MINISTERO DELL'AMBIENTE
E DELLA SICUREZZA ENERGETICA

ANNEX æ
PROPOSAL FOR THE INSCRIPTION ON
THE UNESCO NATURAL WORLD HERITAGE LIST

PALEONTOLOGY OF THE DEPOSITS

THE EOCENE MARINE ECOSYSTEM IN THE VAL D'ALPONE - BOLCA, SAN GIOVANNI ILARIONE, RONCÀ







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Verona Civic Museum of Natural History.
Paper files of the Section of Geology and Paleontology

æ.1
THE COLLECTIONS OF THE SERIAL SITE IN THE MUSEUMS OF THE WORLD

ITALY					
REGION	**MUSEUM/INSTITUTE**	**Bolca component**	**Roncà component**	**San Giovanni Ilarione component**	**No collection**
CALABRIA					
	Museo di Paleontologia e Scienze Naturali dell'Aspromonte - Bova	x	x		
CAMPANIA					
	Museo di Paleontologia - Centro Musei delle Scienze Naturali e Fisiche - Università Federico II - Napoli	x			
EMILIA ROMAGNA					
	Museo Capellini - Bologna	x			
	Museo Giardino Sandra Forni - Bologna				x
	Museo Civico di Storia Naturale di Ferrara*	x			
	Museo "Giuseppe Scarabelli" - Imola	x	x		
	Museo di Paleontologia - Università degli studi di Modena e Reggio Emilia	x	x		
	Museo di Paleontologia dell'Università degli studi di Parma*	x			
	Museo civico di Storia naturale di Piacenza				x
FRIULI VENEZIA GIULIA					
	Associazione naturalisti Alvise Comel - Gorizia				x
	Museo Civico di Storia Naturale di Trieste	x			
	Museo friulano di storia naturale - Udine	x	x		
LAZIO					
	Museo Universitario di Scienze della Terra - Roma**	x			
LIGURIA					
	Museo Civico di Storia Naturale Giacomo Doria - Genova	x			
LOMBARDY					
	Civico Museo Archeologico di Arsago Seprio (VA)	x			
	Museo Civico di Scienze Naturali "E. Caffi" di Bergamo	x	x	x	
	Museo civico di scienze naturali di Brescia	x	x		
	Museo di storia naturale di Cremona	x			
	Museo di Storia naturale Jerago con Orago				x
	Museo di Scienze Naturali "Mario Realini" di Malnate (VA)	x			

	Palazzo Ducale di Mantova**	x	x		
	Museo Civico di Storia Naturale di Milano	x			
	Museo Civico di Storia Naturale di Morbegno (SO)	x	x		
	Museo di Storia Naturale dell'Università di Pavia	x	x	x	

MARCHE

	Museo Civico di Storia Naturale di Macerata	x	x		

PIEDMONT

	Museo Paleontologico territoriale dell'Astigiano - Asti**	x			
	Museo Civico di Storia Naturale di Carmagnola (TO)				x
	Museo regionale di Scienze Naturali di Torino	x	x	x	

PUGLIA

	Museo di Scienze della Terra dell'Università degli Studi di Bari Aldo Moro				x
	Museo di storia naturale di Foggia	x			
	Museo Missionario Cinese e di Storia Naturale - Lecce	x			
	Museo Civico della Paleontologia e dell'Uomo - Lizzano (TA)				x

SICILY

	Museo scienze della Terra - Catania	x			
	Museo Civico di Storia Naturale di Comiso	x			
	Museo Geologico G.G. Gemmellaro - Palermo	x			

TUSCANY

	Liceo Classico N. Machiavelli - Lucca	x			
	Museo di Storia Naturale a Firenze	x	x	x	
	Museo di Storia Naturale dell'Università di Pisa	x	x	x	

TRENTINO ALTO ADIGE

	Istituto Salesiano Rainerum di Bolzano**	x			
	Museo di scienze naturali di Bolzano	x			
	Museo del fossile di Brentonico				x
	Fondazione Museo Civico di Rovereto	x	x		

VENETO

	Museo civico di Bassano del Grappa	x	x		
	Museo dei fossili di Bolca	x	x	x	
	Collezione privata Cerato - Bolca	x			

	Museo Geopaleontologico di Camposilvano – Velo V.se		x		
	Museo Padre Aurelio Menin - Chiampo	x	x		
	Museo G. Zannato – Montecchio maggiore	x	x	x	
	Museo civico di Crocetta del Montello "La Terra e l'Uomo"	x			
	Museo di storia naturale e archeologia di Montebelluna	x			
	Museo paleontologico "Michele Gortani" di Portogruaro	x	x		
	Museo della Natura e dell'Uomo dell'Università di Padova	x	x	x	
	Museo paleontologico di Roncà		x		
	Museo Civico Geopaleontologico di San Bonifacio "Abate Don Giuseppe Dalla Tomba"	x	x		
	Museo Paleontologico e dell' Origine del Territorio "Attilio Fedrigo" – Sona (VR)	x	x		
	Museo Civico "Domenico dal Lago" - Vicenza	x	x		
	Museo di storia naturale Giancarlo Ligabue di Venezia	x			
	Museo civico di Storia naturale di Verona	x	x	x	
	Museo naturalistico archeologico di Vicenza	x			
	Museo Madonna di Monte Berico - Vicenza	x	x		
	Museo Villa Godi Malinverni**	x			
	Museo Storico Naturalistico del Seminario Vescovile di Vicenza	x	x	x	
	Museo di Scienze Naturali "A. De Nardi" di Vittorio Veneto	x	x	x	

EUROPE					
COUNTRY	**MUSEUM/INSTITUTE**	**Bolca component**	**Roncà component**	**S.Giovanni Ilarione component**	**No collection**
AUSTRIA					
	Universal museum Joanneum				x
	Tiroler Landesmuseen - Hall in Tirol				x
	Museum Mödling				x
	Museum Niederösterreich				x
	Museum für Natur und Technik - Salzburg				x
	Naturhistorisches Museum Wien	x	x	x	
BELGIUM					
	Institut Royal des sciences naturelles de Belgique*	x			
BULGARIA					
	National Museum of Natural History – Sofia				x
DENMARK					
	Statens Naturhistoriske Museum – Copenhagen*	x			
ESTONIA					
	Natural History Museum, University of Tartu	x	x	x	
FRANCE					
	Muséum des sciences naturelles - Ville d'Angers	x			
	Musée des Confluences	x			
	Musée Vert du Mans*	x			
	Muséum d'histoire Naturelle de Marseille	x			
	Institut des Sciences de l'Évolution de Montpellier	x			
	Muséum d'Histoire Naturelle de Nantes*	x			
	Muséum d'histoire naturelle de Nîmes*	x			
	Muséum national d'histoire naturelle - Paris	x	x	x	
	Muséum d'histoire Naturelle de Toulose		x		
	Requien museum				x
GERMANY					
	Museum für Naturkunde - Berlin*	x			
	Übersee-Museum*	x			
	HessischesLandesmuseum Darmstadt*	x			
	Senckenberg Naturhistorische Sammlungen Dresden	x	x	x	

	Senckenberg Forschungsinstitut und Naturmuseum Frankfurt	x			
	Senckenberg Museum für Naturkunde Görlitz				x
	Staatliches Museum für Naturkunde Karlsruhe	x	x	x	
	Paläontologisches Museum München*	x			
	Staatliches Museum für Naturkunde Stuttgart	x			
	Goethe Nationalmuseum - Weimar*	x			

HUNGARY

	Déri Museum				x
	Janus PannoniusMuzeum				x
	Magyar Természettudományi Múzeum*	x			

MOLDOVA

	National Museum of Ethnography and Natural History - Chișinău**	x			

MONTENEGRO

	Natural History Museum of Montenegro				x

NETHERLANDS

	Naturalis Biodiversity Center	x	x	x	
	Museon-Omniversum				x
	Oertijd Museum	x			
	Natuurhistorisch Museum Rotterdam				x

NORWAY

	University Museum of Bergen				x
	Arctic University Museum of Norway				x

POLAND

	Nature education Centre of Jagiellonian University	x			
	Muzeum Górnośląskie Bytomiu				x
	Upper Silesian Museum				x

PORTUGAL

	Museu Geologico – Laboratorio nacional de Energia e Geologia - Lisbona				x
	Academia das Ciências de Lisboa				x
	Natural history and science museum of the university of Porto	x	x		

ROMANIA

	"GrigoreAntipa" National Museum of Natural History - Bucharest				x
	ȚăriiCrișurilor Museum - Oradea				x
	Natural History Museum Sibiu				x

RUSSIA

	Orlov Paleontological Museum - Moscow**	x			

SLOVAKIA

	Slovak National Museum - Bratislava	x	x		

SLOVENIA

	Prirodoslovni muzej Slovenije - Ljubljana	x			

SPAIN

	Museo Nacional de Ciencias Naturales - Madrid	x	x	x	
	Museo de Ciencias Naturales de la Universidad de Zaragoza				x
	Institut Català de Paleontologia «Miquel Crusafont»*	x			

SWEDEN

	Museum of Evolution of Uppsala University	x	x		
	Naturhistoriska Riksmuseet - Stockholm	x	x		

SWISS

	Muséum d'Histoire Naturelle de Neuchâtel	X			
	Naturhistorisches Museum Bern	x	x	x	
	Naturmuseum Luzern	x			
	Muséum d'histoire naturelle - Geneve	x	x	x	
	Musée d'histoire naturelle Fribourg	x			
	Naturhistorisches Museum Basel	x	x		
	University of Zurich's Paleontological Museum*	x			

UNITED KINGDOM

	Sedgwick Museum of Earth Sciences, University of Cambridge	x	x		
	Bristol Museum & Art Gallery	x			
	Sunderland Museum (Great North Museum)	x			
	Hancock Museum (Great North Museum)	x			
	Kirklees Museums and Galleries				x
	Leicester Museums & Galleries	x			

	World Museum Liverpool	x			
	Natural History Museum of London*	x			
	Hunterian at Kelvin Hall -University of Glasgow	x			
	National museums Scotland	x			
	Manchester Museum	x			
	Oxford University Museum of Natural History	x	x		
	Ulster Museum – National Museums Northern Ireland	x			
	Lapworth Museum of Geology	x			

NORTH AMERICA					
COUNTRY	**MUSEUM/INSTITUTE**	**Bolca component**	**Roncà component**	**S.Giovanni Ilarione component**	**No collection**
CANADA					
	Beaty Biodiversity Museum - University of British Columbia - Vancouver				x
	Glenbow Museum - Calgary				x
	Royal Tyrrell Museum of Palaeontology - Drumheller				x
	Royal Ontario Museum - Toronto*	x			
	Nova Scotia Museum - Halifax				x
	Canadian Museum of Nature - Ottawa				x
	Royal Saskatchewan Museum - Regina				x
	Musee de la nature et des sciences de Sherbrooke				x
	Mcgill university - Redpath museum - Montreal	x			
	University of Waterloo Earth Sciences Museum - Waterloo				x
UNITED STATES					
	Alabama Museum of Natural History - Tuscaloosa				x
	Buena Vista Museum of Natural History & Science - Bakersfield				x
	UC Museum of Paleontology – Berkeley				x
	San Diego Natural History Museum				x
	University of Colorado Museum of Natural History - Boulder				x
	Morrison Natural History Museum				x
	The Charleston Museum				x
	Smithsonian National Museum of Natural History - Washington	x	x		
	Yale Peabody Museum of Natural History – New Haven	x			

	Karl Limper Geology Museum – Oxford (Ohio)				x
	Tellus Science Museum - Cartersville				x
	William P. Wall Museum of Natural History - Milledgeville				x
	Field museum - Chicago	x			
	Chicago Academy of Sciences / Peggy Notebaert Nature Museum				x
	Harvard Museum of Comparative zoology	x	x		
	University of Michigan Museum of Paleontology – An Arbor	x			
	Michigan State University Museum – East Lansing				x
	Science Museum of Minnesota – Saint Paul				x
	Central Methodist University – Fayette (Missouri)				x
	Pahrump Valley Museum and Historical Society - Pahrump				x
	New Mexico Museum of Natural History and Science - Albuquerque				x
	Princeton University Museum*	x			
	New Jersey State Museum - Trenton				x
	Rutgers Geology Museum – New Brunswick				x
	New York State Museum				x
	American museum of Natural History – New York	x			
	Cincinnati Museum Center	x			
	Cleveland museum of Natural History	x			
	University of Oregon Museum of Natural and Cultural History, Condon Fossil Collection - Eugene	x			
	Carnegie Museum of Natural History - Pittsburg	x	x		
	Museum of Geology South Dakota Mines – Rapid City				x
	W. H. Over Museum - Vermillion				x
	Texas Memorial Museum - Austin				x
	Brazos Valley Museum of Natural History - Bryan				x
	Natural History Museum of Utah – Salt Lake City				x
	Virginia Museum of Natural History - Martinsville				x
	Neville Public Museum of Brown County – Green Bay				x
	Fossil Butte National Monument - Wyoming				x
	Wyoming State Museum - Cheyenne				x

SOUTH AMERICA					
COUNTRY	MUSEUM/INSTITUTE	Bolca component	Roncà component	S.Giovanni Ilarione component	No collection
ARGENTINA					
	Museo Municipal De Ciencias Naturales Lorenzo Scaglia – Mar del Plata				x
	Museo Carmen Funes – Plaza Huincul				x
	Museo de Ciencias Naturales y Antropológicas «Prof. Antonio Serrano» - Paranà	x			
	Museum - Universidad Nacional de San Juan – Ciudad de San Juan				x
BRASIL					
	Museu Nacional - UFRJ, Rio de Janeiro				x

OCEANIA					
COUNTRY	MUSEUM/INSTITUTE	Bolca component	Roncà component	S.Giovanni Ilarione component	No collection
AUSTRALIA					
	Australian Museum - Darlinghurst	x			
	South Australian Museum - Adelaide		x		
	Queensland museum – South Brisbane				x
NEW ZEALAND					
	Auckland war memorial museum				x
	Museum of New Zealand Te Papa Tongarewa - Wellington				x

ASIA					
COUNTRY	MUSEUM/INSTITUTE	Bolca component	Roncà component	S.Giovanni Ilarione component	No collection
ARMENIA					
	State Museum of Nature of Armenia - Erevan				x
	Institute of Geological Sciences, Armenian National Academy of Sciences - Erevan				x
IRAN					
	Natural History and Technology Museum of Shiraz				x
OMAN					
	Oman Natural History Museum - Mascate				x
PHILIPPINES					
	National Museum of Natural History –Philippines - Manila				x
TAIWAN					
	National Museum of Natural Science - Taiwan				x

Museum/Institute with fossil collections from the serial site

Museum/Institute without fossil collections from the serial site

* Data not updated, to be integrated based on Jacques Blot's data collection carried out for the 1969 publication

** Data to be integrated, based on reporting



Museum of Fossils in Bolca

æ.2
THE HISTORICAL FOSSILS COLLECTIONS OF BOLCA

Bolca fossils in historical collections

Since the first news of discoveries, the Bolca fossils have been at the center of intense discussions and debates on naturalistic and philosophical themes, aimed at explaining the presence of animals and plants within the rocks. A very rich collection of publications, spanning almost five centuries of history, testifies to the scientific interest and human curiosity towards these fascinating legacies of a distant past, underlining, among other things, the importance and leading role that the Bolca fossils have played a role in the evolution of the process of understanding natural phenomena and in the development of paleontology.
The first known author to give notice of the Bolca fossils was Andrea Mattioli in 1555. In the work "Discorsi sopra Dioscorides" Mattioli cites *"Mr. Don Diego Ultado of Menodozza"* for having shown him some *"stone slabs"* brought by Veronese *" in which (splitting through the middle) various species of fish are found carved with each of their particles conversed in stone"*. The collection of fish from Bolca of Don Diego Hurtado of Mendoza, ambassador for the Emperor Charles V, resident in Venice at the time of his acquaintance with Mattioli, can be considered the first known collection of fossils from this deposit. About fifteen years later, in 1571, there is evidence of the presence of Bolca fossils in another very famous collection: that of the Veronese pharmacist Francesco Calzolari.
The collection that Michele Mercati created in Rome for Pope Sixtus V dates back to 1574, in which fish from the Veronese area are mentioned, most likely attributable to Bolca, while ichthyoliths from this locality appeared in the Bolognese Musaeum metallicum of Ulisse Aldrovandi (1522-1605). In 1600, Ludovico Moscardo continued the museological tradition of Calzolari, establishing his own Museum, which he described in a work published in 1656, where he also illustrated 6 fish from Bolca, classifying two of them, one as Orada and the other as Eel.

If in the 1500 the fossils from Bolca made their appearance in literature and in collections, of which however limited evidence remains, in the second half of the 1600 and in particular in the 1700 and 1800 the collections relating to fossils from Bolca multiplied. The collection of Scipione Maffei (1675-1755) in Verona must have been important, while other examples of collections, also created to examine the nature of fossils and find evidence to support one's theses on their origin, were those of Vallisneri (1661-1730) in Padua or of the archpriest of Grezzana Gian Giacomo Spada.
Distributed within collections present in Italy and abroad, the Bolca finds are starting to spread more and more: first reported in Europe, they will then cross the Atlantic to land in America, within museum collections of the most prestigious institutes and of the major universities.
However, still in 1700 an important group of collectors was found in Verona and, among these, the undoubtedly most important collection was that of the Gazola counts.
Also enriched with specimens given by relatives and friends it will become the Gazola Museum, the contents of which will be entrusted for study to the abbot G. Serafino Volta who in 1796 will publish the work "Ittiolitologia Veronese", a fundamental monograph on fossil fish.
A well-known historical fact, with the arrival of Napoleon's troops in Verona for the Italian campaign, a commissioner in charge confiscated a good part of the finds from the Gazola collection, causing it to flow into the Natural History Museum of Paris in 1798. Gazola was then compensated for this operation and created a second collection of which he then donated some specimens to Napoleon himself.
The remaining collection was acquired by the city of Verona in 1892 and placed in the Civic Museum of Natural History, together with another important collection, that of the paleobotanist Abramo Massalongo, an important scholar of fossil plants from Bolca.

The historical collections of Bolca: method and results

By specifically analyzing the distribution of the Bolca fossils in the historical collections and trying to obtain information on the diffusion of the collections over the centuries, a preliminary bibliographic research was carried out which allowed us to produce the list below, together with a designed map with the open source software Qgis of which some extracts are included. This list was integrated through the information provided by current museums, subsequently contacted for the census. Despite being aware of the bias of the data, due to the enormous amount of publications present on Bolca and the loss of information over time, it was possible to draw a first infographic of the localization of finds from this location in historical collections and collections, based on the information currently known.



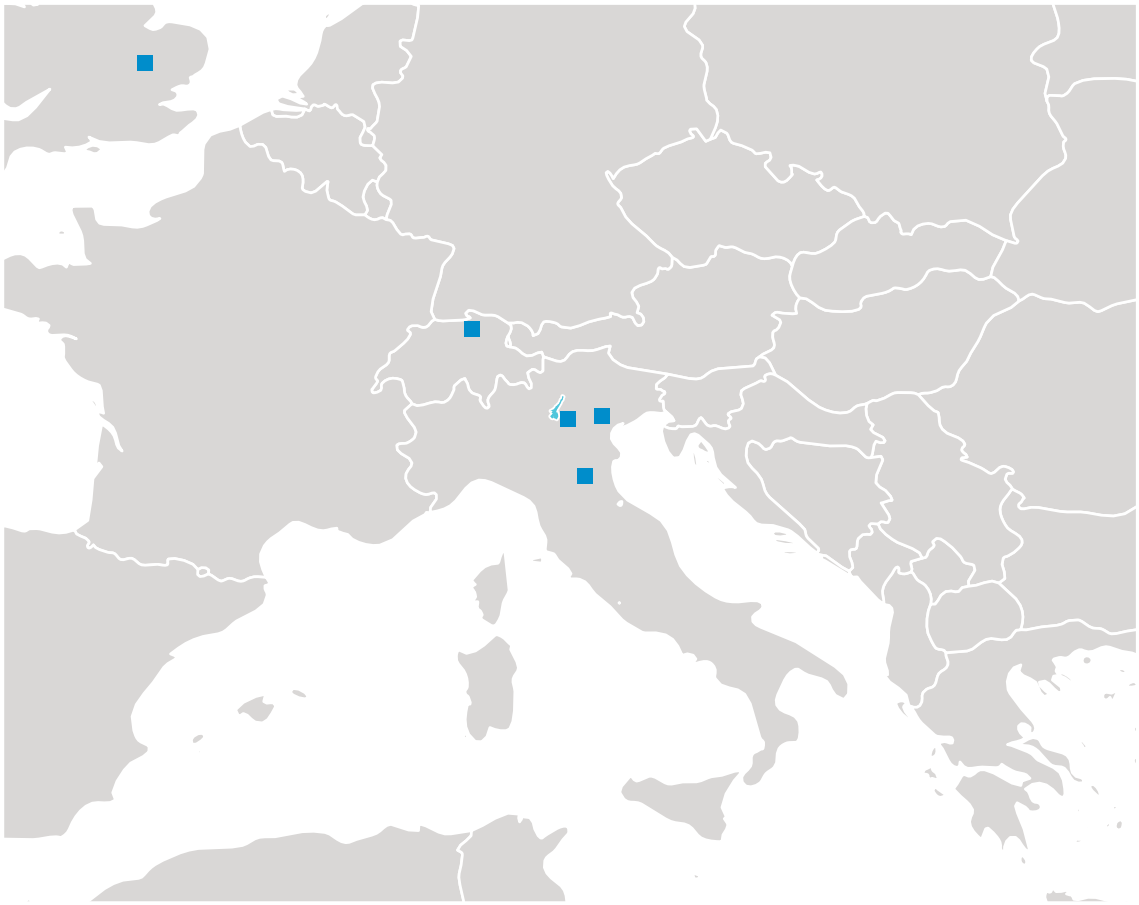
Collection from 1500

Venezia: Don Diego Hurtado di Mendoza collection

Verona: Calzolari collection

Roma: Collezione Mercati – Papa Sisto V collection

Bologna: Musaeum Metallicum of Ulisse Aldrovandi



Collection from 1600

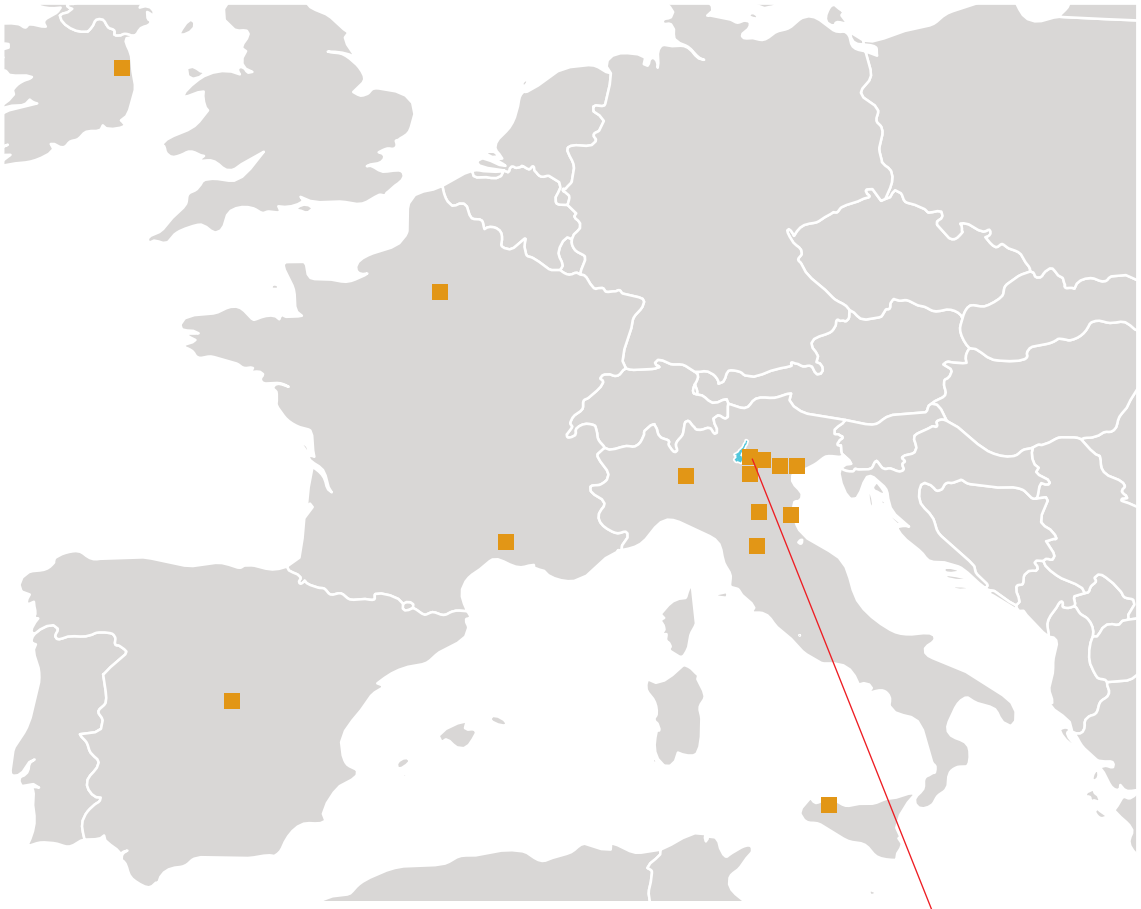
Verona: Museo Moscardo

Padova: Museo Vallisneriano

Bologna: Marsili collection

Zurich: Scheuchzer collection

Cambridge: Woodward collection



Collection from 1700

Bologna: Institute of Bologna, founded by Marsili in 1711. Collects the Aldrovandi collection

Grezzana: Giacomo Spada collection

Verona: Maffe collection, Cavalier Antonio Bianchi collection, Giulio Cesare Moreni collection, Gasparo Bordoni collection, Vincenzo Bozza collection, Rotari collection, Canossa collection, Buri collection, Dionisi collection, Rota collection, Gazola collection

Arzignano: Don Giuliano Serpe collection, Matteo Stacco collection

Padova: Vallisneri collection

Venezia: Zannichelli collection

Pavia: Museo Bellisomiano, Collezione Spallanzani

Firenze: Baillou collection

Ravenna: Museo Ginanni

S.Martino delle Scale, Palermo: Collection of the Monastery di S.Martino delle Scale

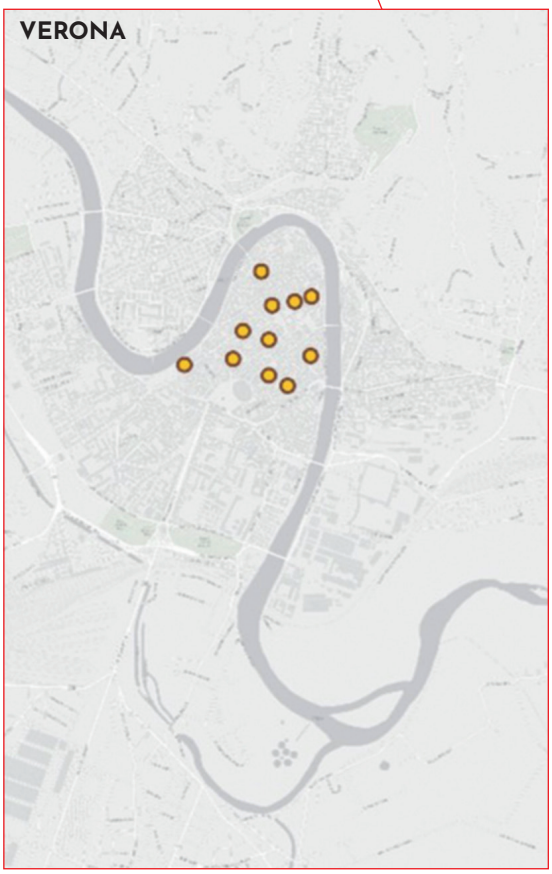
Paris: Davila collection

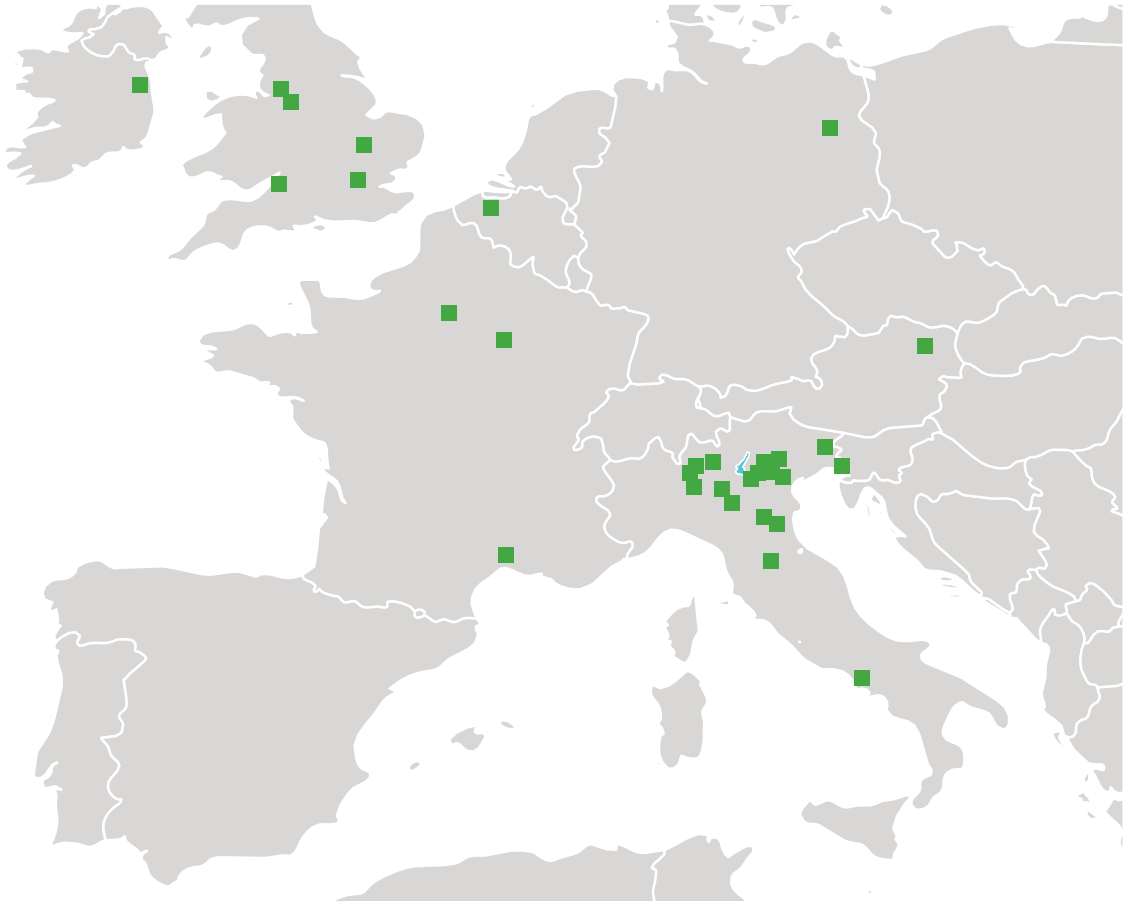
Nimes: Jean-Francois Seguier collection

Madrid: Real Gabinete de Historia Natural

France: M.Galois collection

Dublin: George Graydon collection





Collection from 1800

Pavia: Gabinetto di Pavia

Cremona: Museo Civico di Cremona

Milano: Milano University collection

Bergamo: Paolo Conte Vimercati Sozzi collection

Cinisello: Villa Silva collection

Verona: Gazola and Massalongo collections, Museo Civico di Verona

Vicenza: Biblioteca Bertoliana, Museo Civico di Vicenza

Castelgomberto: Castellini collection

Bassano del Grappa: Parolini, Brocchi collection

Padova: De Zigno collection, Gabinetto di Storia naturale dell'Università di Padova

Trieste: Museo di Storia Naturale di Trieste

Udine: Gabinetto di Storia Naturale Antonio Zanon

Parma: Regia Università di Parma

Bologna: Cappellini collection

Imola: Scarabelli collection

Accademia Valdarnese

Napoli: Museo di Geologia

Dublin: Royal Irish academy

Cheshire: Philip Grey Egerton collection, Lord Cole

Bristol: James Johnson collection

Cambridge: J. Chaning Pearce collection

London: British Museum, Royal College of Surgeons of England

Paris: Muséum national d'Historie naturelle

Troyes: Musée d'art moderne de Troyes

Montpellier: Jules de Christol collection

Gand: Gand University collection

Vienna: Francis I collection, Naturhistorisches Museum

Berlin: Museum für Naturkunde

Yale: Gabinetto del College

Cambridge: Museum of Comparative Zoology

Pittsburgh: Carnegie





Civic Museum of Natural History in Verona

æ.3
LIST OF BOLCA FOSSIL TYPES (HOLOTYPE AND PARATYPE) PRESERVED AT THE CIVIC MUSEUM OF NATURAL HISTORY OF VERONA

VERTEBRATES: FISHES							
HOLOTYPE	NEOTYPE	PARATYPE	TYPE SERIES	SYNTYPE	LECTOTYPE	PARALECTOTYPE	SPECIES
BPGM 14							*"Dentex" microdon*
Placement unknown							*"Dentex" ventralis*
MNHN 10914-10915							*"Labrus" valenciennesi*
MPD 6853-6854							*"Syngnathus" bolcensis*
MPD 6856-6857							*"Syngnathus" heckeli*
MNHN 10944-10945							*"Engraulis" evolans*
MNHN F.Bol567a-b							*"Platyrhina" gigantea*
NHMUK P.9830a-b							*Abdobalistum thyrsus*
MNHN 10784/10785							*Abromoasta microdon*
				MNHN Bol51-Bol52			*Acanthonemus subaureus*
MCZ 5093 NHMUK P 9832							*Acanthopygaeus agassizi*
NHMUK P 9831							*Acanthuroides massalongoi*
MCSNV IG 135601							*Acronuroides eocaenicus*
BPGM 744		MCSNV II P 100; MCSNV T.125-T.126; MBO 1976/I BO; MPD 1056					*Acropoma lepidotum*
MCSNV T.184-T.185							*Aeoliscoides longirostris*
MNHN 10878-10878a							*Amphistium paradoxum*
CMC 39		MCSNV I.C. 2-3; MCSNV I.C. 5					*Angiolinia mirabilis*
MNHN 10952-10953							*Anguilloides branchiostegalis*
MCSNV IG 43390 IG 43391							*Anorevus lorenzonii*
MCSNV IG23596		MCSNV 447; MCSNV T.227-T.228; MCSNV IG145096; MCSNV IG126493					*Apogoniscus pauciradiatus*

MNHN Bol219							*Archaephippus asper*
	MCSNV IG.VR.27607						*Arechia crassicaudata*
MCSNV I.G. VR 61448-61449							*Aspesiganus margaritae*
MCSNV IG24485-T.288		MCSNV IG16842-IG16843					*Aspesiperca ruffoi*
MNHN 10927-10928							*Atherina (?) macrocephala*
NMW 1974 1633 1					MPD 26022		*Aulorhamphus bolcensis*
MPD 6860							*Aulorhamphus capellinii*
MCSNV I.G. VR. 69320 I.G. VR. 69321							*Aulorhamphus chiarasorbiniae*
MNHN Bol00901							*Aulostomoides tyleri*
MNHN 1084							*Auxides propterygius*
MCSNV T.922-T.923							*Bajaichthys elegans*
MCSNV T111-T112		MCSNV T.251-T.252; MCSNV T.448-IG23701; MFB IG129663-IG129664					*Bassanichthys pesciaraensis*
MCSNV IGVR 71214-71215							*Bellwoodilabrus landinii*
BPGM As 773							*Berybolcensis leptacanthus*
MNHN 10868-10869		MNHN 10864-10865; MNHN 10866-10867					*Blochius longirostris*
MPD 156							*Blochius macropterus*
NHMUK P 551-3921							*Blotichthys coleanus*
MCSNV T.434							*Bolcabalistes varii*
NHMUK P.3829a							*Bolcaichthys catopygopterus*
MSNM V 120							*Bolcanguilla brachycephala*
MCSNV IG135659-IG135667		MCSNV IG142556; MCSNV IG43360-IG43404; MCSNV 440-441					*Bolcaperca craccorum*
MCSNV IG135696		MCNSV IG 37596					*Bolcapogon johnsoni*

MCSNV T.941							*Bolcyrus bajai*
MNHN 10958-10959							*Bolcyrus formosissimus*
MCSNV 21.689-21.690							*Bradyurus alessandroi*
MPD 6898							*Bradyurus szajnochae*
Placement unknown							*Calamostoma lesiniforme*
					MNHN 10822-10823a	MCSNV T.118	*Callipteryx speciosus*
MPD 8807-8808		MCSNV VI A.55 – VI A.56					*Carangodes bicornis*
MNHN 10892-10893							*Carangopsis brevis*
MNHN 10896-10897							*Carangopsis dorsalis*
MCSNV IGVR71187							*Carlomonnius quasigobius*
MNHN Bol42/43							*Caruso brachysomus*
MNHN 10766-10767							*Ceratoichthys pinnatiformis*
MNHN Bol 0077/0078							*Chanoides macropoma*
NMW 3408							*Chanos forcipatus*
MNHN 10943							*Coelogaster leptostea*
MNHN 10711-10712			NHMUK P1927b-39050; NHMUK P1926-P3903; MPD 25104-25105; MCSNV IIP81 – IIP82; MCSNV II P93-IIP94				*Cyclopoma gigas*
MPD 8848-8849							*Dalpiazella brevicauda*
MCSNV VR.21.107 VR 21.108							*Dasyomyliobatis thomyorkei*
MNHN 10855-10856							*Ductor vestenae*
MCZ							*Eastmanalepes primaevus*
NHMUK P1938/3900							*Ellaserrata monksi*
MNHN Bol475							*Eoalosa janvieri*

MNHN 10949-10950							*Eoanguilla leptoptera*
MCSNV T.924							*Eoantigonia veronensis*
MCSNV T423-IG24554		MCSNV IG43426-IG43427; MCSNV IG23697					*Eoapogon fraseri*
MNHN 10920							*Eoaulostomus bolcensis*
MNHN 10921-10922							*Eoaulostomus gracilis*
BPGM As I 68							*Eobothus minimus*
MCSNV T.298-T.303							*Eocoris bloti*
MNHN 10916							*Eocottus veronensis*
MCSNV IG.23695							*Eoellimmichthys superstes*
MCSNV T.54							*Eoengraulis fasoloi*
MCSNV T.311							*Eogaleus bolcensis*
MNHN 10737P			MNHN 10738; MNHN 10737; MPD 8669; MSNT TO1				*Eoholocentrum macrocephalum*
MCSNV T.6-T.7							*Eolactoria sorbinii*
MNHN 10695-10696			MCSNV I.G.23151-I. G23152; NHMUK P1913b; MPD 14-15; MSNM V102				*Eolates gracilis*
	MCSNV T.94-T.95						*Eoleiognathus dorsalis*
MCSNV B.65.13							*Eophryne barbutii*
MNHN Bol92 - Bol93							*Eoplatax papilio*
MPD 8873C-8874C							*Eoplatyrhina bolcensis*
MCSNV IG 23203 IG 23204							*Eoplectus bloti*
MCSNV VIII C 58 VIII C 59							*Eorandallius elegans*
MNHN Bol15-Bol16							*Eorandallius rectifrons*

MPD 26278							*Eorhinobatos primaevus*
MNHN 10751-10751a		MCSNV VIII C 62-VIII C 63					*Eoscatophagus frontalis*
MNHN Bol34							*Eosphaeramia pygopterus*
MPD 6890-6891							*Eotetraodon pygmaeus*
MCSNV IGVR 81994							*Eotetraodon tavernei*
MNHN Bol4 - Bol5							*Eozanclus brevirostris*
				MNHN Bol385-Bol386			*Exellia velifer*
MCSNV VII C 19-20							*Fistularioides phyllolepis*
MNHN 11101-11102							*Fistularioides veronensis*
NHMUK P 16821							*Foreyichthys bolcensis*
MCSNV T.445-IG23696							*Frigoichthys margaritae*
MCSNV IG 24490 IG 24491							*Frigosorbinia baldwinae*
MCSNV T 187		MCSNV IG 23594-IG 23595; MCSNV IG 43395- IG 43396					*Frippia labroiformis*
MNHN Bol516							*Galeorhinus cuvieri*
MCSNV B 65 14							*Gazolaichthys vestenanovae*
MCSNV VII A 20 VII A 20 bis							*Gazolapodus homopterus*
MNHN Bol12 - Bol13							*Gillidia antiqua*
MCSNV T.381-T.382							*Gilmourella minuta*
				MNHN Bol72 - Bol73; MNHN Bol312-Bol313			*Godsilia lanceolata*
MNHN Bol40 – Bol41							*Goslinophis acuticaudus*
MNHN Bol8/9							*Goujetia crassispina*
	MCSNV T1044						*Guus microcephalus*
MPD 8866							*Hemiramphus edwardsi*

FMNH PF 3456		MCSNV T.424-IG 24555; MCSNV I.G. 186677					*Hendrixella grandei*
NMW 1853. XXVII.6a-6b							*Heptadiodon echinus*
NMW 1974.1639.25 - 1974.1639.24							*Heteronectes chaneti*
MPD 68487							*Histionotophorus bassani*
MNHN Bol175							*Holosteus esocinus*
					MNHN Bol532/533		*Jimtylerius temnopterus*
NHMUK P9836							*Jurgensenichthys elongatus*
PIN 5540/1		MCSNV IG 23214; MCSNV IG 145095					*Labrobolcus giorgioi*
MSNM V6060a/b		MNHN Bol3					*Latellagnathus teruzzii*
MCSNV B.65-12							*Latellopsis latellai*
MCSNV T.421-IG 24552							*Lehmanichthys lessiniensis*
CMNH 4228-4519		MCSNV IGVR66619-IGVR66620					*Leptolumamia vetula*
MCSNV IGVR 71613							*Lessinia horrenda*
MNHN Bol566		MSNFI IGF 103555; MFSN GP.864					*Lessiniabatis aenigmatica*
MPD 8766							*Lichia veronensis*
MCSNV T 430							*Lorenzichthys olihan*
MCSNV VII A 20-20bis							*Macroaulostomus veronensis*
Placement unknown							*Malacopygaeus*
MCSNV VIII D 200 VIII D 201							*Massalongius gazolai*
MNHN 10890-10891							*Mene oblonga*
					BPGM 24		*Mene rhombea*
					MNHN ?		*Mesogaster sphyraenoides*
MCSNV T.3							*Metacanthurus veronensis*
MSNM V 71							*Metaspisurus emmanueli*

MSNM V 131		NHMUK P8951					*Milananguilla lehmani*
MNHN Bol288-Bol285							*Monopteros gigas*
MCSNV 9F/24							*Montepostalia annamariae*
CMC 3							*Neilpeartia ceratoi*
MCSNV I.G. VR. 66660 I.G. VR. 66661							*Nickcaves pterygocephalus*
MCSNV II. D. 172-173							*Nursallia veronae*
MPD							*Oncolepis isseli*
MCSNV T.156-T.157							*Ophidium voltianum*
MCSNV T.160-T.161		MCSNV T.164-T.165					*Orrichthys longimanus*
MNHN Bol14a/14b							*Ottaviania leptacanthus*
MCSNV T.925							*Ottaviania mariae*
MPD 11405-11406							*Padovathurus gaudryi*
MNHN Bol0523							*Palaeobalistum orbiculatum*
MCSNV IG 23692		NHMUK P. 5 126					*Palaeopomacentrum orphae*
MCSNV IG VR 67499/67500		MCSNV VIII.B.28/29					*Palaeorhynchus zorzini*
NMW 1855 VI 70 1855 VI 69							*Paracongroides heckeli*
MCSNV IG 23688							*Paraeoliscus robinetae*
MCSNV VR 27624							*Paralabrus rossiae*
MPD 6883							*Paramphisile weileri*
MNHN 10962-10963							*Paranguilla tigrina*
MNHN Bol70/71							*Parapelates quindecimalis*
MNHN 1955 I 249							*Parapygaeus polyacanthus*
MNHN 10926							*Parasynarcualis longirostris*
MNHN Bol407-Bol408							*Paratrachinotus tenuiceps*

MPD 9153							*Patavichthys bolcensis*
MCSNV 21.702-21.703							*Pavarottia astescalpone*
AMNH 9529		MCSNV T99-T100					*Pavarottia maiseyi*
MCSNV IGVR71259							*Pavarottia lonardonii*
MNHN Bol65-Bol66,							*Pegasus volans*
MCSNV I.G. VR. 71873							*Pesciarhamphus carnevalei*
MCSNV T.13-IG 23197							*Pesciarichthys punctatus*
MCSNV T.149-T.150							*Phyllopharyngodon longipinnis*
MCSNV I.G. VR. 66741							*Pietschellus aenigmaticus*
MNHN 10964-10965							*Platinx macropterus*
MPD 154Z							*Plesiozonobatus egertoni*
MNHN Bol529							*Pristigenys substriata*
NHMUK P 16130-17020							*Proacanthurus bonatoi*
MCSNV B 47							*Proacanthurus elongatus*
					NMS 1863 4 102 A-B		*Proacanthurus ovalis*
MNHN Bol0044-0045							*Proacanthurus tenuis*
					MNHN Bol59-Bol60		*Proaracana dubia*
NHMUK P 3873							*Prodiodon erinaceus*
MNHN LP 10976-10977							*Prodiodon tenuispinus*
MCSNV VII.B.90 - VII.B.91							*Promyliobatis gazolai*
MCSNV IG37597							*Prosolenostomus lessinii*
MHNN 002							*Protacanthodes nimesensis*
MPD 10901-10902							*Protacanthodes ombonii*
CTH 8384 – 8385							*Proteomyrus ventralis*
MCSNV T.21 – T.22							*Protobalistum imperiale*

NHMUK 36877							*Protoaulopsis bolcensis*
MCSNV I.G.24549-24550							*Protozebrasoma bloti*
MNHN 10786							*Psettopsis subarcuatus*
				MNHN Bol102 - Bol517			*Pseudauxides speciosus*
NMW 1853.XVII.4							*Pseudorhinobatos dezignii*
MNHN 10729/10730							*Pseudosparnodus microstomus*
MNHN 10983-10984							*Pseudosyngnathus opisthopterus*
MNHN Bol0090-0091							*Pterygocephalus paradoxus*
				MNHN Bol94 – Bol95			*Pycnodus apodus*
MNHN Bol520 - Bol515							*Pygaeus bolcanus*
CTH 8374-8375							*Pygaeus nobilis*
Placement unknown							*Pygaeus nuchalis*
MCSNV T.253-T.254		MCSNV S61-S62; MCSNV S64-S65					*Quasicichla mucistonaver*
MCSNV I.G.142538		MCSNV II P.64; MCSNV S.2; MCSNV T.463-464, MCSNV II P.53-54					*Quasimullus sorbinii*
MCSNV IG 91152							*Quasinectes durello*
MSNM V294							*Rhamphexocoetus volans*
					MNHN Bol10		*Rhamphognathus paralepoides*
MPD 8879-8880							*Rhamphosus biserratus*
MCSNV VII C.13-14		MCSNV VII C.15-16					*Rhamphosus bloti*
MCSNV T.1004-T.1005		CNHM 5328					*Rhamphosus brevirostris*
MCSNV IG.24560-T.429		MCSNV B.6; CMC 15; MCSNV IG.24483; MCSNV IG.186655-186656t; MCSNV T.1000-1001 MPD 8730-8731; CNHM 4213-4213a; CNHM 5310-5310; NHMUK P.9834-14400					*Rhamphosus longispinatus*

	MCSNV T.286						*Rhamphosus rastrum*
CNHM 4227-5312							*Rhamphosus tubulirostris*
MCSNV IG VR 71980/71981							*Robertannia sorbiniorum*
MCSNV IG 132595-132596		MCSNV II B 65					*Ruffoichthys bannikovi*
MCSNV T.920							*Ruffoichthys spinosus*
MNHN 10839-10840							*Seriola prisca*
MNHN Bol38-39							*Sharfia mirabilis*
NMW 1853.XXVII.3							*Solenorhynchus elegans*
MCSNV I.G.186665							*Sorbinia caudopunctata*
MCSNV VR. 27634 VR. 27635		MCSNV VIII.C9- VIII C.10					*Sorbinicapros sorbiniorum*
MCSNV IG135613/91149							*Sorbinichromis francescoi*
PIMUZ A/I 2488		NMW 1843.XXV.4a-b					*Sorbiniperca scheuchzeri*
MCSNV 524							*Sorbinithurus sorbinii*
		MNHN 10803-10804					*Sparnodus elongatus*
MNHN 10796/10797							*Sparnodus vulgaris*
MNHN 11012-11013							*Sphyraena bolcensis*
MNHN LP 10918							*Spinacanthus cuneiformis*
MCSNV IGVR 71178/71179							*Squamibolcoides minciottii*
MFB IG186670/ IG186671		CMNH 4356					*Stefanichthys mariannae*
NHMUK P11170 a-b							*Synhypuralis banisteri*
MNHN 11094-11095							*Synhypuralis jurgenseni*
MCSNV T.158-T.159		MCSNV T371; MCSNV T492; MCSNV T281; MCSNV B28/29					*Tarkus squirei*
MCSNV T.17							*Tauichthys aspesae*

MPM 4							*Tauichthys padremenini*
MPD 6928-6929			MCSNV T.456-T.457; MCSNV T.451-T.452; MCSNV IG 24492; NHMUK P 19062				*Tenuicentrum lanceolatum*
MNHN Bol564							*Tethytrygon muricatus*
MPD 8839-8840							*Thrissopterus catullii*
				MNHN Bol537, Bol538			*Thunnoscomberoides bolcensis*
MCSNV IG.135576							*Titanonarke megapterygia*
MPD 26275/6							*Titanonarke molini*
MCSNV T.927-T.928							*Tortonesia esilis*
MCSNV V D 96-V D 97							*Trachicaranx pleuronectifomes*
MSNM V2890a/b		NHMUK OR 37227; MSNM V235; MCSNV IG.VR.24388; MCSNV IG.VR.132573/132574; MCSNV IG.VR.81999/82000; MCSNV. IG.VR.82193/82194					*Trollichthys bolcensis*
WNMNH 023484							*Tyleria necopinata*
NHMUK P 19058-19059							*Tylerichthys milani*
MNHN Bol53-Bol54							*Tylerichthys nuchalis*
MNHN 10923							*Urosphen dubius*
					MNHN Bol275	MNHN Bol24	*Veranichthys ventralis*
					MNHN Bol530/531		*Veronabrax schizurus*
MCSNV B 46							*Veronanguilla ruffoi*
MCSNV VI.A.24		MCSNV VI.N.27					*Veronaphleges brunae*
	MCSNV T.18						*Veronarhamphus canossae*

MCSNV I.G. 37576 I.G. 37577							*Veronavelifer sorbinii*
MNHN 10947-10948			MCSNV T74-T75; NHMUK P1889-P3875				*Voltaconger latispinus*
MCSNV VI.A.35		MCSNV T.222; MCSNV I.G.16834					*Voltamulloides ceratorum*
MNHN Bol413-Bol414							*Vomeropsis triurus*
MCSNV V.D.110 MPD 6852							*Wettonius angeloi*
MNHN Bol0031-0032							*Whitapodus breviculus*
MNHN Bol544a - Bol544b							*Xiphopterus falcatus*
MCSNV 22.285-22.286							*Zaiaichthys postalensis*
MFB IG129669/ IG129670		MCSNV IG126426					*Zaiaichthys watersi*
MPD 6894							*Zignodon fornasieroae*
MPD 6789							*Zignoichthys oblungus*
MCSNV I.G. VR 57597/57596		MCSNV I.G. VR 16856/16857; MCSNV I.G. VR 145296					*Zorzinia postalensis*
MCSNV T.289-I.G.24486							*Zorzinichthys annae*
MCSNV T.1042							*Zorzinilabrus furcatus*

VERTEBRATES: REPTILES						
HOLOTYPE	NEOTYPE	PARATYPE	SYNTYPE	LECTOTYPE	PARALECTOTYPE	SPECIES
MPD 6810Z						*Neochelys capellinii*
MNB 19021357						*Archaeophis proavus*
MCZ 1001, 1002, 1003						*Anomalophis bolcensis*

INVERTEBRATES : ANNELIDS						
HOLOTYPE	NEOTYPE	PARATYPE	SYNTYPE	LECTOTYPE	PARALECTOTYPE	SPECIES
MCSNV V.B.5-V.B.6						*Eunicites gazolae*
MPD 9148-9147						*Eunicites affinis*
MSNM i 10478		MPD 91790				*Eunicites pinnai*
MCSNV V.B.1 – V.B.2		MPD 6806-6807				*Siphonostomites hesionoides*
INVERTEBRATES : CRUSTACEANS						
HOLOTYPE	NEOTYPE	PARATYPE	TYPE SERIES	LECTOTYPE	PARALECTOTYPE	SPECIES
MSNM i4563a, b		MSNM i4564; MCSNV 103–104				*Archaeocypoda veronensis*
MCSNV B4-B5						*Bolcacalliax eocenica*
MCSNV M1-M2						*Enoplonotus armatus*
				MCSNV 23-90bis	MCSNV 24; MCSNV 25-25bis; MCSNV 93-93bis; MCSNV Cr 57-92; MCSNV 94-MSNM i22867	*Eolinurus desmaresti*
MCSNV Cr13-14						*Dynamenella veronensis*
MSNVE 6298		MCSNV M 02; MCSNV M 18; MCSNV Cr17; MCSNV B17-17bis; MCSNV 20; MCSNV 23B; MFB IG 132590-132605; MPD 7445- 7446				*Justitia confusa*
MCSNV 95						*Lessinoachela scaligera*

	MCSNV 50-50bis					*Lysiosquilla antiqua*
				MPD 6793-6803	MCSNV Cr 51-52; MNHN 18	*Lophopanopeus bolcensis*
MCSNV 8			MPD 6800, MPD 6801; MSNM i4565-4566; MCSNV NS Cr 1; MCSNV 2-2bis; MCSNV 3; MCSNV 6-6bis: MCSNV 9;MCSNV 11; MCSNV 12; MCSNV 15; MCSNV Cr 7; MCSNV Cr 13			*?Macropipus ovalipes*
MCSNV 13						*Cirolana acuticauda*
MCSNV 135576A						*Cirolana titanophila*
MNB MB.A 88						*?Parsacus cristatus*
MCSNV 100-100bis			MCSNV F2; MCSNV M01; MCSNV M04; MCSNV 110, MCSNV 112-112bis; MCSNV 114; MPD 6794-6797; MPD 10.094			*Penaeus bolcensis*
MCSNV 106			MCSNV 101-101bis: MCSNV 102-102bis; MCSNV 104; MCSNV 105; MCSNV 111-111bis; MCSNV 113; MCSNV 115; MCSNV 118; MCSNV 120; MCSNV 121; MCSNV 122			*?Penaeus obtusus*
MCSNV 103			MCSNV B 11; MCSNV 108; MCSNV 109			*?Pseudobombur nummuliticus*
MCSNV IGVR 67497-67291						*Pseudosquilla lessinea*
MCSNV 69353						*Scyllarides bolcensis*
INVERTEBRATES : INSECTS						
HOLOTYPE	NEOTYPE	PARATYPE	SYNTYPE	LECTOTYPE	PARALECTOTYPE	SPECIES
MCSNV I.G.132602						*Bolcacordulia paradoxa*
MCSNV i.B.16 - MFB I.G. 24566						*Bolcathemis nervosa*
MCSNV I.G. 37582/37583		MCSNV i.B.5-i.B.6; MCSNV i.B.1; MCSNV i.B.15				*Bolcathore colorata*

MCSNV IG 24517 IG 24516						*Gryllotalpa tridactylina*
MCSNV IG 24526 IG 24527						*Halobates ruffoi*
INVERTEBRATES : JELLYFISHES						
HOLOTYPE	NEOTYPE	PARATYPE	SYNTYPE	LECTOTYPE	PARALECTOTYPE	SPECIES
MCSNV m.B.2		MCSNV m.B.1				*Simplicibranchia bolcensis*

ABBREVIATION

AMNH = American Museum of Natural History
BPGM = Bayerische staatssammlung fur Palaontologie und Historische Geologie Munchen
CMC = Collezione Massimo Cerato, Bolca, Vestenanova (VR)
CNHM = Carnegie Museum of Natural History
CTH = Cabinet Teyler Haarlem
FMNH = Field Museum, Chicago
MBO= Museo Giovanni Capellini Bologna
MCSNV = Museo Civico di Storia Naturale di Verona
MCZ = Museum Comparative Zoology
MFB = Museo dei Fossili di Bolca, Vestenanova (VR)
MHNN = Museum d'Histoire Naturelle Nimes
MNB = Museum für Naturkunde Berlin
MNHN = Museum National d'Histoire Naturelle, Paris
MPD = Museo della Natura e dell'Uomo di Padova
MPM = Museo Padre Aurelio Menin, Chiampo (VI)
MSNF = Museo Friulano di Storia Naturale di Udine
MSNFI = Museo di Storia Naturale dell'Università di Firenze
MSNM = Museo civico di Storia Naturale di Milano
MSNT= Museo Regionale di Scienze Naturali di Torino
MSNVE=Museo di Storia Naturale di Venezia
NHMUK = Natural History Museum, London
NMS= National Museum of Scotland
NMW= Naturhistorisches Museum Wien
PIMUZ= Palaontologisches Museum der Universitat Zurich
PIN = Orlov Paleontological Museum
WNMNH = Washington National Museum of Natural History

æ.4
EXCAVATION, RESTORATION, STUDY AND ENHANCEMENT

1. Excavation techniques in Bolca and Roncà

Fossils are a hidden heritage, which remains invisible until they are identified and brought to light in ways that preserve their integrity.
In the upper Val d'Alpone and, in particular for the Bolca area, the role of the Cerato family has been fundamental in this action of recognition and extraction for centuries. Historic owner family with various properties in the Bolca area and profound knowledge of the territory, who for over 200 years have passed down the skills of fossil extraction orally, a skill that over time has become a real art, respectful of the environment. The most traditional way to investigate any fossiliferous deposit would be to approach it directly on the surface to dig upstream and in depth until reaching the fossiliferous level: practically as one would operate in an open-air rock quarry.
The Cerato family, however, has always worked differently, rejecting an invasive and destructive approach towards the mountain, preferring the much more complex tunnel excavation (Sorbini, 1972; Cerato, 2011). This is also an aspect that makes the site a unique example in the world of paleontological method and practice.
The Cerato excavations were preferably conducted in winter (to avoid the problems linked to water infiltration typical of the spring, summer and autumn periods) using methods proven by experience, respectful of the environment and effective in their results. Begun in the nineteenth century, they are the only ones of which we have certain and continuous information. In fact, they continued until the end of the 1930s when the change in national legislation has defined that the fossils found on Italian soil are property of the State. Finally, in 1988 all their researches, excavation and fossil extraction activities were blocked due to the new regulation of concession criteria by the Ministry of Cultural Heritage. Only in 1999 the Civic Museum of Natural History of Verona did resume excavations on the slope along the southern part of Monte Postale. Over the years, excavations on Monte Postale have involved three open-air sites, two upstream of the roads leading to Pesciara and one downstream (2019). As far as Pesciara is concerned, in 2004 the area of future excavations was identified at the head of a small valley located at the north-eastern top of the historical deposit. In this position a bank of laminated limestone emerged, approximately 150 cm long and made up of 13 layers; and it is precisely at this point that the opening work on a new tunnel began in 2005 (Zorzin, 2016; Zorzin *et al.*, 2022). The excavation in Pesciara is to date the only paleontological excavation in Europe and perhaps in the world, carried out completely in an artificial tunnel: this aspect also makes the area nominated to become a UNESCO World Heritage Site an international excellence. The sole owner of the two excavation concessions (Pesciara and Monte Postale) is the Civic Museum of Natural History of Verona, currently renewed until 2024 and under the direction of Roberto Zorzin.
As regards the paleontological excavations launched by the Municipality of Roncà (Paleontological Museum of Roncà), these have been active since 2010 and, over time, have involved two main locations: Monte Duello and Valle della Chiesa. Since 2019 the excavations have only affected the Valle della Chiesa area and are conducted under the scientific direction of Roberto Zorzin.
In conjunction with the excavation work or shortly beforehand, the geological, stratigraphic and morphological survey of the surrounding area is carried out or updated if it is a deposit already investigated. The survey is carried out on vector computer support for the creation of a GIS. The thicknesses of the various layers are numbered and measured, rock samples of the stratigraphic succession are taken, and the excavation journal is drawn up.
Each operation is recorded, and each specimen found is cataloged and marked with an identification code. From the point of view of the extraction technique, in order to be able to work easily in the opening of the plates/layers within which the fossils are found, it is necessary to separate each individual layer into blocks of 45-50 cm on each side.







Above: Use of micro-engravers to verify the presence of the fossil

Above left: Paleontological excavation on Monte Duello

Next to: Excavation on Monte Postale

For this intervention, perforating hammers, wedgesand mallets of various shapes and weights are used. The various blocks of rock extracted are carefully observed in section and at the surfaces of the lower/upper layer and in section to verify the presence of fossil remains within the rock. At this point begins, with the use of a small hammer and a particular technique, the dense "staking" along the sectional plates which determines their opening. We proceed with this technique until the initial block is reduced into slabs with a surface area of a few cm^2 and a thickness of a few mm. In the case of the discovery of a fossil remains, depending on the needs, to streamline and facilitate the extraction and initial restoration operations of the find, it is possible touse micro-engravers and field microscopes. As far as regards the excavation methodologies, these depend on the type of intervention you intend to carry out. The different methods adopted by the Civic Museum of Natural History of Verona included both the extraction techniques used and tested for centuries by the Cerato family, and the most modern excavation methodologies; all of these depend on the geomechanical characteristics of the extracted lithotypes, as well as the position of the layers and the density and spatial arrangement of the fractures.

2. The recovery of fossils



The discovery and recovery of fossil remains can occur by chance or following planned research and scientific projects (universities, museums, etc.). In the first case, the discovery of a fossiliferous site can also occur during the most common anthropic activities (excavations to build roads, foundations of buildings, etc.), or during quarrying activity.
Before addressing this topic, it seems appropriate to clarify that the fossils that we commonly see lined up in museum showcases were, in most cases, incorporated into the rock. On the surface they may not have been visible or just appeared as vague hieroglyphics that only the expert eye of the paleontologist recognizes. In most cases, fossil isolation and restoration must be carried out in an equipped laboratory and by qualified personnel.

The most important operations that precede the recovery of paleontological material can be summarized:

a. to survey of the positions of the layers and of the fossil (using a geologist's compass) and correct positioning of the same in the stratigraphic succession (numbering of the layers);
b. drawing and/or photographs of the find;
c. to dig carefully, first around the fossil to free it as much as possible from the rock that encases it;
d. marking of any fragments that make up the fossil so as to be able to carry out a good recomposition of the same once returned to the laboratory.

Based on the different type of matrix that incorporates the fossils, the extraction operations will be carried out using the most suitable excavation equipment. In the presence of very compact and hard rocks (limestone, dolomite and sandstone) more or less powerful mechanical means will be used, generally hammers, mallets and chisels of various shapes and sizes, wedges, demolishers, percussion drills, etc.
Only in particular cases and work phases can bulldozers or small excavators be used.

If the paleontological material is contained in soft and inconsistent rocks (clays, marls), in addition to small chisels, shovels, trowels, spatulas and brushes can also be used. Among the field equipment you cannot miss a good magnifying glass, glues of various types, paper and nylon bags for packing the finds, indelible markers, labels indicating the location and other useful information (age of the rock, layer



The most common equipment used in fossil extraction operations

of discovery, date) and a field notebook where you can make a sketch of the area where the fossils were found and write down all the useful information.
In some particular cases (large, fragile and poorly preserved fossils), the recovery of the paleontological material can only take place after wrapping the find using a "gypsum jacket" or expanded polyurethane. The use of these substances, in addition to having the aim of preventing the fossil from crumbling during the extraction phases, also allows for the safe transport of the find from the discovery area to the laboratory equipped for restoration.
Depending on the weight and size of the fossil to be recovered, the journey from the site to the vehicle can take place with a specially made "stretcher".

3. Open-air excavation

This excavation technique is applied in all the deposits in the Val d'Alpone (Monte Postale, Valle della Chiesa, Monte Duello), except in the Pesciara di Bolca as the excavation takes place in tunnels. Generally, before starting the actual work, the intervention area is delimited with electro-welded square metal mesh (generally 15 cm on each side) and/or with orange plastic construction site mesh.
Signs relating to safety regulations are positioned at the entrance to the excavation area and inside it. Only at this point is the soil covering the rocky outcrops identified by the geological surveys removed.
This operation takes place, depending on the case, using a mechanical excavator or manually and, usually, on a limited surface.
The excavation takes place by proceeding from top to bottom, isolating and lifting the rock layers with the utmost attention.
To progress in depth, it is always important to exploit the natural fracturing of the rock mass and, alternatively, make a series of aligned, vertical holes, with a depth at least equal to the thickness of the layer you intend to extract and a length of at least 50 cm.
Subsequently, by operating with wedges inserted into the holes, the rock block is isolated. At the end of the excavation campaign, it will be appropriate to close the area by adopting the most appropriate means for the location and type of excavation.
In the case of Monte Postale, for example, non-woven fabric sheets are spread over the entire excavation bottom surface and the pit is then filled with the resulting debris material.
On the rocky walls that are created as the excavation proceeds, electro-welded nets with 10-15 cm mesh are positioned, fixed with a series of fixings. These operations are essential to prevent any illegal excavations from occurring during the months of interruption of the works. In subsequent campaigns it will be necessary, from time to time, to remove the electro-welded mesh and loose debris material (generally a few cubic metres) and resume excavation operations.



4. Tunnel excavation

Tunnel excavation involves very specific operations, in a closed and limited-sized environment. Due to its particularity (no other official paleontological excavations carried out in tunnels are known), the excavation in Pesciara represents one of the peculiarities of the candidate area.
Excavation operations are always preceded by the safety of the construction site which involves:

1. careful blasting of the rock walls present along the access road to the tunnels;
2. verification of the "health" status of the valance installed on the wall above the tunnel entrance;
3. checking the crack meters located outside and inside the tunnel.

In tunnel excavation it is essential to use a technique, now tested for centuries and peculiar to the tradition of the Cerato family, which involves excavation by hand, carried out using levers, mallets, and iron wedges, as well as hammers and small chisels for opening the tunnels. millimetric layers.
Only in a few specific situations is the drill used. The historical excavations conducted by the Ceratos were carried out in winter (when there is a significant slowdown in agricultural work), while the excavation campaigns of the Verona Museum today take place starting from the end of summer and continue until December and, in some case even further. The excavation begins with the removal (for approximately 20 cm of depth, and for a lengthdepending on the natural fracturing (usually a few decimetres), of a thin marly horizon which is found at the roof of the fossiliferous laminated layers. Once this soft horizon has been removed, we then proceed to lift the first isolated block of rock with one or more cutting chisels, and we proceed in this way, horizontally for the entire section of the excavation and vertically for the thickness of the rolled bench. within the mountainous relief a tunnel is created whose vault, depending on the width and density of the fractures that intersect the rocky massif, needs to be made safe.

This occurs through the construction of reinforced concrete columns and concrete beams of connection. Given the limited volumes excavated in the individual excavation campaigns (on average less than 2 m^3 of rocklaminate) there is no need to create the columns during the excavation operations. These are designed at the end of the works and built during the following spring.
In the rare dangerous situations that may arise, the work in progress is made safe by positioning one or more chestnut supports of adequate diameter, which will later be replaced by creating a reinforced concrete column. It is customary to use chestnut supports since this wood is particularly resistant to compression and at the same time "flexible" since, in the case of some small sagging/ settling of the vault, it produces clear creaks which anticipate in time the possible sagging/ collapse of the tunnel roof. To verify even the smallest movements of the rock layers of the vault and walls, in correspondence with open fractures, crack meters are used, positioned in the most critical points, which are periodically monitored.

Previous page: Locality Costo (Valle della Chiesa): open-air excavation carried out in 2023
Below: Pesciara: tunnel excavation



5. The restoration of fossils

Most of the fossils collected during paleontological excavations require more or less thorough cleaning to remove the matrix that still covers them. In the cleaning and/or roughing phases of the sample, depending on the type of rock that still incorporates the fossil (limestone, marly limestone, marl), hammers and chisels of various shapes and sizes can be used, generally much lighter than those used during excavation operations. The use of an electric vibropen to speed up preparation times can be very useful. Once the roughing phase is concluded, the finishing phase begins; in this second and delicate phase, the cleaning operations are often carried out with the aid of a stereo microscope, using light tools (sturdy needles, small flat-tipped chisels, blades). The stereo microscope is a necessary tool for examining fossils in detail and for facilitating micro-interventions for their restoration and cleaning. During these operations it may be necessary to use glues to attach fossil fragments that become detached, or diluted solutions of hardening substances (Paraloid B-72) to consolidate the most fragile and altered parts of the fossil. For this purpose, strong and transparent glues are used which can, however, be removed for possible repositioning of the fragments.

Laboratory recomposition of *Dasyomyliobatis thomyorkei* found in the 2020 excavations in Pesciara (disc width 99.9 cm)

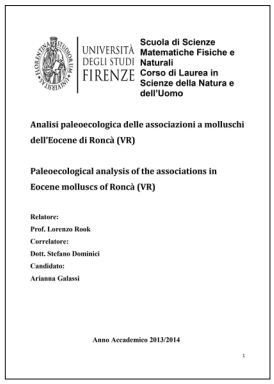




6. The study and display of fossils

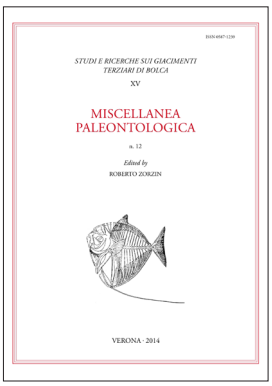
Once the preparation/restoration of the artefact has been completed, before it becomes part of the collections and is possibly exhibited in the educational circuit of a museum, it will be necessary to classify and inventory it. The identification of a fossil consists in the attribution a specific systematic category.
The careful observation of the specialist can recognize specimens never discovered before which therefore require careful study (Brenchley *et al.*, 1998; Società Paleontologica Italiana, 2022). In this case we proceed with the photograph of the find, while the actual study of the fossil can take place using a binocular microscope and will conclude with the drawing of the skeleton, trying to reconstruct any missing parts, and with an accurate description.
After classification and inventory, the fossil finds can be included in scientific collections or exhibited in the educational circuit of a museum (Bolca Fossil Museum and Roncà Paleontological Museum). The setting up of the exhibition part is a very important and demanding intervention since it must be able to "reach" the heterogeneous public that normally frequents natural history or paleontology museums. The exhibits on display must intrigue the visitor and be part of a captivating educational journey, in a scientific context, and accompanied by texts, images, paleoenvironmental reconstructions using the most modern graphic and multimedia techniques.
Due to their rarity and the importance of the information that fossil remains provide in the reconstruction of geological and paleobiological processes on a regional scale, vertebrate but also invertebrate deposits frequently constitute valuable natural sites to be protected and enhanced because of "high scientific value" (Geosites).
The majority of vertebrate deposits possess those characteristics considered relevant in the Wimbledon classification (1990), which tends to define geological sites which, due to their importance, represent a heritage to be protected. This is the case of the Cenozoic deposits of Pesciara, Monte Postale, Monte Purga di Bolca (Eocene); once included in collections, fossils can be objects of detailed studies carried out by researchers.
These studies often lead to specialist publications and/or degree and PhD theses. Overall, over the last 50 years, the candidacy components have been the subject of 25 master degree theses in Paleontology.
Added to these are a few hundred texts of a popular and scientific nature, many of which are published in a dedicated magazine: "Studi e ricerche sui giacimenti terziari di Bolca – Miscellanea paleontologica". For several decades, the Civic Museum of Natural History of Verona has hosted numerous Italian and foreign paleontologists to study the vertebrate faunas of Pesciara and Monte Postale.

Some theses and scientific publications









7. History of the twinning between Bolca di Vestenanova and Eichstätt

The twinning between Bolca di Vestenanova and Eichstätt is probably the only example of a partnership based on paleontology. Both locations are known throughout the world for their fossiliferous deposits: Bolca for its laminated Eocene limestones rich in fossil flora and fauna, especially fish, from around 50 million years ago; Eichstätt for *Archeopteryx* and other fossils from the Solnhofen lithographic limestones which are approximately 150 million years old.
The twinning was made official in 1969 with a visit by the then assistant of the Higher College of Theology and Philosophy of the Bavarian town, Dr. Günter Viohl, to the Civic Museum of Natural History of Verona and to Massimiliano Cerato, owner of Pesciara di Bolca. This was followed in 1970 by the visit to Eichstätt of Cerato by the journalist Dr. Enzo Stanghellini and Sergio Caobelli of the Civic Museum of Natural History of Verona. The idea of a twinning between the two municipalities, officially sealed in 1973, came from Enzo Stanghellini and was immediately supported by the mayor of Eichstätt, Dr. Hans Hutter and the mayor of Vestenanova Giovanbattista Caltran. In the following time, a lively human and cultural exchange developed between the two twinned municipalities which also extended to the city of Verona and the Lessini Mountains and to which many associations and groups of passionate paleontologists and naturalists joined.

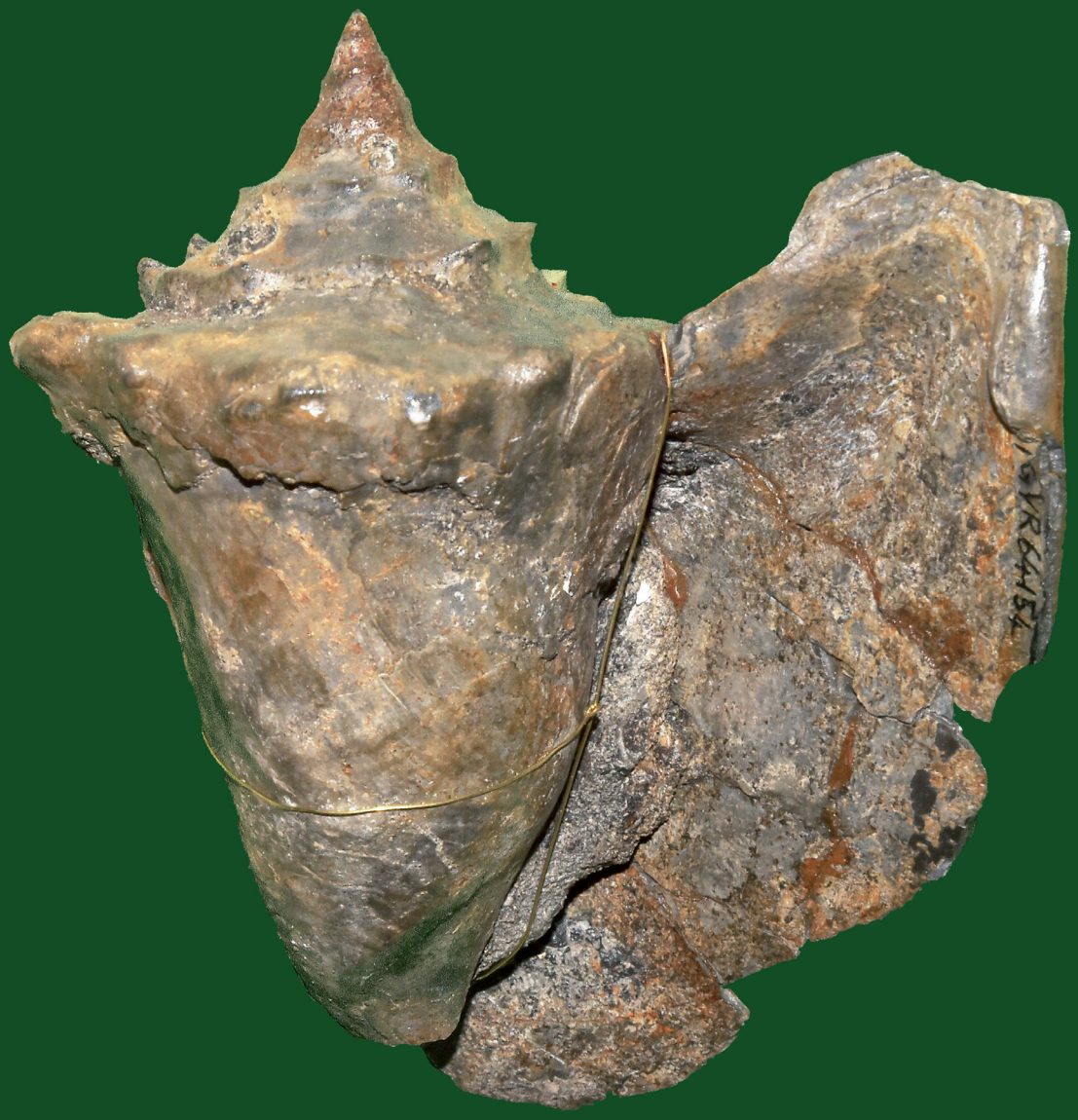
Below: The celebration of the twinning in Vestenanova on 24 June 1973. At the table from left: The Burgomaster (Oberbürgermeister) of Eichstätt Dr. Hans Hutter delivering the copy of a fossil, The President of the Provincial Tourist Board of Verona Prof. Giuseppe Arcaroli and the Mayor of Vestenanova Cav. Giovanbattista Caltran. Second from the left the Deputy Mayor (Bürgermeister) of Eichstätt Sebastian Hermann, to the right of him the Director of the Civic Museum of Natural History of Verona Prof. Sandro Ruffo, the director of the Bergér Museum, Dr. Günter Viohl.





Celebration of the fiftieth anniversary of the Bolca-Eichstätt twinning at Vestenanova on 22 October 2023

In addition to the Cerato family, the Civic Museum of Natural History of Verona played an important role in the twinning, initially with its director Prof. Sandro Ruffo and then with prof. Lorenzo Sorbini, his successor and curator of the Geology and Paleontology Department. Lorenzo Sorbini with his studies has considerably expanded the paleontological knowledge of Bolca and organized excursions both to Bolca and to various locations in the Lessini Mountains. After his premature death in 1997, the collaboration between the Jura-Museum of Eichstätt, founded (only) in 1976, and the Natural History Museum of Verona has continued to this day with Roberto Zorzin former curator of the Geology and Paleontology section.
Great credit for the development of the twinning went to Sergio Caobelli, employee of the Civic Museum of Natural History.
He can almost be considered the "permanent ambassador" of Bolca and Verona in Eichstätt.
On the occasion of his 200th visit in 1989, the City of Eichstätt awarded him the civic medal.
Only during the celebration of the thirtieth anniversary of the twinning did the Eichstätt delegation learn that in 1944/45 the German armed forces had committed war crimes in Vestenanova and other neighboring municipalities. Since then, on November 4th every year, representatives of Eichstätt, mostly under the leadership of the burgomaster, come to Vestenanova to place a wreath for the war dead.
To promote youth exchange, on the initiative of the former mayor Arnulf Neumeyer, an annual football tournament takes place between Eichstätt and the twinned municipalities of Vestenanova and Chrastava (Czech Republic). In the years 2015, 2017, 2018 and 2019 there were also some musical meetings. The association "Amici Bolca-Eichstätt" was formed in Eichstätt with the aim of cultivating twinning, developing it further and also making contacts with other countries in the region. A regular exchange with the world of primary and secondary schools would be particularly desirable.
On 22 October 2023 the fiftieth anniversary of the twinning was celebrated in Vestenanonva. Among the people who participated in the partnership signing ceremony were Günter Viohl, Tarcisio Caltran and Margherita Frigo Sorbini.



Dilatilabrum fortisi found in the Valle della Chiesa and exhibited at the Paleontological Museum of Roncà (length 11.5 cm)



Montlivaltia sp. Coral exhibited in the Paleontological Museum of Roncà (width 11.5 cm)





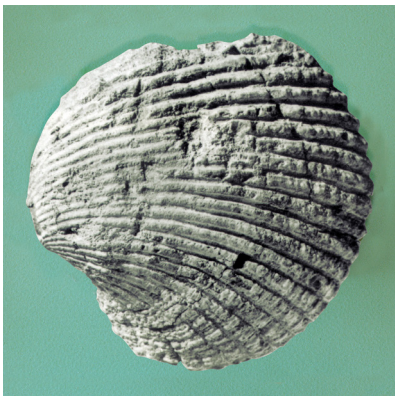














Associazione **T**emporanea di **S**copo
Val d'Alpone - faune, flore e rocce del Cenozoico