanda Ramírez

Yucatan Current (27–54 nm/50–100 km wide) intensifies its strength (Athié et al. 2021). The current flows northward from the south of Cozumel Island, passing along the western shore of the Channel, and entering the Gulf of Mexico from the southeast, with velocities between 2.5 and 0.6 m/s. When this current hits the coastal shelf in front of the Louisiana coast, it drastically turns its orientation and becomes the Loop Current (Badan et al. 2005; Athié et al. 2011). Cyclonic eddies, too, affect the local-scale velocity and orientation of the Yucatan Current (Candela et al. 2002, 2003; Cetina et al. 2006; Ezer et al. 2003; Rivero Ordaz et al. 2022).

In the summer, the prevailing winds come from the southwest to northwest, with average speeds ranging from 0.44 m/s to 0.29 m/s. Cyclones from the Caribbean Sea occur between August and October. In winter, winds shift to a northwest-southwest direction.

Usual hydrometeorological phenomena are northerlies or '*Nortes*' (November to March), squalls (April to May), and summer tropical storms of varying intensities (June to September).

Between the sixteenth and nineteenth centuries, understanding sea currents, prevailing winds, bathymetry, and coastal landscape was crucial to the development of navigation. This resulted in the production of nautical cartography and pilot books intended to guide Spanish, French, English, or Dutch sailors safe and sound across the hazardous waters of the West Indies. But in spite of this, since colonial times sailors from different nations, sailing along the eastern coast of the Yucatan Peninsula, faced dark fates against the barrier reef patches (MRBS). The challenging environment and the multiple nautical risks it posed, in conjunction with a lack of specific knowledge of the area, or storms impact, or technical or human error, did lead to many nautical accidents like the one whose remains we analyze in this document.

Research Background

During 2009, through the *Integral Project for the Protection, Conservation, Research, and Dissemination of the Underwater Cultural Heritage of the Yucatán Peninsula, Southeast Mexico* (PIPY), the team of the SAS-INAH, addressed the inventory of the Sian Ka'an Reserve Underwater Cultural Heritage (Luna Erreguerena, 2010). Fourteen underwater archaeological contexts were identified: nine were remains of contemporary nautical accidents (twentieth century), four were shipwrecks of steamships or related nautical elements (nineteenth century), and one apparently corresponded to the late-seventeenth or eighteenth century (Barba-Meinecke and de María Curiel Ezcárzaga 2011). The latter, the ADLV wreck site, was chosen for further research due to its temporality and particularly interesting features.

The ADLV site was located and documented with the support and guidance of local fishermen José Ángel Canto and Hilario Sulu. The name of the wreck site was given in allusion to the many cannons observed, metaphorically designed by their bores—'*animas*' in Spanish—and the fact that it is located right in front of *La Victoria* fishing camp. General documentation was conducted, producing the first site map and photographic/video records, and collecting several material samples (ceramic and glass fragments) to help in defining dating and provenance of the wreck. This initial exploration clearly signaled the research potential of the ADLV site.

In 2022, a second visit to the wreck was carried out, bringing together an international team of specialists. Activities included surveying—both visually and with metal detectors—in search of additional artifacts hidden among the coral formations; the development of a new, accurate, and detailed map of the site; photogrammetric documentation; and the

recording of individual artillery pieces. Of special interest was the removal of calcareous concretions from the trunnions and breech sections of several cannons, searching for potentially significant casting marks, in order to determine the date and provenance of the weapons.

Additionally, in 2023, a cannon removed from the site years earlier (according to locals' testimonies), currently at the Punta Pájaros ranch, was recorded to obtain more information on the general morphology, caliber, and preservation of the design elements.

Site Description

The archaeological context of the ADLV is composed of the remains of a nautical accident, scattered along a 200-m east–west central axis toward the reef breakers. A cluster of the wreck materials is found within the barrier reef, southwest of the main axis. The most notable artifacts from the site are four common-admiralty-type iron anchors, 19 cast-iron long guns, an iron cannonball, a brick, ceramic fragments from olive jars, and green glass fragments corresponding to square bottle bases (Fig. 2).

In this reef environment, most of the artillery pieces and anchors are covered by calcareous concretions and colonized by living organisms: fire coral (*Millepora complanata*), fan coral (*Gorgonia flabellum*), elkhorn coral (*Acropora palmata*), sponges (mainly *Ircinia strobolina*), and green algae (of the genera *Penicillus*, *Ventricaria*, *Valonia*, and *Halimeda*).

To facilitate recording and interpreting the context, the site was divided into five sectors:

Deposition sector 1: *Anchors A*1 *and A*2

At the SE end of the site, in the deepest zone (7 m depth), a pair of coupled iron anchors (Anchor 1 and Anchor 2) are located (Fig. 3). These superimposed anchors, of different morphology and dimensions, lie with their crowns oriented to WNW, and the heads ESE.

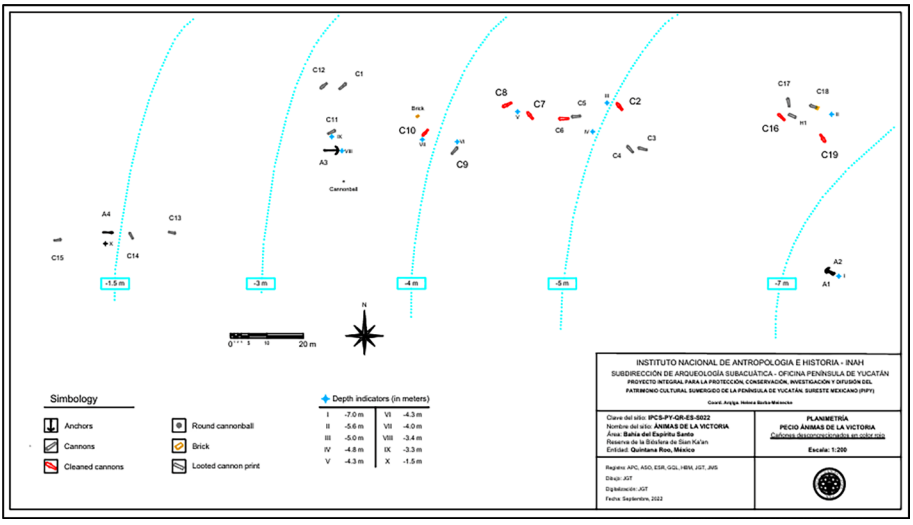

Fig. 2 Planimetry of the ADLV wreck. SAS-INAH Archive, 2022. Prepared by Josué Guzmán Torres

Their deposition, almost united at the crowns with their shanks in a slightly divergent orientation, not working on the bottom, does not correspond to what should be expected from a usual anchoring maneuver.

Deposition sector 2: Cannons C16–C19

It is located 35 m north of the previous sector. The depth recorded is 6 m. This group is composed of four (4) cannons (C16, C17, C18, and C19)—in general oriented SE to NW—and the imprint on the coral bottom of a fifth piece (H1), reported as plundered—at present located in the Punta Pájaros ranch.

Deposition sector 3: Cannons C2–C10

Forty meters to the west, nine cannons were observed. This is the largest and most diverse conglomerate of materials from the wreck, following a 62 m-long E-W axis. This artillery lies in an apparent paired pattern (at 5 m and 4 m depth). It is noteworthy that unlike what was observed in the cannons of Deposition sector 2, in this sector, the pieces present a much more heterogeneous general orientation. There seems to be a change in the orientation of the rattle-mouth axis of the pieces. Those lying in the W part of the assemblage have a SE-NW orientation. On the other hand, the bores of the central section are oriented E-W (C6 and C7), SSE-NNW (C7), and NE-SW (C8). The pieces at the W edge (C9 and C10) lie on an approximately NNE-SSW axis, and the orientation of their mouths are opposite.

Deposition sector 4: Anchor A3, Cannons C1, C11–C12

It is located 25 m west of the previous sector. It is made of large iron artifacts: three cannons and a third anchor, the largest of the wreck with 4.70 m shank length and 2.74 m beam (maximum arms opening). Its head is oriented to the west, its crown E. This anchor

Fig. 3 Image of Anchor 1 (A1) and Anchor 2 (A2), ADLV wreck. SAS-INAH Archive, 2022. Photo: Helena Barba-Meinecke

is almost covered by fan corals (*Gorgonia flabellum*). Near this anchor, a single iron cannonball was discovered using metal detectors.

Deposition sector 5: Anchor A4, Cannons C13–C15

47 meters WSW of the ring of Anchor 3, is the last sector 5, in the westernmost section of the wreck, just off the reef break, where the depth decreases to around only 1.5 m.

Anchor 4 is observed in an apparently working position, that is, with one arm partially stuck in the coral substrate. Its shank, heavily bent, is visible only for 2.90 m of its lower part; the rest is probably hidden under corals. This could possibly include some remains of the stock. Its crown is oriented to the east, its head to the west.

Diagnostic Materials

Anchors

Four anchors have been found in the *Animas de la Victoria* wreck site, all belonging to the morphological type usually called 'admiralty anchor'—or 'common admiralty anchor'—not to confuse them with the British Admiralty Longshank and Shortshank designs. However, both definitions are improper, because this type appeared many centuries before admiralties started being concerned with anchor morphology. They were all fitted with wooden stocks that did not survive. Beyond the general similitude, the ADLV anchors have different characteristics; their main dimensions and proportions are listed in Table 1.

Anchor 1

At the eastern end of the ADLV site, Anchor 1 (A1) lies horizontally at a depth of 7 m, its head oriented to ESE. Its straight arms, almost perfectly superposed to those of Anchor 2, meet to form a 'V' (Fig. 4, left). This design, that we will call the 'V-shaped-straight-arms' design, is commonly associated with British Admiralty Longshank anchors forged from the early eighteenth century to 1840 (Curryer 1999, pp. 51–62, 83–84). However, it was not exclusive to British anchors: the same design was also present in the anchors of the wreck of the Dutch ship *Mauritius*, sunk in 1609 (L'Hour et al. 1989, p. 191). Some late seventeenth- and eighteenth-century French anchors had the same feature. Gay (1997, p. 107) remarked that, out of 17 models of French ships built between 1678 and 1795, exhibited in the *Musée de la Marine* in Paris, one-third had anchors with the 'V-shaped-straight-arms' design. The same can be seen in a drawing on a 1731 French document by M. Deslongchamps, inspector at the *Forges Royales* in Cosne (A.N.M. D3.32.64, *Plan d'une ancre de* 2680 *livres,* 28-1-1731).[1] To determine A1 origin, its proportions have been compared with

[1] Sadania M (2009) *Les ancres en fer en Bretagne*, unpublished Master's dissertation, p. 51. Sadania wonders whether such an anchor had ever been produced in France, or if this drawing was just a proposed plan, and she correctly points out that 'V-shaped-straight-arms' anchors should not be automatically identified as British anchors.

Table 1 Dimensions and proportions of the anchors of ADLV wreck

Measures in cm	Anchor 1 (A1)	Anchor 2 (A2)	Anchor 3 (A3)	Anchor 4 (A4)
Shank length × beam	*285* × *194*	*320* × *190*	*470* × *274*	Hidden under coral
Ring diameter				
Outer	*52*	*51*	*68*	Hidden under coral
Mid	*44.5*	*44.5*	*57*	
Inner	*37*	*38*	*46*	
Shank minimum width × thickness	*15* × not available	Not available	*21* × *15*	Hidden under coral
Shank maximum width × thickness	*21* × not available	*20* × not available	*22* × *20*	*22* × not available
Arm length	*128.5* at crown	*112.5* at crown	*135* at throat	c. *150* at throat
Palm length × width	*59* × not available	*59* × not available	*70* × *68*	*85* × *70*
Shank-arm angle ^	49° at crown	58° at crown	69° at throat	Not available
'Beam to shank length' ratio	0.68	0.59	0.58	Not available
'Ring mid-diameter to shank length' ratio	0.156	0.139	0.121	Not available
'Shank min width to shank length' ratio	0.053	Not available	0.045	Not available
'Shank max width to shank length' ratio	0.074	0.063	0.047	Not available
'Shank length to arm length' ratio	2.22 at crown	2.84 at crown	3.48 at throat	Not available
'Palm length to arm length' ratio	0.46 at crown	0.52 at crown	0.52 at throat	Not available
'Palm length to shank length' ratio	0.207	0.184	0.149	Not available
'Palm width to palm length' ratio	Not available	Not available	0.97	0.82

SAS-INAH, 2025. Prepared by Fabrizio Ciacchella

*…*Measures over concretion

^Angles calculated applying a trigonometry method; example: angle at the crown = arcsin (½ beam / arm length)

those of the above-mentioned anchors of similar design: they are very far from the Dutch and British examples, and very similar to those of the 1731 French plan, including the only anchor known associating the straight arms with such very low 'shank length to arm length' ratio, 2.22 (Table 2). Being the smallest anchor on the site, A1 should have been a kedger, a small anchor used to move a moored ship within a bay, or to navigate upstream in river. It was usually carried on one side of the upper deck at mid-ship.

Anchor 2

Anchor 2 (A2) lies horizontally under Anchor 1, with its head oriented to ESE. Anchor 2 has curved arms and nuts oriented perpendicular to arms (Fig. 4, right), a prevalent feature in early modern anchors. The earliest iconographic evidence for nuts perpendicular to arms is a drawing in a Dutch treatise written by Witsen in 1671. Still, recent observations have found it in the four anchors of the Dutch ship *Utrecht*, sunk in 1648 off Itaparica, Brazil (Ciacchella 2022, pp. 107–131; Ciacchella in preparation). A2 proportions are common in eighteenth-century anchors. Its size (320 cm, barely larger than A1) suggests that A2 was used as a stream anchor to moor the ship in a mild stream; occasionally, it could be used for 'tandem mooring': adding it to the bower's cable and giving more cable length, when the bower anchor was not holding because of a strong wind. The stream anchor was carried on the upper deck at mid-ship, opposite to the kedger side.

'Palm width to palm length' ratio	—	—	0.74	1.06	0.79	—	—	0.79

**...*: measures over concretion*

#: proportions calculated once the estimated thickness of concretion (2.5 cm at each side) from the dimensions indicated in Table 1

^: angles calculated applying a trigonometry method; example: angle at the crown = arcsin (½ beam / arm length)

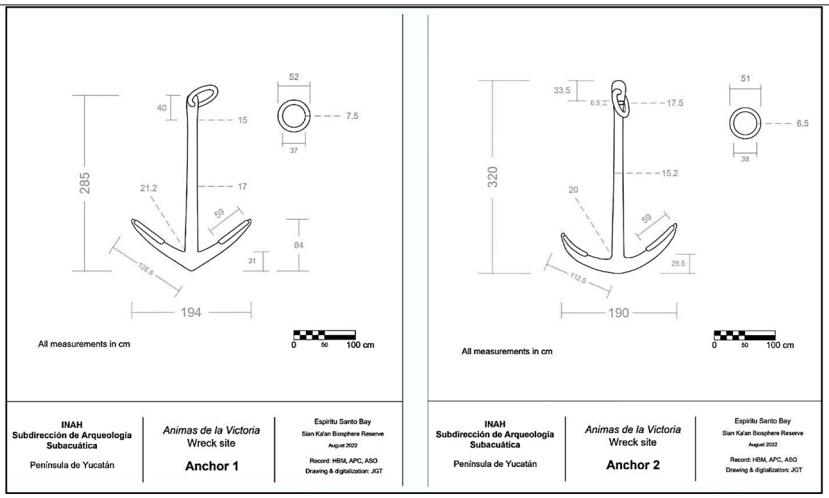

Fig. 4 Drawings. Left: Anchor 1 (A1); Right: Anchor 2 (A2) of the ADLV wreck. SAS-INAH Archive, 2022. Prepared by Josué Guzmán Torres

Table 2 Comparison of the proportions of ADLV Anchor 'A1' and other anchors with similar 'V-shaped-straight arms' design. SAS-INAH, 2025. Elab. Fabrizio Ciacchella

Measures	'Animas de la Victoria' wreck A1	Dutch wreck *Mauritius* 1609 A2	British treatise by Sutherland 1717 (drawing)	British Royal Navy document circa 1763 (table)	British Royal Navy document circa 1790 (drawing)	British treatise by Steel 1794 (table/plate)	British treatise by Burney 1809 (table)	French document by Deslongchamps 1731 (drawing)
Shank length × beam	*285 × 194* cm	*390 × 200* cm	Proportions from the drawing	286 × – cm (9′4½ ″)	Proportions from the drawing	290 × – cm (9′6″)	290 × – cm (9′6″)	Proportions from the drawing
Weight	–	–	–	381 kg (7½ cwt)	–	406 kg (8 cwt)	406 kg (8 cwt)	–
'Beam to shank length' ratio	0.68	0.51	0.63	–	0.62	–	–	0.65
'Ring diameter to shank length' ratio	[0.168] # outer 0.156 mid-	– –	0.144 outer 0.128 mid-	0.166 outer 0.150 mid-	0.163 outer 0.140 mid-	0.149 outer 0.133 mid-	0.149 outer 0.133 mid-	0.152 0.133
'Shank min width to shank length' ratio	*0.053* [0.036] #	–	0.044	–	0.035	0.033	0.033	0.038
'Shank width (trend) to shank length' ratio	–	–	–	0.033	–	0.036	0.037	0.044
'Shank max width to shank length' ratio	*0.074* [0.057] #	–	0.055	–	0.052	–	–	0.054
Shank-arm angle ^		From photo						
@ throat	–	55°	58°	–	58°	–	–	56°
@ crown	49°	50°	51°	–	54°	–	–	48°
Arm form	Straight	Straight	Straight	(Straight)	Straight	Straight	(Straight)	Straight
'Shank length to arm length' ratio	– 2.22 crown	– 2.73 crown	3.0 throat 2.50 crown	– –	3.0 throat 2.53 crown	3 unspecified	3 unspecified	2.72 2.29

Table 2 (continued)

Measures	'Animas de la Victoria' wreck A1	Dutch wreck *Mauritius* 1609 A2	British treatise by Sutherland 1717 (drawing)	British Royal Navy document circa 1763 (table)	British Royal Navy document circa 1790 (drawing)	British treatise by Steel 1794 (table/plate)	British treatise by Burney 1809 (table)	French document by Deslongchamps 1731 (drawing)
'Palm length (incl. bill) to arm length' ratio	–	0.41 throat	0.65 throat	–	0.62 throat	–	–	0.57 throat
	0.46 crown	0.35 crown	0.54crown	–	0.52 crown	–	–	0.48 crown
'Palm length to shank length' ratio	0.207	0.127	0.217	0.155	0.206	–	–	0.209
'Palm width to palm length' ratio	–	–	0.74	1.06	0.79	–	–	0.79

…: measures over concretion

#proportions calculated once the estimated thickness of concretion (2.5 cm at each side) from the dimensions indicated in Table 1

^angles calculated applying a trigonometry method; example: angle at the crown = arcsin (½ beam / arm length)

Anchor 3

Anchor 3 (A3) lies horizontally in the mid-western part of the site, at 3.3 m depth. Due to its large size (470 cm), A3 should have been a bower anchor, held at one side of the bow, ready for use (Fig. 5). Just like A2, this item has curved arms, a very common feature in early modern anchors. A3 proportions (especially about the shank, 3.5 times as long as a single arm) are common in anchors from sixteenth- and early-seventeenth-century wrecks, and not present in those of the eighteenth and nineteenth centuries. The latest examples known are the anchors from the Spanish *Santa Margarita* and the *Nuestra Señora de Atocha* wrecks (1622) off the Florida coast, and those from the British *Trial* wreck, sunk off Western Australia in 1622, as well. Following a long period with a total lack of archaeological records of anchors, this proportion seems to disappear in the last decade of the seventeenth century, as it can be seen in one anchor in the middle of the wreck of the *Dartmouth*, sunk in 1690 (Mathewson 1986, pp. 38–39; Green 1977, Fig. 15; Muckelroy 1978, p. 97). On the other hand, A3 nuts, or stock keys, are oriented on a plane perpendicular to arms, a feature documented since the mid-seventeenth century. For these reasons, the anchor A3 may have been forged in the second half of the seventeenth century.

Anchor 4

Anchor 4 (A4) lies at a depth of 2 m at the western end of the site, in an apparently activated position, with its crown oriented to the east. The lower palm and the upper shank (including head and ring) are hidden under thick coral layers; it is possible that some stock remains survive under the coral. Unfortunately, it is not possible to complete a morphological study of this anchor because many key parts remain hidden. Some details, such as the

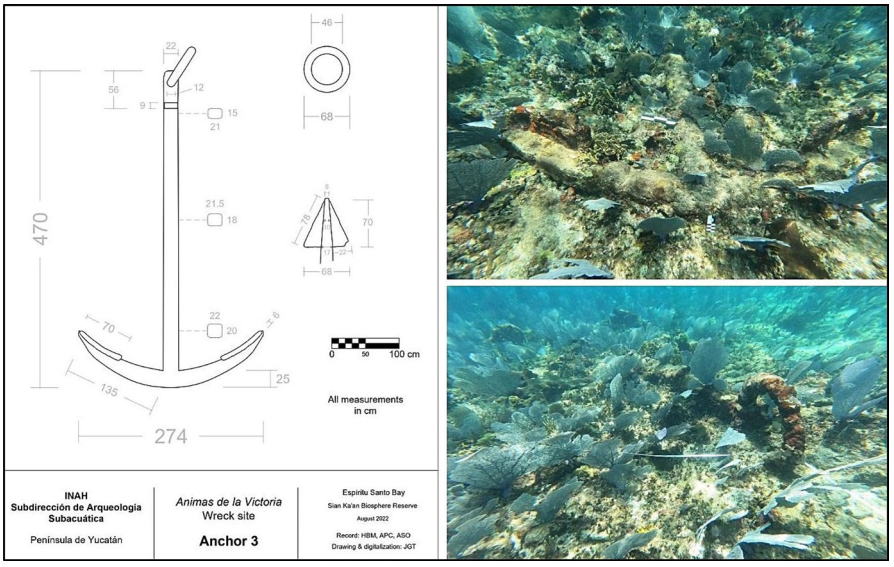

Fig. 5 Left: Drawing of Anchor 3 (A3) of the ADLV wreck. Right: Images of A3 deposition. SAS-INAH Archive, 2022. Prepared by Josué Guzmán Torres. Photos: Helena Barba-Meinecke

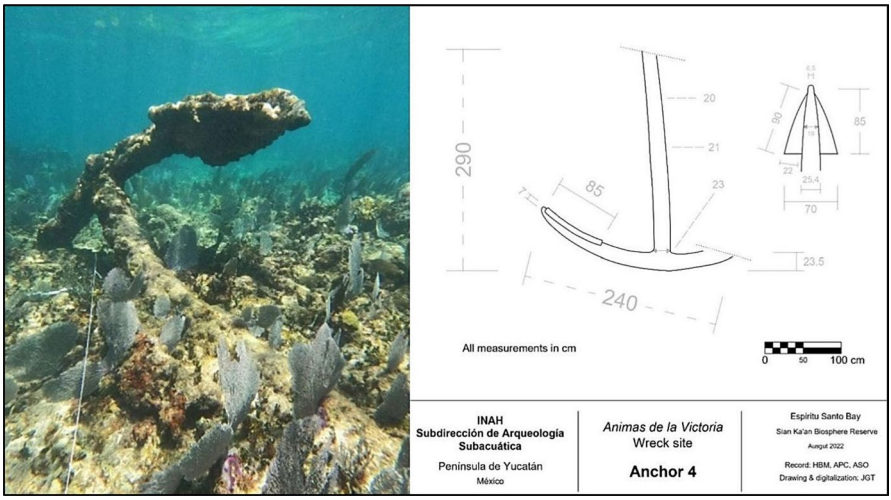

Fig. 6 Left: Image. Right: Drawing. Anchor 4 (A4) ADLV wreck. SAS-INAH Archive, 2022. Prepared by Josué Guzmán Torres. Photo: Helena Barba-Meinecke

form of the arms, may suggest a parallel with a French drawing of the second half of the eighteenth century (Diderot 1762 pl. XII [Fig. 1]), but further research is needed to confirm this. The visible part of the shank is heavily bent, a common deformation produced while weighing an anchor stuck on a rocky seabed (Réaumur 1764, pl. I [Fig. 26]). Other examples of anchors with a bent shank are the bower anchor of the *Santa Margarita* wreck (1622, Florida), the 'Gresham' shipwreck anchor (circa 1574, United Kingdom), and the kedger of the Venetian wreck of Sveti Pavao (late sixteenth century, Mljet Island, Croatia) (Mathewson 1986, p. 39; Ciacchella 2015, pp. 62, 68 [Fig. 15]). A4 length cannot be measured due to the presence of coral. Its visible palm and arm are the biggest among the ADLV anchors, but this does not necessarily mean that A4 was the biggest anchor. Due to the significant variability in proportions between the shank and arm, as well as between the shank and palm, using these proportions to determine shank length is not a reliable method. For instance, in A1, A2, and A3, 'shank length to palm length' ratios are respectively 4.8, 5.4 and 6.7 (see Table 1): estimating A4 length by multiplying these ratios

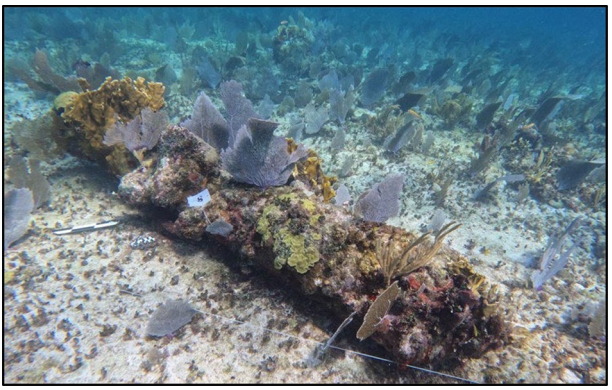

Fig. 7 Image of one of the ADLV cannons (C8). SAS-INAH, 2022. Photo: Helena Barba-Meinecke

by the length of its palm (85 cm), gives 408 cm, 459 cm and 570 cm; the latter value is unlikely for being the length of the biggest anchors, used in First Rate ships carrying 90 to 100 guns. The range of the estimated lengths for A4 suggests that it was a bower anchor, just as A3 (Fig. 6).

Ordnance

Ordnance was another key aspect of the 2022 fieldwork campaign. A detailed documentation of the 19 pieces was done (despite the coral concretions layer): taking/reviewing the general measurements of each cannon, determining their obverse and reverse positions on the bottom, and verifying whether the upper breech and/or the trunnions were accessible, to plan subsequent specific removal of marine growth.

It is important to note that most of the cannons were heavily colonized by corals, which often cover almost the entire surface of the visible area of each cannon (Fig. 7). Though it was difficult even to distinguish the trunnions or appreciate the morphology of some specific parts of the artillery pieces; it has been possible to recognize the cannon segments illustrated in Fig. 8, and collect the data shown in Table 3.

Despite the concretion layers, in several cannons some original morphology details are still visible enough. Some general features can be noted:

1. Trunnions are circular, positioned below the central axis of the piece; the distance between trunnions differs between the obverse and reverse of the barrel, hence it is possible to distinguish whether the pieces are lying in firing position or upside down.
2. Cascables are spherical, with rounded profile, with no ornaments, and a short neck.
3. Muzzle diameters are not much larger than the base ring diameters; the tube gets slightly thicker in the swell of the muzzle.
4. There are two incomplete cannons: C13, missing part of its muzzle, and C17, lacking its cascabel.

Given the scarcity of significant information from the ordnance morphological analysis, specific ‘deconcretion’ (removal of outer coral concretion), using hand tools such as a hammer, chisel, and wire-bristle brush was planned on some suitable cannons, looking for marks on the original surfaces denoting dates, places, owners, producers, etc.

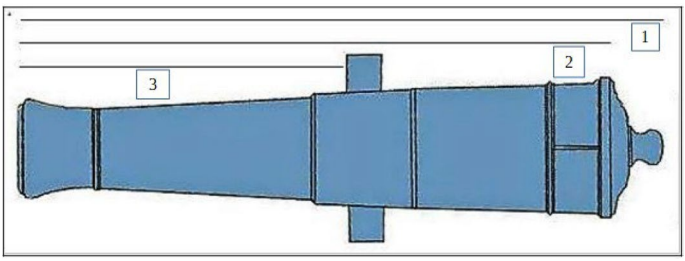

Fig. 8 Drawing. Basic cannon plan, indicating relevant segments for its analysis: (1) Total length; (2) Length of the gun; (3) Distance from the trunnion to the plane of the muzzle. Prepared by Josefa Martí Solano

Table 3 Measurements of the cannons sections of the ADLV shipwreck (cm)

Cannon	Total length (1)	Weapon length (2)	Cascable width	Mouth to trunnion length (3)	Trunnions diameter (without concretion)	Notes
C1	230	215	55	–		
C2	234	218	53	114	10	No trunnion mark
C3	235	200	56	100		
C4	245	220	57	112		
C5	260	225	46	–		
C6	240	228	55	118		
C7	257	238	46	138	9	Trunnion mark: incised letter 'X'
C8	265	248	33	138	12	Trunnion mark: Embossed letter 'C'
C9	255	228	–	125	9	No trunnion mark
C10	247	225	55	130	9	Trunnion mark: Embossed letter 'C'
C11	Embedded in the coral					
C12	257	230	47	124		
C13	152	138	46	75		Incomplete mouth
C14	+230	220	46	123		
C15	165	155	53	60		
C16	246	225	53	127	9	No trunnion mark
C17	+240	240	50	80		Without cascable
C18	170	155	48	80		
C19	185	165	43	86		
C20	165	–	–	–		Cannon imprint on the sea bed

SAS-INAH, 2022. Prepared by Josefa Martí Solano

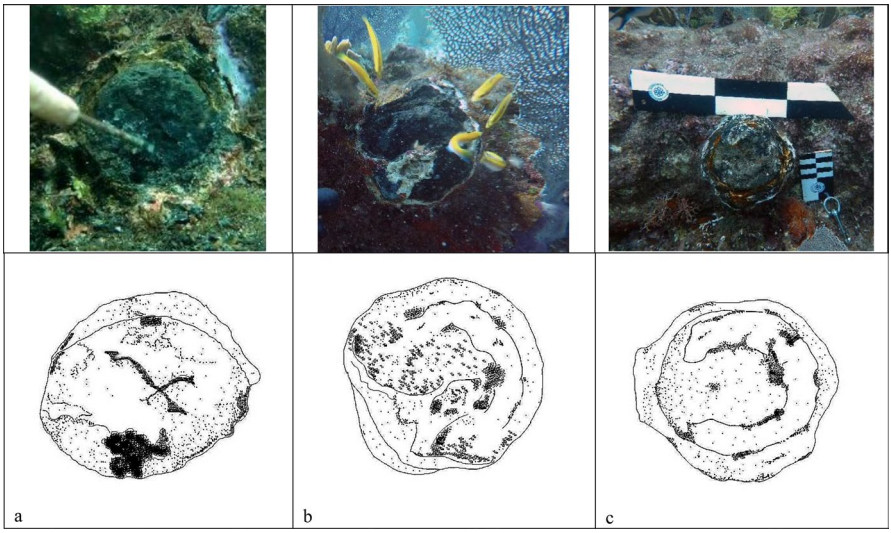

Fig. 9 Documented marks on the trunnions face of cannons. **a** C2, **b** C8, and **c** C10. Observed marks on the trunnions were letters "X" and "C". SAS-INAH, 2025

Marine growth removal was carried out on nine spots: six on the trunnions of cannons C2, C7, C8, C9, C10, and C16, and three on the base rings of C3, C10, and C16 (Table 3, Fig. 9).

Remarkably, a 'C' mark appeared in relief on the left trunnion faces of cannons C8 and C10—but it should be noted that the letters 'C' and 'G' can sometimes be misleading and can be confused, especially when the piece is in a poor-preservation situation. 'C' markings in relief have been reported on late seventeenth-century Swedish artillery pieces (Blackmore 1976, p. 150), but they are morphologically different from those found on the ADLV wreck. This marking is also found on French artillery pieces (Boudriot 1977, plate XXXVIII), possibly corresponding to the *Le Creusot* foundry, which began production in the late eighteenth century—it is worth noting that France often marked its cannons with incised letters. The 'C' mark is also found on English cannons from the second half of the eighteenth century: the letter 'C' corresponds to the *Conster* foundry (Beckley) in Sussex, southern England (Brown 2007, p. 326). Little information is available regarding these productions, but ordnance from *Conster* (bearing the "C" mark) is mentioned as arming the HMS *Bedford* decks in 1778.[2]

In 1743, William Harrison and John Legas formed a partnership that lasted for sixteen years (Hodgkinson 1993, p. 105). They jointly leased the Gloucester (Lamberhurst), Conster (Beckley), and Waldron furnaces, as well as a house in Horsmonden and forges

[2] In 1777, HMS *Bedford* was fitted for service in the Channel; but apparently the ship was armed with old Carron cannons, rather than according to the valid Ordinances. In 1778, the captain of HMS *Bedford* suspected that his ship's cannons might have come from the Carron foundry and requested an inspection on board. The Board of Ordinance eventually reported that "the Bedford cannons marked "C" appear to have been cast at the *Conster* furnace in Sussex" (Brown 2007, p. 236).

at Westfield and Hawksden (Mayfield). John Fuller, a cannon founder, mentioned Beckley (*Conster*) as one of the few furnaces able to supply large cannons (Straker 1931, p. 165). However, existing documentation on the *Harrison* partnership production makes it clear that it was limited to small and medium-sized cannons: from half- to twelve-pounders, intended for government ships of exploration and private merchant shipping (Serafín 13 May 2020). The *Conster* production is recorded from 1700 to 1760; characteristic 'C' marks have been documented on both trunnions of the surviving pieces like a nine-pounder bearing the George II monogram in the Chatham Dockyard collection (Brown 2007, p. 326).

Deconcretion was also carried out in the base ring area of cannons C6, C10, and C16 (items not completely covered by concretions and marine organisms). The objectives were primarily to observe the distinctive morphology of the breech design (to attempt to recognize the specific cast pattern), and to look for names, dates, or symbols usually engraved or in relief in this sector. Unfortunately, the expected results were not obtained because the thickness of the accumulated concretion layer was so significant, and in some cases, the calcareous coral adhesions were too hard for the manual means at our disposal.

After deconcretion, all exposed parts were sealed using a two-component epoxy resin suitable for immersion casting (Klipton Plast). The resin mixture provides an easy-to-work and moldable mass, perfectly adapting to the irregularities of the different areas to be covered.

To complement the ordnance study, an isolated round cannonball was located in the central area of the wreck site. This element was collected and mechanically cleaned from coral concretion—later, it was chemically stabilized in the Conservation and Restoration Section of the INAH Yucatán Center. The ball is a solid iron round shot, weighing 1.235 kg, with a diameter of 8.2 cm. It is without marks or peculiarities, neither indicating a specific Navy nor resulting from the casting process.

During the cleaning process it was confirmed to be a solid cannonball with no fuse hole, it was also possible to verify the significant deterioration of the metal, due to particular impact of processes affecting underwater ferrous materials—each object, depending on circumstances, responds in a specific way to deterioration (this is why, in the same deposit, and with the same metal, different situations can occur). In addition, the chemical properties of the eighteenth-century iron cannonballs manufacturing process imply that, under corrosion, artillery round shots will lose their mass and decrease in volume. That is why the diameter and weight obtained from the iron cannonball cannot be taken as definitive and cannot be used for a comparative analysis to determine the round shot caliber. Nevertheless, it can be proposed, with some caution, that the ball corresponds to a small caliber of four pounds; or, since the diameter difference with the upper caliber is just one and a half centimeters, it could be at most a six-pounder shot—if the ball had considerable loss of volume. Analytical studies will be conducted shortly on the cannonball, which will include metallography, SEM–EDS, XRF, FTIR, Raman, color, and hardness analysis.

Analysis of Punta Pájaros Cannon, presumably looted from the ADLV Wreck

There is evidence of the looting of a cannon at this site, as the imprint on the seabed can be seen in Deposition sector 2; the length of this hollow mark in the sea bottom (C20) is 1.65 m. Based on local oral information, this "recovered" cannon is currently located within a private property in Punta Pájaros—a small cape to the north of the wreck location. Present-day images of this piece have been obtained, revealing evidence of its very poor

preservation; trying to counteract this decay, presumably, the rear part of the barrel was coated with a layer of fiberglass. Although the condition of this cannon is not optimal, it has been possible to document it with some detail, getting from the photographs and photogrammetric model a more accurate idea of the piece morphology, with basic measurements (Fig. 10).

Based on the documentation made, this cannon, presumably the retrieved C20 of the ADLV wreck context, is a four-pounder with a total length of 165 cm, which coincides with the measurement obtained from the cannon imprint at the site. Because of its design and proportions, this piece seems to correspond to some mid eighteenth-century British casting patterns.

Discussion

Chronology

From ordnance analysis: the Punta Pájaros cannon (C20) cast pattern indicates a production date about mid-eighteenth century; not inconsistent with the chronology indicated by trunnion marks of C8 and C10—the second half of the eighteenth century. As for the ADLV anchors: A1 morphology and proportions have a parallel in a drawing of 1731, while A3

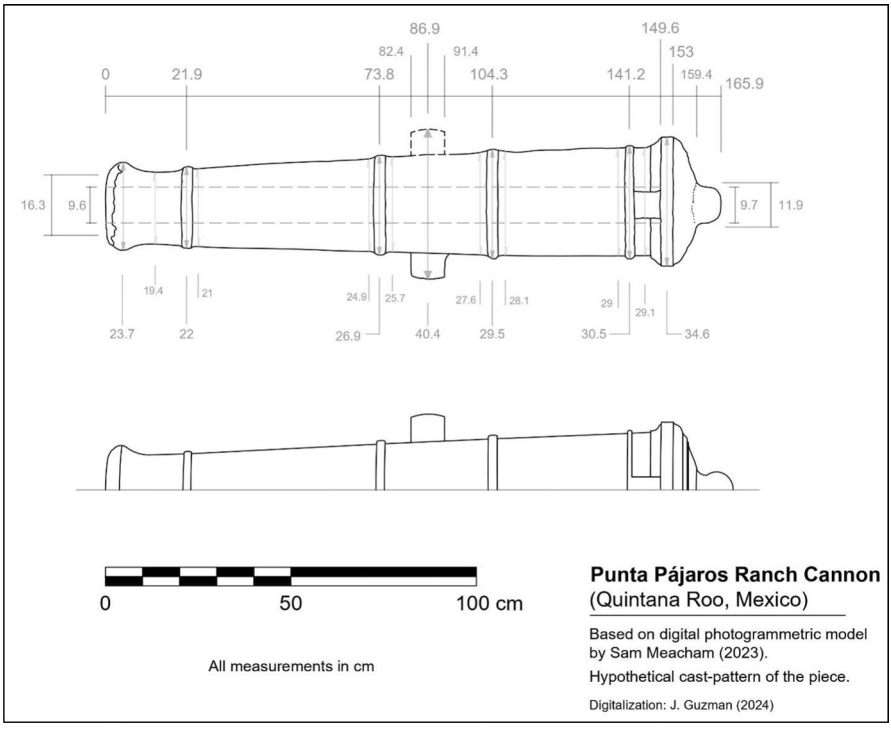

Fig. 10 Drawing of the relocated cannon (C20), kept in Punta Pájaros property. SAS-INAH, 2024. Prepared by Josué Guzmán Torres

proportions suggest it was forged about the second half of the seventeenth century. Considering that the anchors period of use could extend over half a century (Friel 1995, p. 124; Gay 1997, p. 181), the ADLV shipwreck may have occurred no later than the second half of the eighteenth century.

Ship Size is Related to the Heaviest Anchor on Board

The weight of the heaviest anchor on board (called 'sheet anchor', and later 'best bower') was proportional to ship tonnage: many tables existed in the different navies, establishing the number and weight of anchors for every ship's class.[3] As for the *Animas de la Victoria* anchors, to estimate ship size, we will consider A3 as the biggest one—since the length of A4 is unknown; therefore, the results will be considered as *minimum value*, in case A4 was bigger than A3.

The weight of Anchor 3 is unknown, but it is possible to estimate it by comparing A3 dimensions with those of mid-eighteenth-century anchors exposed in the nautical literature of the period (Réaumur 1764, p. 40; Tellechea Idigoras 1977, pp. 13–14; Diderot 1762, p. 12; Curryer 1999, p. 56). Though historically recorded lengths (464–466 cm) are similar to the length of A3 (470 cm), especially once a few centimeters of calcareous concretions are subtracted, these anchors show significant difference in weight, ranging from 1678 to 2668 kg (see Table 4).

The lightest one, a 33 cwt British Admiralty Longshank anchor listed in an official Royal Navy document of circa 1763, is very similar in dimensions to A3—the other models have thicker cross-sections in the shank and arms, justifying their heavier weight. However, A3 morphology differs from the British Longshank design in having curved arms instead of straight, and a wider angle between the shank and each arm. A3 weight can also be estimated through its volume: assuming an average concretion thickness of 2.5 cm all around, the resulting weight is approximately 1646 kg, equivalent to 321/3 cwt.[4]

Regarding tonnage correspondence, according to a British table of 1717, a 30-cwt anchor was the heaviest anchor for ships of 625 burthen tons. Proportions between anchor weight and ship tonnage had not changed until 1830, when, according to another British table, anchors of 29 cwt 15 lbs and 31 cwt 41 lbs were the heaviest on-board ships of 600 and 650 tons; those of 33 cwt 66 lbs fitted 700 tons ships (Curryer 1999, pp. 53, 59). So,

[3] Besides the general rules relating anchors weight to ships tonnage (or number of guns for warships), in some navies a 'rule of the thumb' existed. At the very end of the seventeenth century in the Dutch Navy, and the early eighteenth century in the British Royal Navy, the length of the heaviest anchor was two-fifths of ship the maximum breadth of the vessel, the so-called 'beam' (Van Yk 1697, p. 220.; Curryer 1999, pp. 45, 53). This rule worked for warships of the period; it is not known if it worked in later periods or for merchantmen too.

[4] A3 volume has been calculated as the sum of shank and arms volume + palm volume + ring volume, after subtracting concretion thickness estimate. A3 weight has been obtained by multiplying the volume by iron density (7.8 kg/dm^3).

Supposing concretion average thickness 2.5 cm:

$V = (46.5 + 13.25 + 13.25) \times (1.6 \times 1 + 1.7 \times 1.5)$: $2 + 2 \times (6.5 \times 6.3 \times 0.4$: $2) + (6.3\ \pi \times 0.7\ \pi) = 211$ dm^3.

$W = 211$ dm$^3 \times 7.8$ kg/dm$^3 = 1646$ kg.

A3 dimensions, expressed in dm, are taken from Table 1, after subtracting 2.5 cm each side as hypothetical average concretion thickness. Shank and arms volumes are calculated as the product of their lengths by average cross-section surface; the latter is calculated as the average surface between the big of the shank near the crown and the small of the shank near the head. Palm thickness is considered equal to nut thickness, as it usually was.

Table 4 Estimate of the weight of Anchor A3 by comparing it with some eighteenth-century anchors of similar dimensions

Measures in cm except where specified	Animas de la Victoria Anchor 3 *Field measures over concretion*	French Réaumur, 1723 Réaumur 1764	French Diderot 1762	Spanish Oquendo 1750–1755	British Royal Navy official document circa 1763
Weight	Unknown	5300 *livres #*	4000 *livres #*	58 *quintales* °	33 cwt §
		2594 kg	1958 kg	2668 kg	1663 kg
Shank length	*470* cm	14 *pieds #*	14 *pieds #*	16 *pies* °	15 *feet* §
		3 *pouces #*	3 *pouces #*	9 *pulgadas* °	3 *inches* §
		464 cm	464 cm	466 cm	465 cm
Ring diameter Outer	*68*	70	72	66	67
Mid	57	Not specified	64.5	58.5	[c. 59]
Inner	*46*	Not specified	57	51	[c. 51]
shank min width	*21*	–	17	17.5	
Shank min perimeter	*72*	60.5	–	–	–
Shank width at trend	[*21.5*]	–	–	–	17.5
Shank max width	*22*	–	25.5	24	–
Shank max perimeter	*84*	91	–	–	–
Arm form	Curved	Curved	Straight near the crown curved under the palm	Not specified	[Straight]
Arm length	*135* at throat	167	163	140	[155 at crown]
Palm length (Including bill if present)	*70*	88	98	75.5	69
Palm width	*68*	91	77	72	67

Table 4 (continued)

Measures in cm except where specified	Animas de la Victoria Anchor 3 *Field measures over concretion*	French Réaumur, 1723 Réaumur 1764		French Diderot 1762	Spanish Oquendo 1750–1755	British Royal Navy official document circa 1763
Arm-shank angle ^		Pl. I Figure 1	Pl. IV Figure 7	Plate XII Figure 1		
at throat	69°	58°	61°	55°	–	[60°]
at crown	–	52°	51°	50°	–	–

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* *Measurements were taken over concretion (estimated average thickness 2.5 cm all around); net dimensions can be obtained by subtracting 5 cm

1 French *livre* = 0.4895 kg; 1 *pouce* = 2.71 cm; 1 *pied* = 12 *pouces* = 32.48 cm

°: 1 Spanish *quintal* = 46.01 kg; 1 *pulgada* = 2.32 cm; 1 *pie* = 12 *pulgadas* = 27.86 cm

§: 1 English *pound* (lb) = 0.454 kg; 1 *hundredweight (cwt)* = 112 *pounds* = 50.85 kg

1 *inch (“)* = 2.54 cm; 1 *foot (‘)* = 12 *inches* = 30.48 cm

^: angle calculated using field measures or measures taken from archaeological drawings or photos, applying a trigonometry method

Example for the angle at crown: angle = arcsin (½ beam / arm length)

in view of the estimated A3 weight, the tonnage of the ADLV ship may have been around 650–700 tons (1840–1980 m^3). Since the first half of the seventeenth century, British warships of such tonnage were ranked as Fourth Rate ships, but their ordnance was bigger in number as well as in weight: 40 to 54 guns—usually nine-pounders and twelve-pounders, sometimes eighteen-pounders. In the eighteenth century, an artillery battery like the one found in the ADLV site was the established ordnance onboard Sixth Rate ships (later called *corvettes*): vessels of the 1719 Establishment class carrying 20 six-pounder guns, were just 375 tons, 32 m long, with an 8.5 m beam and a 2.8 m depth of hold. Their bower anchors, according to the 1717 table mentioned, weighed just around 19 cwt each. Smaller units, such as sloops, brigs, and ketches, below the rating system, had even smaller anchors and no more than 14 guns (Curryer 1999, pp. 53, 56, 58). Merchant frigates were a type of ship matching higher tonnage and anchor weight with a small number of light-weight ordnance. Those established by the 1741 Revision were 498 tons and 34 m long, with a beam of 10 m, a depth of hold of 3.3 m; their ordnance consisted of 20 six-pounder guns. The *Animas de la Victoria* ship had to be larger, built as a merchant frigate, or more likely as an armed merchantman with similar ordnance.

Anchor Context and the Dynamics of the Shipwreck

A1 and A2 lie horizontally with their arms almost perfectly superimposed at 7 m depth, too deep for a ship like the *Animas de la Victoria* to run aground.

That horizontal position indicates that they have not been worked on, and their heads pointing in the opposite direction to the rest of the site suggests that their cable was not even put into tension. Anchor 4 lies in an apparently working position, but, as it lies at a depth of 2 m, a ship like the ADLV couldn't drop anchor in such shallow waters, even considering that at the time of the shipwreck, the seabed may have been half a meter deeper (the thickness of the coral covering A4 lower palm). To reach this point, the ship must have been lifted by the waves and left to break on the top of the shoal. This proves that the nautical accident that happened to the ADLV ship ended up with a shipwreck, and that it wasn't just a successful attempt to refloat the vessel after running aground. Furthermore, A4 lies on the west end of the site, its head pointing westward; to activate it, a ship had to be west of the site, under an eastern wind, and it would have been impossible for her to sink upwind in the *Animas de la Victoria* site. Therefore, A4 has never been activated, nor did its cable come under tension; it had to fall in this position at the moment the ship was wrecked. The shank of A4 is markedly bent in the way produced when weighing anchors. Still, this deformation had to occur before A4 was deposited at the site, because here the sea is too shallow to allow a ship like the ADLV not only to drop anchor but also to weigh it.

Almost all the sectors lie aligned on a 200 m long axis-oriented E-W; sector 1 is the only exception, lying 35 m south of sector 2. This distribution is compatible with the hypothesis of a ship sailing north under a strong eastern wind, giving her a west drift that didn't allow her to navigate far from the coast. A few hundred meters south-east of the top of *Animas de la Victoria* shoal, the crew may have seen the breakers on the port side of the bow; thus, wishing to go back and stay far away from danger (turning east towards the deep sea was impossible because it was upwind), they may have oriented the sails to heave to the ship and reduce her surge north. Then, to narrow the U-turn and prevent the vessel from getting closer to the shallows while turning, they dropped the stream anchor and the kedger, tied together as they were very light (sector 1, 7 m depth). The planned maneuver may have been to have the wind help turn the ship by pivoting her around the anchors with the cable

fixed to the stern. This was the reason for using the anchors carried at mid-ship instead of one hanging from the bow: using the latter under an eastern wind would have resulted in turning the bow eastward, in the direction opposite to the turn.

To give the anchors a sure hold, the practice was to provide as much cable length as seven times the depth of the seabed. For example, 50 m of cable length would have been sufficient, given the depth of just 7 m. The ship never arrived this far: 35 m north of sector 1, she may have started hitting the keel on the seabed when she was in the trough of the wave, so the crew threw overboard five guns (sector 2, 5.6 m depth) to reduce her draught. The ship had stopped her surge north, and now she had started drifting west under the eastern wind. Another 40 m to the west, the ship ran aground, and the crew threw overboard nine more guns (sector 3, 4 m depth), to reduce the draught again and refloat the vessel, just to let her drift 25 m west and run aground a second time. Then the crew dropped Anchor 3 and three more guns (sector 4, at a depth of 3.4 m) to refloat the ship, allowing her to drift once more. Eventually, 50 m to the west, she reached the top of the shallows, and the waves lifted and crushed her on the seabed, where Anchor 4 lies with the three remaining guns (sector 5, 1.5 m depth).

Historical Background

The clues about the dating of the ADLV wreck site formation, based on the observed anchors and cannons, point to the second half of the eighteenth century. It was a time of significant geopolitical turbulence in this region between Spain and Britain, Western European powers who had traditionally been confronted in the Caribbean since the sixteenth century. After the Spanish conquest of nowadays Mexico, a massive silver production and exportation to the Iberian Peninsula started a rich monopolistic trading exchange that excluded all other Old-World Atlantic Nations. France, and later England and the United Provinces (Netherland), immersed in religious and political conflicts with Spain, soon started to attack the ships and ports of the Americas as part of their war strategy against the Iberian enemy, bringing the confrontation to a new battlefield outside Europe. In the seventeenth century, looking for more powerful actions against Spain than piracy, these States set bases in the ill-defended Caribbean islands and continental coasts. France and the Netherlands occupied the Lesser Antilles and Guianas, and England (now constituted as the Kingdom of Great Britain and Northern Ireland) established a colony in Jamaica (1655), and even did dare to set irregular bases in the mainland, close to the Spanish dominions in New Spain: Isla del Carmen (close to Campeche) and Caribbean coast of Honduras (present day Belize). By the eighteenth century, after the War of the Spanish Succession, the Peace of Paris drove out the British from the Gulf of Mexico, but recognized their sovereignty over Honduras, which became the perfect base to overlook and eventually attack the Spanish sea routes (Villegas and Torras 2014).

The whole eastern coast of the Yucatan Peninsula, the geo-cultural region where Espiritu Santo Bay is comprised, was an uninhabited territory according to the Spanish criteria: no cities, towns nor haciendas were established because of the dense tropical jungle (to which the Maya escaped to flee from the European conquest), and the maritime navigation along the coast was almost impossible due to shallow waters, dangerous reef barrier patches, and rough seas. Then, if nominally subjected to the Spanish rule, no effective control was exerted over the huge southeast portion of the Yucatan Peninsula and Central American Caribbean coast, territories plentiful in valuable natural resources, especially logwood (Contreras Sánchez 1987). So, since the early seventeenth century the enemies of the

King of Spain took advantage of this lack of colonial power, and set illegal camps and provisional settlements on the shore of present-day Belize; the only Spanish outpost in the region was the small, isolated, inland village of Bacalar—which was constantly attacked by pirates, until well into the eighteenth century (Contreras Sánchez 1987; Villegas and Torras 2014).

Since there were no inhabited centers, ports, or even production facilities on this coast, in addition to rough seas, dangerous reefs, and shallow waters, the Spaniards did not navigate these waters. This fact can be deduced from the nautical charts and the pilot books, where the lack of details or even the mention of the eastern coast is quite striking. In a review of historical charts and maps drawn and published between 1550 and 1820, it is easy to see how divergent the shore outlines are from another, contrary to the well-known and depicted coasts of the Gulf of Mexico. As late as 1810, the *Derrotero de las Islas Antillas, de las Costas de Tierra Firme y de las del Seno Mexicano* (published by the Royal Direction of Hydrography), the most complete Spanish pilot book edited during the Viceregal period, gives no instructions to sail northward beyond the Belize river, but warns the seafarers about the dangerous reef coast and prevents to sail too close to shore. The 'normal' Spanish maritime route from Central or South American ports (Cartagena, Omoa, Puerto Caballos) headed through the center of the Northwestern Caribbean, entered the Yucatan Current, and then went into the Gulf of Mexico between the Yucatan NE edge (Cabo Catoche) and Cuba's westernmost tip (Cabo San Anton).

On the contrary, British logwood traffickers and smugglers (the pirates-heirs) knew the reef passages and the narrow channels along the coast well (Villegas and Torras 2014), as can be seen in several eighteenth-century nautical charts and in Joseph Speer's 1766 *The West India Pilot*, where general indications to sail across these risky sea locations. Even the 1810 *Derrotero* and other documents from Spanish Navy Officers express, plainly or indirectly, that the English were those who knew how to sail the coastal waters (Fig. 11). Then, at least until well into the nineteenth century, sea lanes passing close to Espiritu Santo Bay were a historic-cultural component of the British (and local Mayan) nautical sphere.

Conclusions

The study of the anchors and guns deposition context has demonstrated that the nautical accident that occurred at the site ended up with a shipwreck. To explain the extension of the site (200 m), a hypothesis has been proposed of a ship sailing north with a heavy west drift, caused by a strong eastern wind.

After an initial and unsuccessful maneuver to avoid the shallows by dropping two small anchors tied together from the stern, aimed to help the ship make a U-turn, there were a few episodes of hull grounding, followed by attempts to refloat the ship by throwing heavy objects overboard to reduce the draught. But it was useless to avoid the ship's tragic end on the top of the shoal.

Defining the wreck site formation date and geo-cultural provenance of the ship has been approached mainly from the design and marks of the cannons, and anchors morphology. The "C" markings identified on the trunnions of two artillery pieces reveal that they were cast either by the *Conster* Foundry, in Sussex, England, or by the *Le Creusot* foundry in Bourgogne, France, both producing guns in the second half of the eighteenth century. The Punta Pájaros cannon, which, according to local fishermen's testimony, was the one retrieved from the ADLV context (C20), seems to correspond to a British mid-eighteenth-century cast pattern.

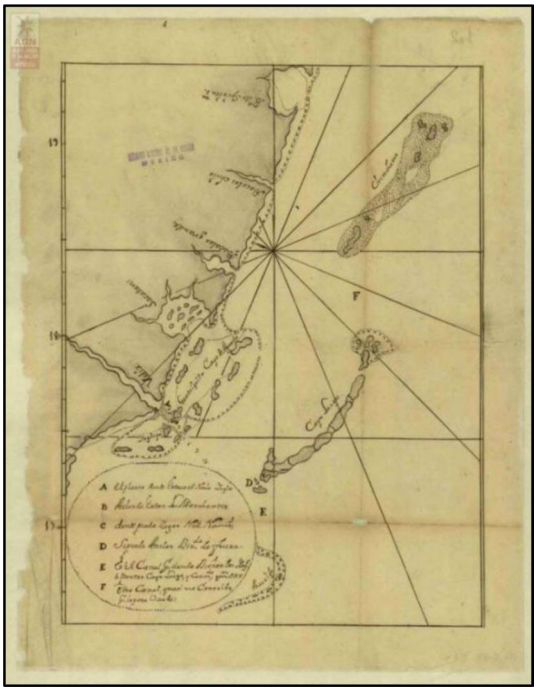

Fig. 11 Map of the eastern coast of Yucatan, from Espiritu Santo (top) to the Belize River. Anonymous. 1725. AGN (Mexico): Historia/39286/Volume 5, f. 118

The wreck site chronology, according to the anchors, is coherent with that of the guns—except for Anchor 3, which, due to its proportions, could have been forged in the second half of the seventeenth century. Considering the anchors' period of use, which in some cases extended over half a century, the ADLV original deposition occurred in the mid-eighteenth century or a little later.

Due to its proportions, Anchor 1 has been identified as a French anchor, which, until recently, was known only through a plan drawn by a forging inspector in 1731. Some details seem to suggest that Anchor 4 could be of French origin too, but further research is needed to confirm it. The presence of two big bower anchors (A3 and A4) in the ADLV wreck, contrasts the small amount of light weight ordnance.

An estimate of the ADLV ship tonnage has been made through the weight of the biggest anchor observed (A3), calculated at c.1650 kg through its volume, and confirmed through the comparison with anchors of similar dimensions and proportions historically recorded. Such an anchor fitted 650–700-ton ships (circa 1800–2000 m^3); in warships, this tonnage corresponded to Fourth Rate warships with 40 to 54 guns (six- to eighteen-pounders). On the other hand, the artillery battery found in the ADLV site (20 three- to six-pounders) was usually carried by Sixth Rate warships (corvettes) of no more than 375 tons, fitted with 970 kg bower anchors, while smaller ships like sloops, brigs or ketches, had lighter anchors and less amount of ordnance—for these reasons, it has been concluded that the ADLV ship was not a warship.

On the contrary, merchant frigates were a type of medium tonnage ship (with corresponding anchor weights) with a small amount of light ordnance. Those established in 1741 (Britain), for instance, were 500 tons, 34 m long and 10 m beam, with 3.3 m depth of hold, armed with 20 six-pounders. The ADLV ship had to be slightly larger, built as a merchant frigate or an armed merchantman with similar ordnance. The hypothesis of a

merchant ship could more easily explain the presence on board of a functional mixture of guns and anchors of French and British origin.

It is hard to imagine a vessel of such dimensions sailing so close to the shore of Espiritu Santo Bay, where the shallow waters would not have the required depth to pass safely. If the ship's British cultural origin hypothesis is considered (i.e., assuming the crew was familiar enough with the nautical landscape of this coast), then the idea of the ship being caught in a gale, trawled by waves, or drifted by winds arises strongly. The deposition pattern of the archaeological context seems to strengthen the hypothesis of such a catastrophic scenario. The paucity of other associated artifacts and the absence of a ballast mound are questions that remain unanswered. Possibly, lighter objects have been scattered by waves and breakers over the centuries and lie under half a meter of coral, given the thickness of the coral covering the lower palm of A4. The absence of cargo could suggest a wood log load that, after the shipwreck, floated away.

The archaeological research of the ADLV wreck site, even though it has just begun, has excellent potential to contribute to the global understanding of the nautical and maritime history of the Northwest Caribbean, including the eastern coast of the Yucatan Peninsula and Belize. Since it is the only eighteenth-century wreck site in Espiritu Santo Bay, it may provide information about the non-recorded, outlaw resources exploitation and maritime smuggling carried out by British subjects, dynamics that were usual in this remote region, nominally under the control of the Spanish Crown.

Future investigations into the ADLV wreck will focus on expanding the study area to search for the ballast mound, the ship's fastenings, and other potential diagnostic artifacts, such as bullets or rigging remnants. Additional studies will be conducted on Anchor 4 to verify its possible French origin. A metallographic analysis of the identified cannonball will be performed. In addition, the photogrammetric record will be completed to facilitate mapping and surveying of the wreck site, thus ensuring the availability of detailed images of the materials.

The goal is to provide additional elements for a more precise archaeological interpretation of the context, the nautical accident, and navigation along the eastern coast of the Yucatán Peninsula in the late eighteenth century.

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Declarations

Competing Interests The authors declare no competing interests.

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