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*Ocypode italicica* n. sp.  
(Crustacea, Decapoda, Brachyura, Ocypodidae) from the  
Piacentian (middle Pliocene) of Tuscany (Central Italy)

**Abstract** – Recently, some brachyuran crabs were discovered in a new fossiliferous locality, located close to Poggibonsi (Firenze, Tuscany). The crabs are preserved inside an uncemented sand from the upper part of the Pliocene Val d’Elsa Basin succession. The studied specimens, three-dimensionally preserved, have been ascribed to *Ocypode italicica* n. sp. (Ocypodidae Rafinesque, 1815). *Ocypode* has previously been reported in the fossil record with the extant *O. cursor* (Linnaeus, 1758) from the Pleistocene of Majorca (Spain) and questionably from the Miocene of Hungary. Due to the inability to confirm the presence of *Ocypode* from the Miocene, *Ocypode italicica* n. sp. represents at present the northernmost discovery of this genus in the Mediterranean Basin and the oldest species in Europe.

**Key words:** Crustacea, Decapoda, Brachyura, Ocypodidae, Pliocene, Italy.

**Riassunto** – *Ocypode italicica* n. sp. (Crustacea, Decapoda, Brachyura, Ocypodidae) del Piacentiano (Pliocene medio) della Toscana (Italia centrale).

Recentemente alcuni crostacei brachiuri sono stati rinvenuti in una nuova località fossilifera, ubicata in prossimità di Poggibonsi (Firenze, Toscana). I granchi sono conservati all’interno di sabbie non cementate della parte superiore della successione pliocenica del bacino della Val d’Elsa. Gli esemplari studiati, conservati tridimensionalmente, sono stati ascritti a *Ocypode italicica* n. sp. (Ocypodidae Rafinesque, 1815). *Ocypode* era già stato segnalato nel record fossile con la forma vivente *O. cursor* (Linnaeus, 1758) del Pleistocene di Maiorca (Spagna) e in forma dubitativa nel Miocene dell’Ungheria. Non potendo confermare la presenza di *Ocypode* nel Miocene dell’Ungheria, *Ocypode italicica* n. sp. rappresenta attualmente il rinvenimento più settentrionale di questo genere nel Bacino Mediterraneo e la più antica specie in Europa.

**Parole chiave:** Crustacea, Decapoda, Brachyura, Ocypodidae, Pliocene, Italia.

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## Introduction and geological framework

The fossiliferous site is located near Poggibonsi, about 40 km SE of Firenze (Fig. 1A), along the western side of the Chianti Mounts. The fossil-bearing deposits consist of uncemented sand belonging to the upper part of the Pliocene Val d'Elsa Basin succession. The Val d'Elsa Basin (Fig. 1B), a 25 km wide and 60 km long NW-SE depression, is one of the numerous post-orogenic basins developed since Upper Miocene along the Eastern side of the Northern Apennines. During Pliocene time, following Miocene lacustrine sedimentation, the Val d'Elsa Basin was characterized by shallow-marine deposition, punctuated by several episodes of seafloor emersion, which led to the formation of unconformity-bounded units (Synthems, Fig. 1C). The fossiliferous deposits belong to the San Miniato Synthem and are middle Pliocene in age (Abbazzi *et al.*, 2008).

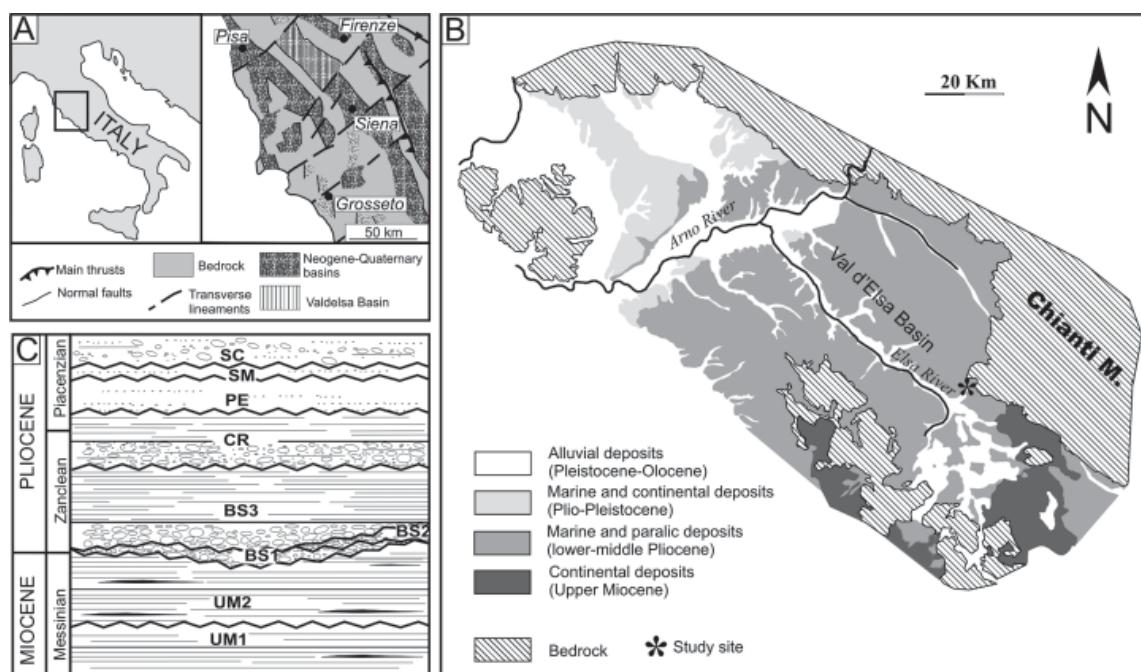
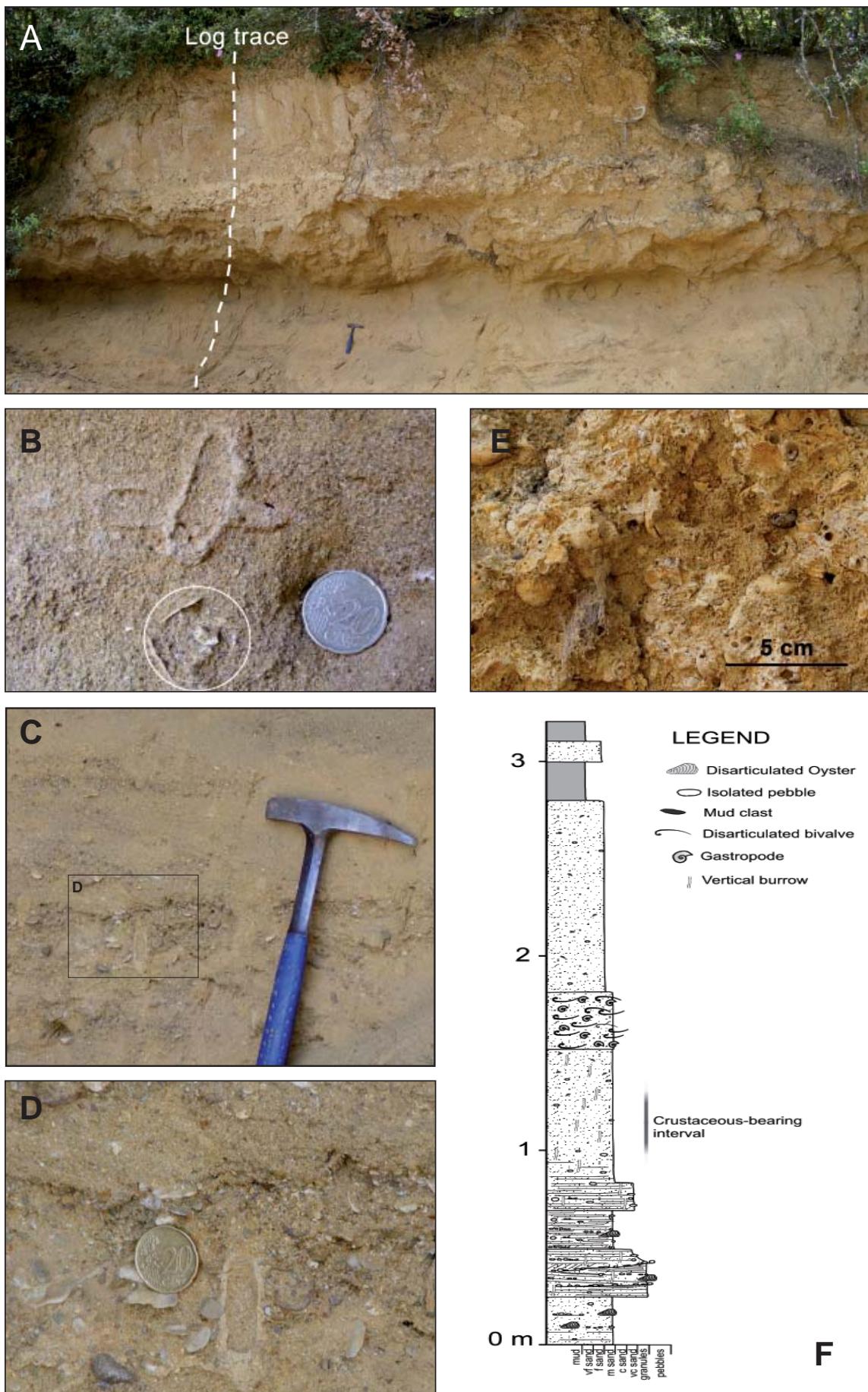


Fig. 1 - A) Location of the Val d'Elsa Basin compare with the other Neogene-Quaternary basins of the Northern Apennines. / Ubicazione del Bacino della Val d'Elsa confrontata con gli altri bacini Neogenici-Quaternari degli Apennini settentrionali. B) Schematic geological map of the Val d'Elsa Basin. / Mappa geologica schematica del Bacino della Val d'Elsa (after/dopo Abbazzi *et al.*, 2008). C) Stratigraphic scheme of the Poggibonsi area. / Schema stratigrafico dell'area di Poggibonsi (after/dopo Abbazzi *et al.*, 2008): BS1-3, sub-synthemes within the Strolla Creek synthem / sub-sintemi all'interno del sintema del fiume Strolla; SM, San Miniato synthem / sintema di San Miniato; SC, San Casciano synthem / sintema di San Casciano; UM1, upper Tortonian-lower Messinian lacustrine deposits / depositi lacustri del Tortoniano superiore-Messiniano inferiore; UM2, Messinian Lago-Mare deposits / depositi messiniani Lago-Mare.

Fig. 2 - A) Study section and relative log trace. / Sezione studiata e relativa traccia colonnare. B) Fossil-crab remains (encircled) close to a vertical cylindrical burrow. / Resti di granchio (cerchio) in prossimità di una galleria verticale cilindrica. C) Close view of the lower part of the section. / Visione ravvicinata della parte inferiore della sezione. D) Detail from C showing a vertical burrow crossing stratified pebbly sand bearing oyster shell fragments. / Dettaglio di C che mostra una galleria verticale che attraversa le sabbie ciottolose a stratificazione incrociata e contenenti resti di ostriche. E) Mollusc-rich sand overlaying the crab-bearing interval. / Sabbie ricche in molluschi sovrastanti l'intervallo contenente i resti di crostacei. F) Sedimentological log through the study section. / Colonna stratigrafica e sedimentologica della sezione studiata.



The study section (Fig. 2A) is about 3 m thick and shows a progressively fining upward trend from coarse sand to sandy silt (Fig. 2F). The lower part (0-1 m; Fig. 1C) is characterized by well-defined subhorizontal bedding. Individual beds, up to 30 cm thick, are tabular and consist of coarse to medium, matrix-free sand bearing scattered pebbles locally grouped into discontinuous strings. The sand shows a clear plane-parallel stratification, locally crossed by vertical cylindrical burrows (Fig. 2D). Locally, lens-shaped, cross-stratified sand with a concave-upward base and flat top occur (Fig. 1C). Disarticulated and deeply abraded oyster shells occur in this interval. The overlying interval (1-1.5 m) is made of medium massive sand with isolated small pebbles characterized by a poorly-defined bedding. These deposits, bearing abundant cylindrical burrows (Figs. 2C, D), provided the study specimens (Fig. 2B). Fossil crabs mainly occur as disarticulated and/or fragmented remains, although some specimens are almost complete. This crustaceous-bearing interval is covered by a massive, 0.5 m thick, medium to fine sand bearing abundant gastropods (*Turritella*, *Conus*, *Nassa*, *Natica*) and bivalves (*Venus*, *Cardium*) chiefly preserved as moulds. The overlying deposits show weakly-defined bedding and consists of structureless, medium to fine sand bearing two muddy intervals (20 and 10 cm thick respectively) in their upper part. Molluscs are rare and consist of badly preserved gastropods (*Natica*, *Turritella*) and bivalves (*Venus*).

The study deposits are interpreted to have been formed in a shallow marine setting, and in particular as accumulating in a shoreface environment (Clifton, 2007). In particular, the well-stratified sand forming the lower part of the section was probably formed in an upper shoreface, according to the grain size and dominance of plane-parallel stratification (Clifton & Dingler, 1984). In this framework, the cross-stratified sand probably derived from the infill of small scours acted by unidirectional current (e.g. longshore currents). An upper shoreface scenario is also proposed also for the crustaceous-bearing interval, although the decrease in grain size and a parallel increase in bioturbation could suggest a decrease in the hydrodynamic regime, possibly forced by a minor increase in water depth. According to this framework, the overlying shell-bearing deposits and amalgamated sand with silty interval are thought to be formed in a lower shoreface setting based upon their decrease in grain-size and increase in amalgamation mainly due to bioturbation.

## Material

The studied sample includes two specimens of ocypod crabs housed in the Museo Geologico e Paleontologico, Firenze (Tuscany) (IGF). The specimens, three-dimensionally preserved, have been ascribed to *Ocypode italicica* n. sp. (Ocypodidae Rafinesque, 1815).

Measurements are given in millimetres (mm).

The systematic arrangement used in this paper follows the recent classification proposed by Schweitzer *et al.* (2010).

Abbreviations. cl: carapace length; cw: carapace width; wo-f: width of orbito-frontal margin; wf: width of frontal margin; wo: width of orbit.

## Systematic Palaeontology

Infraorder Brachyura Linnaeus, 1758  
 Section Eubrachyura de Saint Laurent, 1980  
     Subsection Thoracotremata Guinot, 1977  
     Superfamily Ocypodoidea Rafinesque, 1815  
         Family Ocypodidae Rafinesque, 1815  
         Subfamily Ocypodinae Rafinesque, 1815  
             Genus *Ocypode* Weber, 1795

Type species: *Cancer ceratophthalmus* Pallas, 1772, by subsequent designation by Latreille, 1810.

Included fossil species: *Ocypode* cfr. *O. africana* De Man, 1881; *O. cursor* (Linnaeus, 1758) (also extant); *O. quadrata* (Fabricius, 1787) (also extant); *O. vericoncava* Casadío, Feldmann, Parras & Schweitzer, 2005.

*Ocypode italicica* n. sp.

Figs. 3, 4, 5

**Diagnosis:** carapace rectangular, much wider than long; front very narrow, about 5 percent maximum carapace width; orbits narrow, with triangular, pointed inner sub-orbital spine; fronto-orbital width about 90 percent maximum carapace width; gastro-hepatic groove deep, straight; cervical groove extending to the transverse depression of cardiac region; cardiac region with well-marked transverse depression; chelipeds in both sexes, unequal, well developed; merus and carpus of cheliped and merus, carpus, and propodus of walking legs with finely granulated and spinulated imbricated ridges on upper and lower tips.

**Etymology:** the trivial name alludes to Italy, the country in which the studied specimens were discovered.

**Holotype:** IGF 14632E.

**Paratype:** IGF 14683E.

**Type locality:** Poggibonsi (Tuscany).

**Geological age:** middle Pliocene (Piacentian).

**Occurrence and measurements:** two complete specimens, the holotype, a male (IGF 14632E) with carapace, chelipeds, walking legs, and abdomen, and the paratype, a female (IGF 14683E) with carapace, chelipeds, walking legs, and abdomen.

IGF 14632E: cl: 30; cw: 45; wo-f: 42; wf: 8; wo: 19

IGF 14683E: cl: 30; cw: 50; wo-f: 47; wf: 9; wo: 20

**Description.** Carapace rectangular, much wider than long (cl/cw about 0.66 in the male; cl/cw about 0.6 in the female), strongly convex from front to back. Lateral margins nearly vertical. Front very narrow, about 5 percent maximum carapace width, deflexed. Front extends anteriorly, convex distally, with raised, serrated margins. Lateral margins continue into prominent, acute angle at outer corner of orbit. Orbita narrow, extending length of anterior margin on either side of narrow front, both upper and lower margins crested and dentate; orbits ovate in anterior view, constricted centrally, highest laterally, narrowed axially, with triangular, pointed inner sub-orbital spine, visible in dorsal view; in dorsal view, orbits with sinuous upper margin. Fronto-orbital width about 90 percent maximum carapace width. Dorsal region finely granulated. Gastro-hepatic groove deep, straight, arising medi-

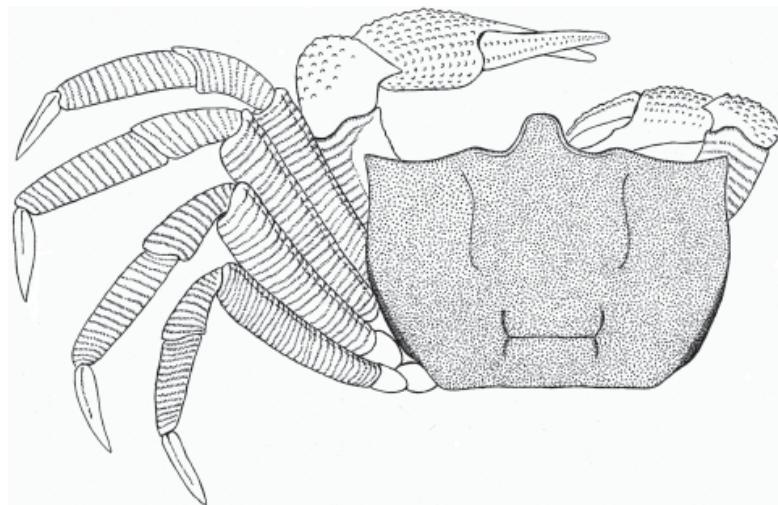


Fig. 3 - *Ocyypode italicica* n. sp., reconstruction/ricostruzione.

ally from the fronto-orbital margin; cervical groove extending to the transverse depression of cardiac region. Cardiac region with well-marked transverse depression. Chelipeds in both sexes unequal, well developed: left chela longer than right one in male, left chela smaller than right one in female. Chelae with subquadrate palm, with serrated upper and lower margins, with spines directed distally; movable and fixed fingers pointed, with occlusal margins dentate; both fingers with well-developed median ridge and serrated upper and lower margins respectively; outer surface of chela strongly granulated; merus and carpus of cheliped with distally directed imbricated, finely granulated ridges; largest chela in male and female with stridulatory apparatus consisting of parallel striae, located in a vertical arch at base of fingers. Merus, carpus, and propodus of walking legs with distally directed imbricated, finely granulated ridges; upper and lower tips of imbricated ridges with small spines; third walking leg longest. Male abdomen narrow in male and very large in female. Abdominal somites progressively restricted distally in male. Somites 1-2 rectangular, narrow, equal in size; somites 3-4 rectangular, slightly much larger; somite 5 subquadrate; somite 6 subquadrate with rounded tip. Abdominal somites poorly preserved in female.

**Discussion.** As reported by Casadío *et al.* (2005: 175) *Ocyypode* shows morphological characters, as follows: “carapace somewhat wider than long, subquadrilateral, dorsal carapace regions typically indistinct, anterolateral margins confluent with posterolateral margins to form straight lateral margins, posterolateral reentrant present, front narrow, deflexed, with concave margins, orbits large, shallow, with sinuous upper margins, fronto-orbital width almost equal to maximum width of carapace, chelae heterochelous, pereiopods 2-4 long, pereiopod 5 shorter, narrow male abdomen”.

The studied specimens are referred to *Ocyypode* based upon their carapace that is much wider than long, dorsal carapace regions typically indistinct, nearly straight lateral margins, front narrow and deflexed, broad orbits, fronto-orbital width almost equal to maximum width of carapace, chelae heterochelous, and narrow male abdomen.

*Uca* Leach, 1814, another genus within the Ocypodidae, has clearly differentiated anterolateral and posterolateral margins, hexagonal carapace, and is typically macrochelous in males which are not consistent with the studied specimens.

The new species is much older than either of the other reported fossil species known to date, *O. cfr. O. africana* and *O. quadrata*, both from the Pleistocene of Morocco and Florida (United States) respectively (Secretan, 1959; Vía Boada, 1980; Portell *et al.*, 2003; Portell & Agnew 2004). However, the material is quite fragmental, avoiding direct comparisons. Due to the inability to confirm the presence of *Ocypode* from the Miocene of Hungary (Müller, 1978: 282, Pl. 23, figs. 1, 2), the oldest species of *Ocypode* known to date is *O. vericoncava* from the Miocene of Patagonia (Argentina). Casadío *et al.* (2005: 175, Fig. 9c) reported just one complete carapace, poorly preserved dorsally, without chelipeds and walking legs. So also in this case the poor state of preservation precludes direct comparisons.

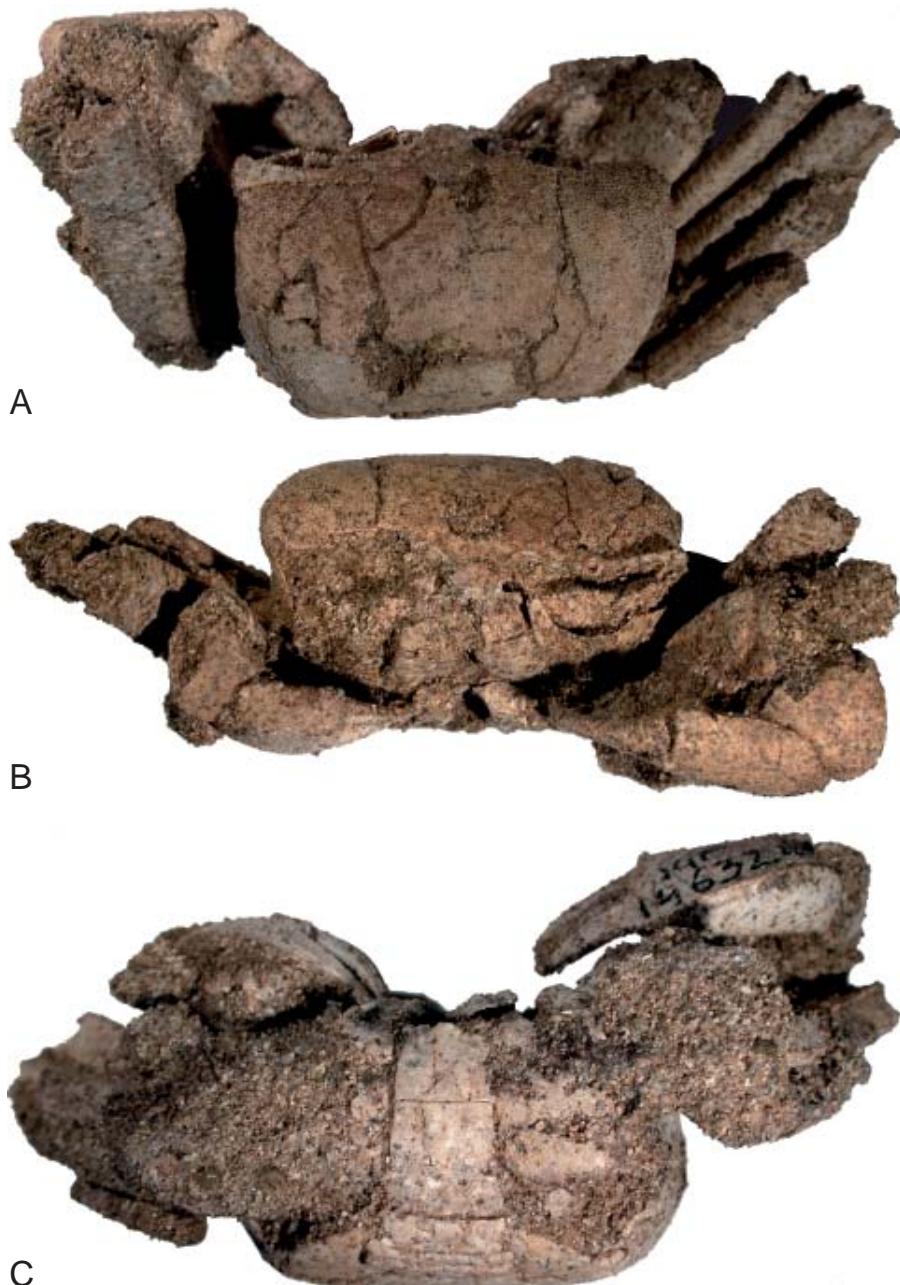


Fig. 4 - *Ocypode italica* n. sp. Holotype / Olotipo, IGF 14632E (x natural size). A) Dorsal view. / Visione dorsale. B) Frontal view. / Visione frontale. C) Ventral view. / Visione ventrale.



Fig. 5 - *Ocypode italicica* n. sp. Detail of ornamentation of walking legs. / Dettaglio dell'ornamentazione degli arti ambulatori. (x 3).

*Ocypode cursor*, living in the Mediterranean Sea and western coast of Africa, reported also from the Pleistocene of Majorca (Vía Boada, 1966, 1976), shows some common morphological characters with the new species, such as the chelipeds with serrated upper and lower margins, with spines directed distally and the articles of chelipeds and walking legs with imbricated ridges. However, *O. italicica* n. sp. shows different characters, as follows: the carapace is subrectangular, strongly wider than long (subquadrate, almost as long as wide in *O. cursor*); gastro-hepatic groove deep, straight, cervical groove extending to the transverse depression in the cardiac region (gastro-hepatic groove deep, sinuous, cervical groove extending to the branchial region in *O. cursor*); and cardiac region with a deep transverse depression (cardiac region with two oblique depression converging toward the branchial region in *O. cursor*).

### Palaeoenvironment considerations

As previously discussed, the only extant *Ocypode* living commonly in the oriental Mediterranean Sea is *O. cursor* that ranges on sandy-shore beaches from Greece, Syria, and Turkey to Cyprus Island.

In southern Italy the species was occasionally recorded from Lampedusa Island (Agrigento) in the Middle Mediterranean and, more recently, from Samperi beach (Ragusa) in the SE of Sicily.

Extant *Ocypode* are common on warm sub-tropical sandy shores around the world, on supralittoral to upper eulittoral zones and in estuarine environments.

The geological data of the Poggibonsi outcrop where *O. italicica* n. sp. was discovered, indicate a similar environment for this area, supporting the hypothesis of a same behaviour for the genus from the Pliocene and a warmer temperature, also in a portion of the northern paleo-Mediterranean Basin; this hypothesis is reinforced by the presence of a typical temperate to subtropical-terrestrial flora in the upper Pliocene succession of the Val d'Elsa Basin (Benvenuti *et al.*, 2007). These climatic conditions permitted the distribution of *Ocypode* toward higher latitudes.

Unfortunately sandy shore-face environments usually do not permit the preservation and fossilization of body remains which are usually buried, displaced and disarticulated. Consequently the record of *Ocypode* in its own habitat is very rare.

Finally the scarce reports of fossil specimens of the genus may be more apparent than real, due to the particular sedimentary conditions of the life environment.

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