# Ostracode Biostratigraphy of Shiranish, Hartha and Mushorah Formations from Selected Boreholes Northwest and Central Iraq

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## ABSTRACT

Ostracode biostratigaphy were investigated in detail from three formations (Shiranish, Hartha and Mushorah ) in subsurface sections of four boreholes Northwest and centre of Iraq.

On the basis of the ostracode species distribution, the studied formations were divided into four ostracode biozones as follows:

**Biozone 1:** *Cytherella* IRC 22 Interval zone. (Early Campanian).
**Biozone 2:** *Occultocythereis elongata* Interval zone. (Late Campanian).
**Biozone 3:** *Krithe* sp. M 1113 Interval zone. (Early Maastrichtian).
**Biozone 4:** *Holcopocythere bassiporosa* Interval zone. (Late Maastrichtian).

Depending on the above biozones correlated with other previous works from Iraq and the Middle East regions the following ages were proposed for the studied formations:

Shiranish Formation: Late Campanian - Maastrichtian.
Hartha Formation: Late Campanian - Early Maastrichtian.
Mushorah Formation: Early Campanian.

**Keywords:** Ostracode, Biostratigraphy, Shiranish, Hartha, Mushorah.

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# الطباقية الحياتية للاوستراكود للتكوينات شرانش، الحارثة و المشورة من مقاطع تحت سطحية مختارة شمال غرب العراق و وسطه

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*قسم علوم الأرض*
*كلية العلوم*
*جامعة الموصل*

**صالح خضر خلف**
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**مروان إدريس العيسى**
*قسم الجيولوجيا*
*شركة نفط الشمال*
*كركوك*

**الملخص**

تمت دراسة الطباقية الحياتية لمتحجرات الاوستراكودا بشكل مفصل من ثلاث تكوينات هي ( شرانش، الحارثة و المشورة) في مقاطع تحت سطحية ضمن اربعة آبار تقع شمال غرب ووسط العراق.

استنادا إلى توزيع أنواع من متحجرات الاوستراكودا تم تقسيم التكاوين المدروسة الى اربعة انطقة حياتية وهي:

**النطاق الحياتي البيني الأول:** *Cytherella* IRC 22 (الكامباني المبكر).

**النطاق الحياتي البيني الثاني:** *Occultocythereis elongata* (الكامباني المتأخر).

**النطاق الحياتي البيني الثالث:** *Krithe* sp. M 1113 (الماسترختيان المبكر).

**النطاق الحياتي البيني الرابع:** *Holcopocythere bassiporosa* (الماسترختيان المتأخر).

من خلال الانطقة الحياتية المذكورة اعلاه و بالمقارنة مع الدراسات السابقة من العراق وبعض مناطق الشرق الاوسط تم اعتماد الاعمار التالية للتكاوين المدروسة و بالشكل التالي:

تكوين شرانش: الكامباني المتأخر ـ الماسترختي.

تكوين الحارثة: الكامباني المتأخر ـ الماسترختي المبكر.

تكوين المشورة: الكامباني المبكر.

**الكلمات الدالة:** الاوستراكودا، الطباقية الحياتية، شرانش، الهارثة، المشورة.

## INTRODUCTION

A total of 300 core and cutting samples were obtained from the Upper Cretaceous successions of four boreholes ( *A*, *B*, *C* and *D* ) located at theWest of Tigris river in the Northwest and central Iraq (Fig. 1). These sections comprised three formations which are from younger towards the older: Shiranish, Hartha and Mushorah Formations. In this respect (Figs. 2, 3, 4 and 5) show the stratigraphical sections of the above formations in the studied boreholes. Geographically the studied area is located Northwest and central Iraq approximately between latitude 34° 20′ - 35° 50′ N and longitude 42° 50′ - 43° 40′ E. Geologically, the investigated area belongs to the unstable shelf of Iraq and situated within Hamrin-Makhul subzone and Tigris subzone (Buday and Jassim,1987). Regionally it is situated between two main Phanerozoic units of the Middle East (the Arabian part of African platform on the west and the Asian branch of the Alpine geosyncline on the east) (Buday, 1980; Buday and Jassim, 1984).

## AIM OF STUDY

The main aim of the present study is to identify the ostracode biozones of Shranish, Hartha and Mushorah Formations and their ages in the studied area.

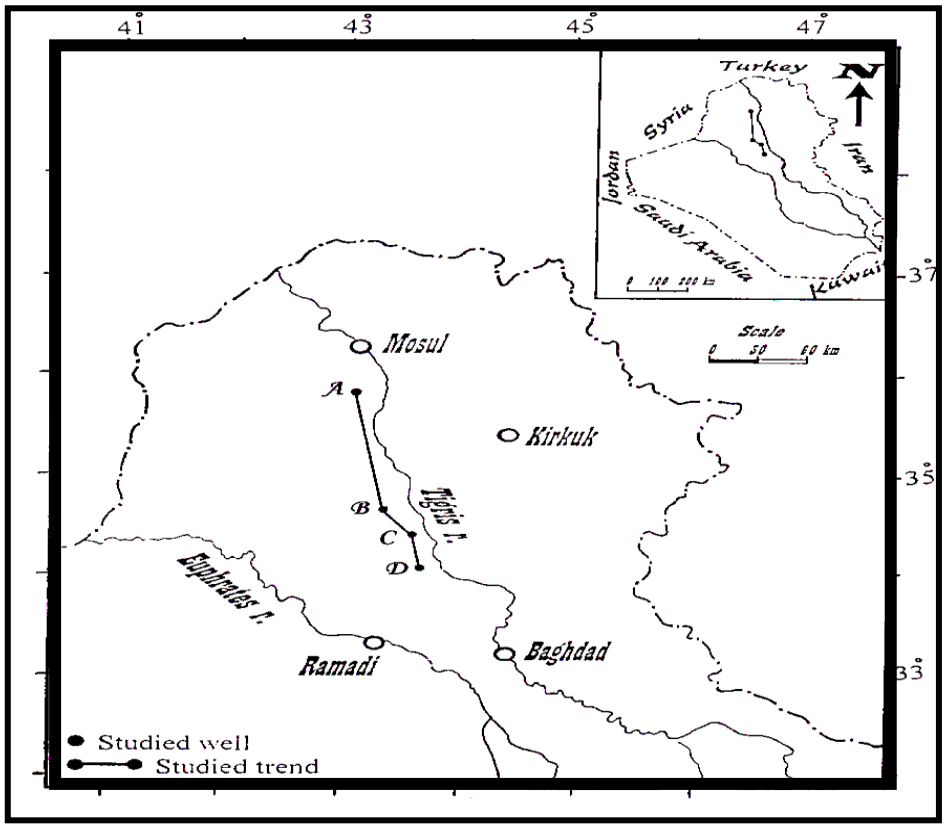


Fig. 1 : Location Map

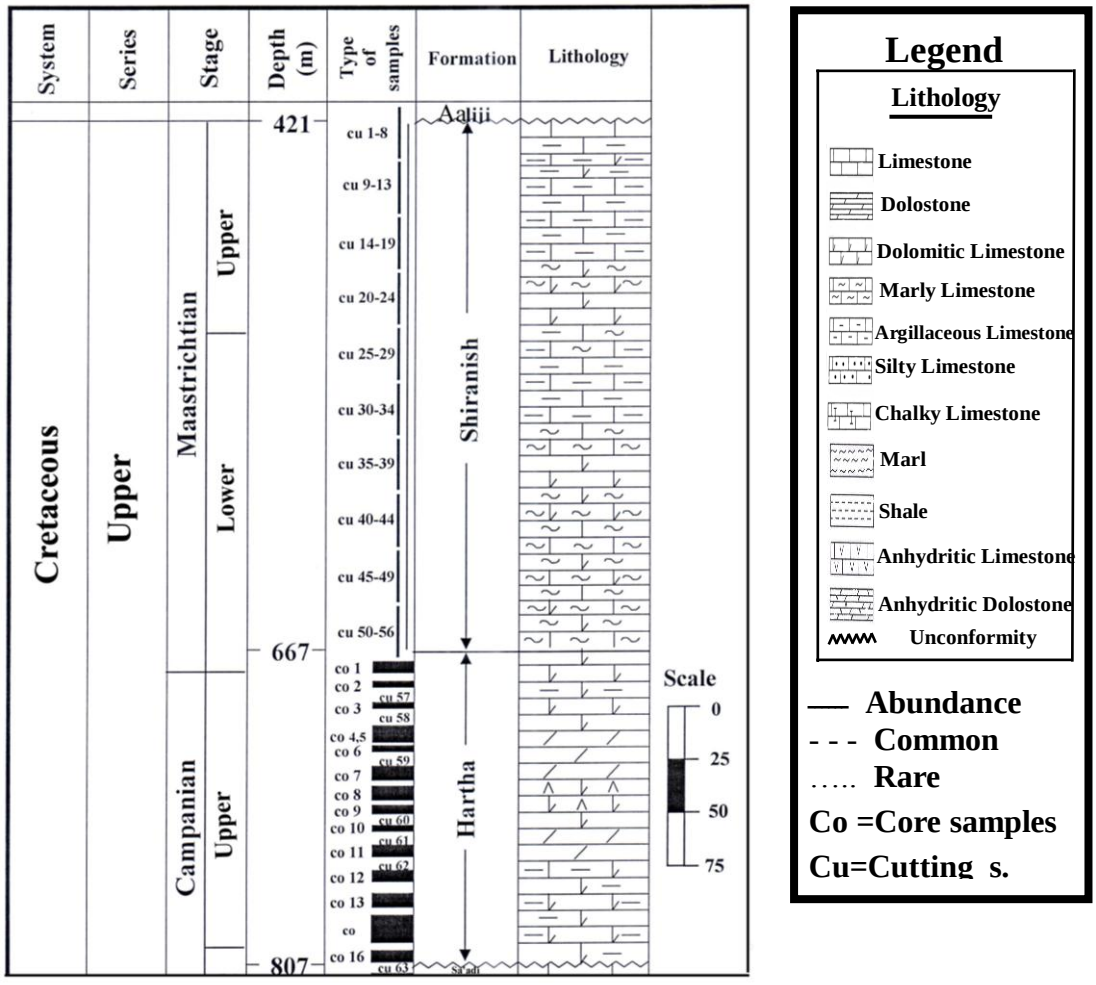


Fig. 2 : Stratigraphic Section of Studied Formations in Borehole *A.*

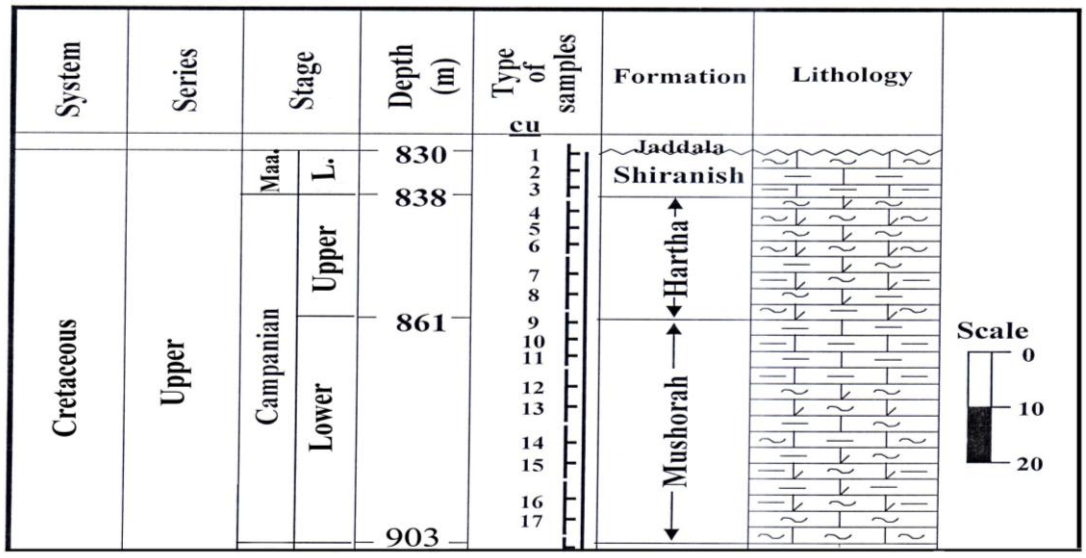


Fig. 3: Stratigraphic Section of Studied Formations in Borehole *B.*

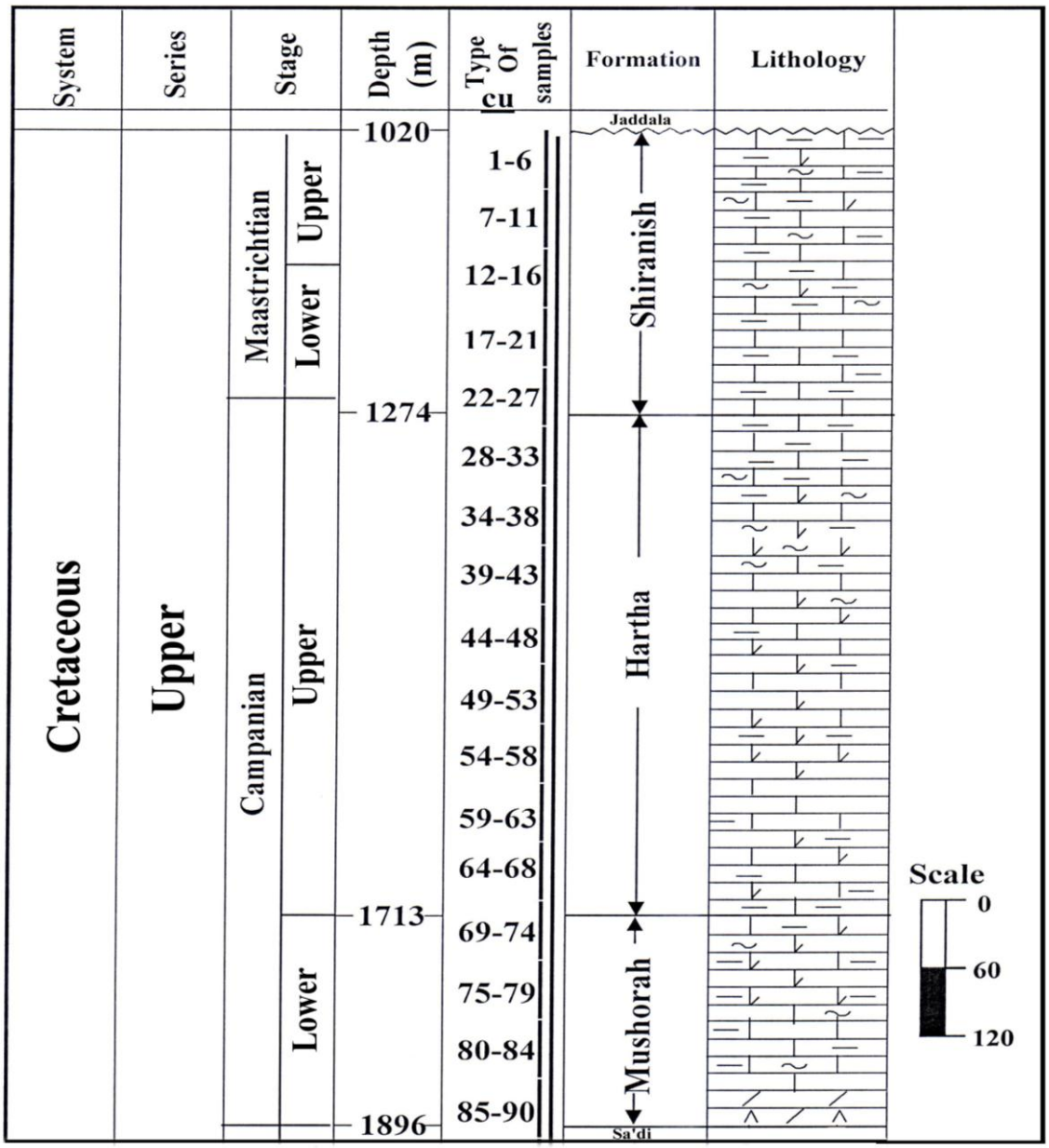


Fig. 4 : Statigraphic Section of the Studied Formations in Borehole ***C***

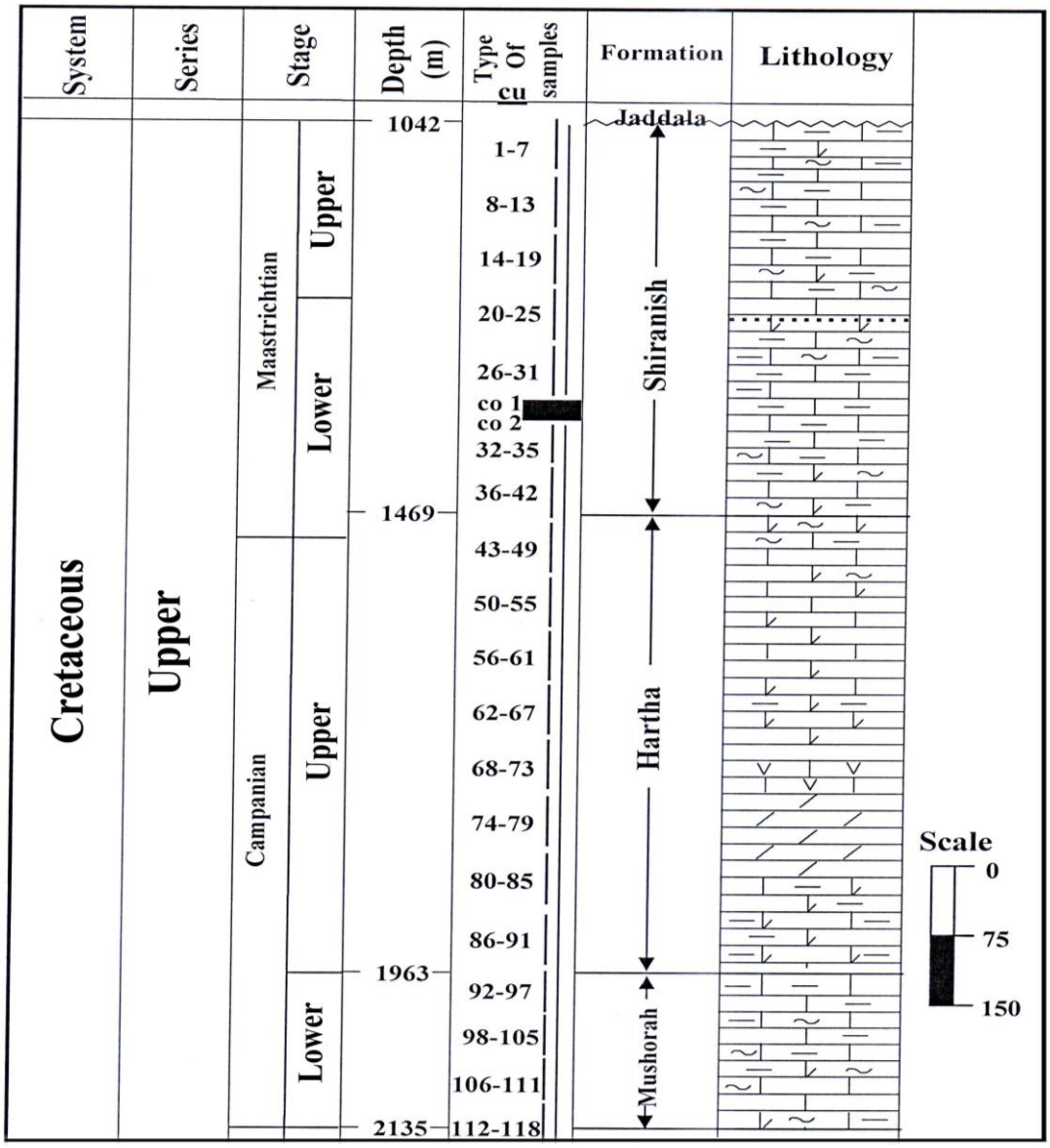


Fig. 5 : Stratigraphic Section of the Studied Formations in Borehole ***D***

## BIOSTRATIGRAPHY

In Iraq, the biozonations by ostracode have received little attention from micropalaeontologists, due to the fact that most of the works have been done on the foraminifera by the oil companies. Therefore there is a shortage of literature dealing with the ostracode biozones in the stratigraphy of Iraq. However this research represent an attempt to use the ostracode species in the definition of biozones on the studied formations.The stratigraphic range of ostracode species in the studied formations from four oil boreholes are illustrated in (Figs. 6, 7, 8 and 9).

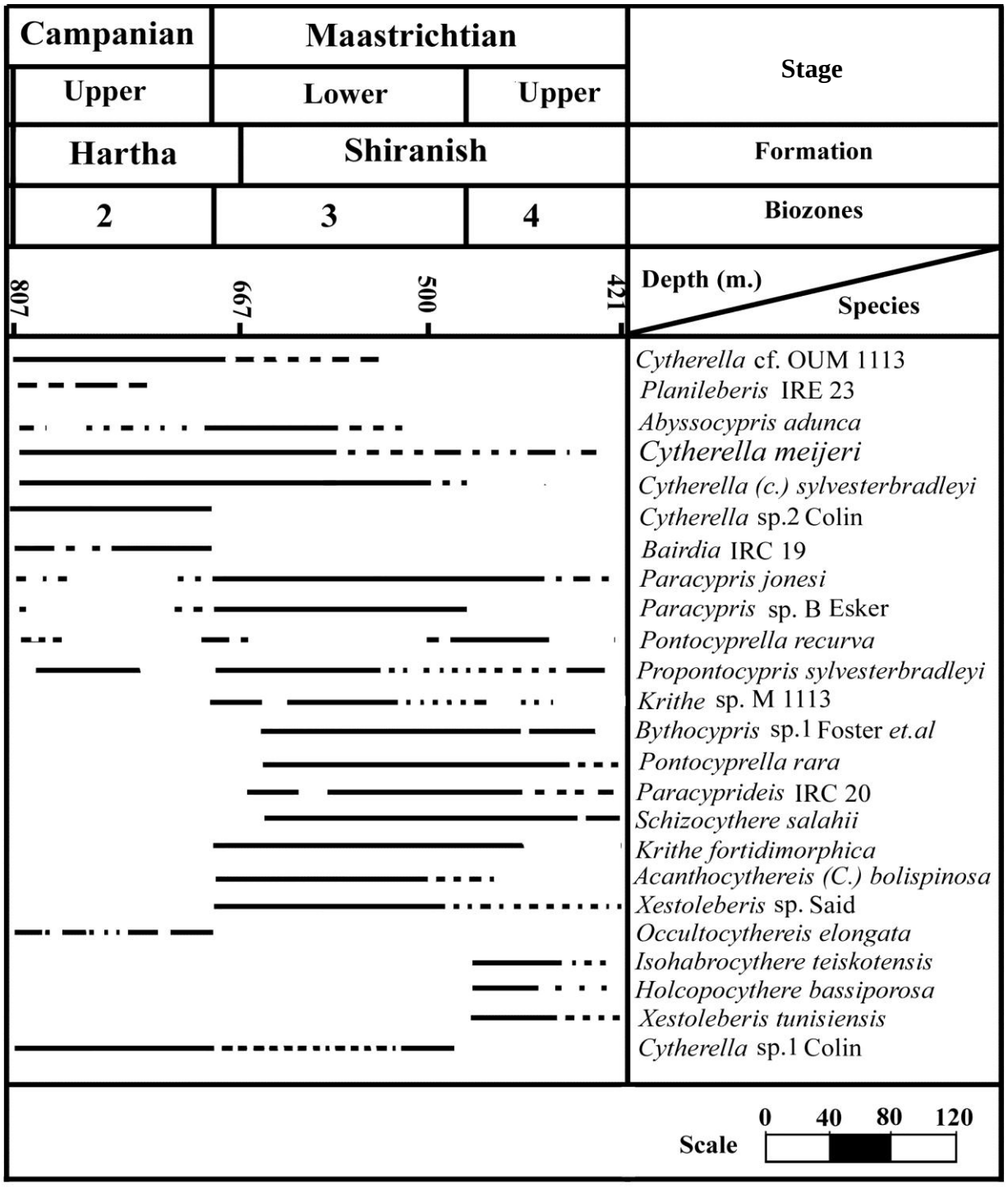


Fig. 6 : Range Chart of Ostracode Species in the Studied Formations in Borehole *A*

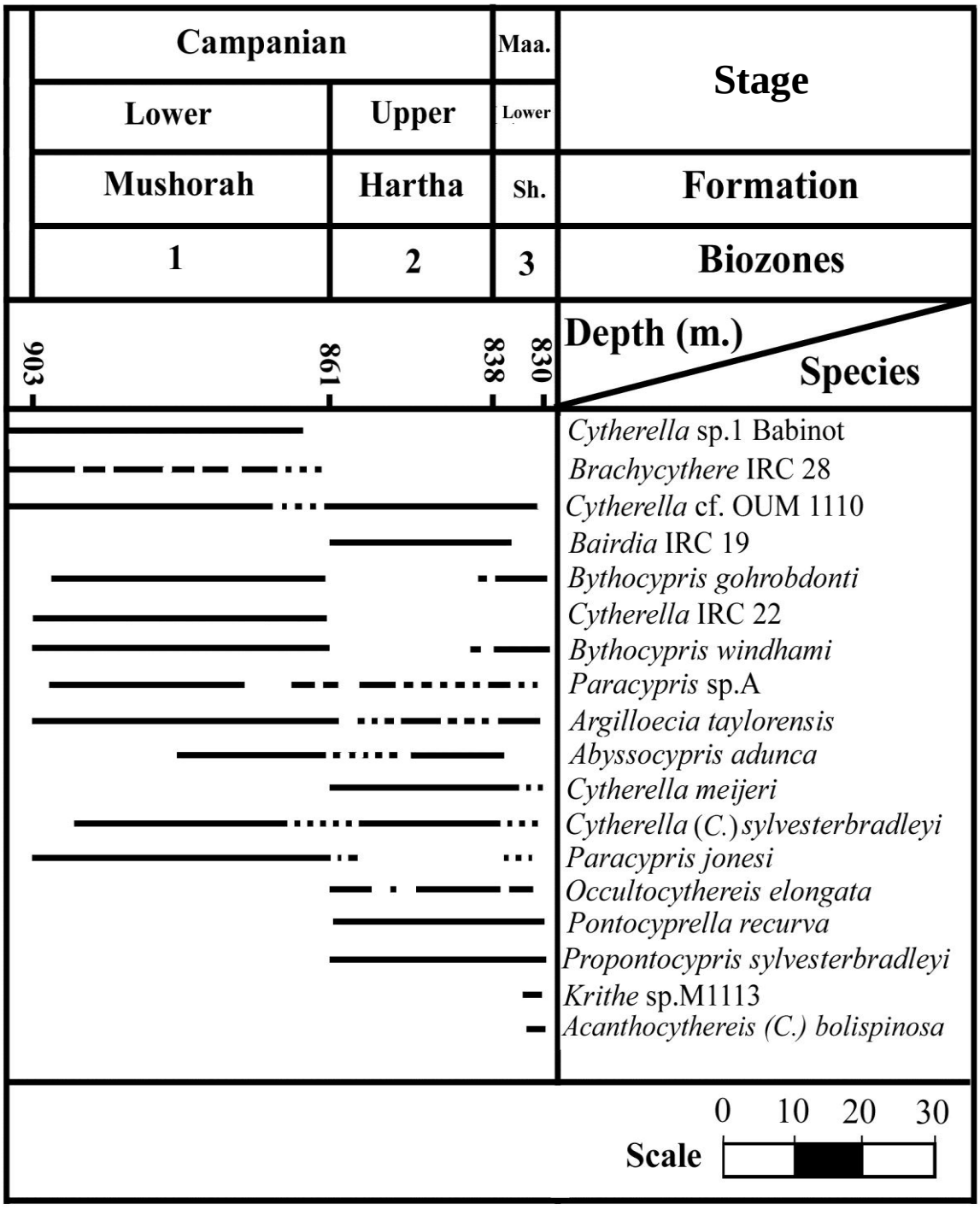


Fig. 7 : Range Chart of Ostracode Species in the Studied Formations in Borehole ***B***

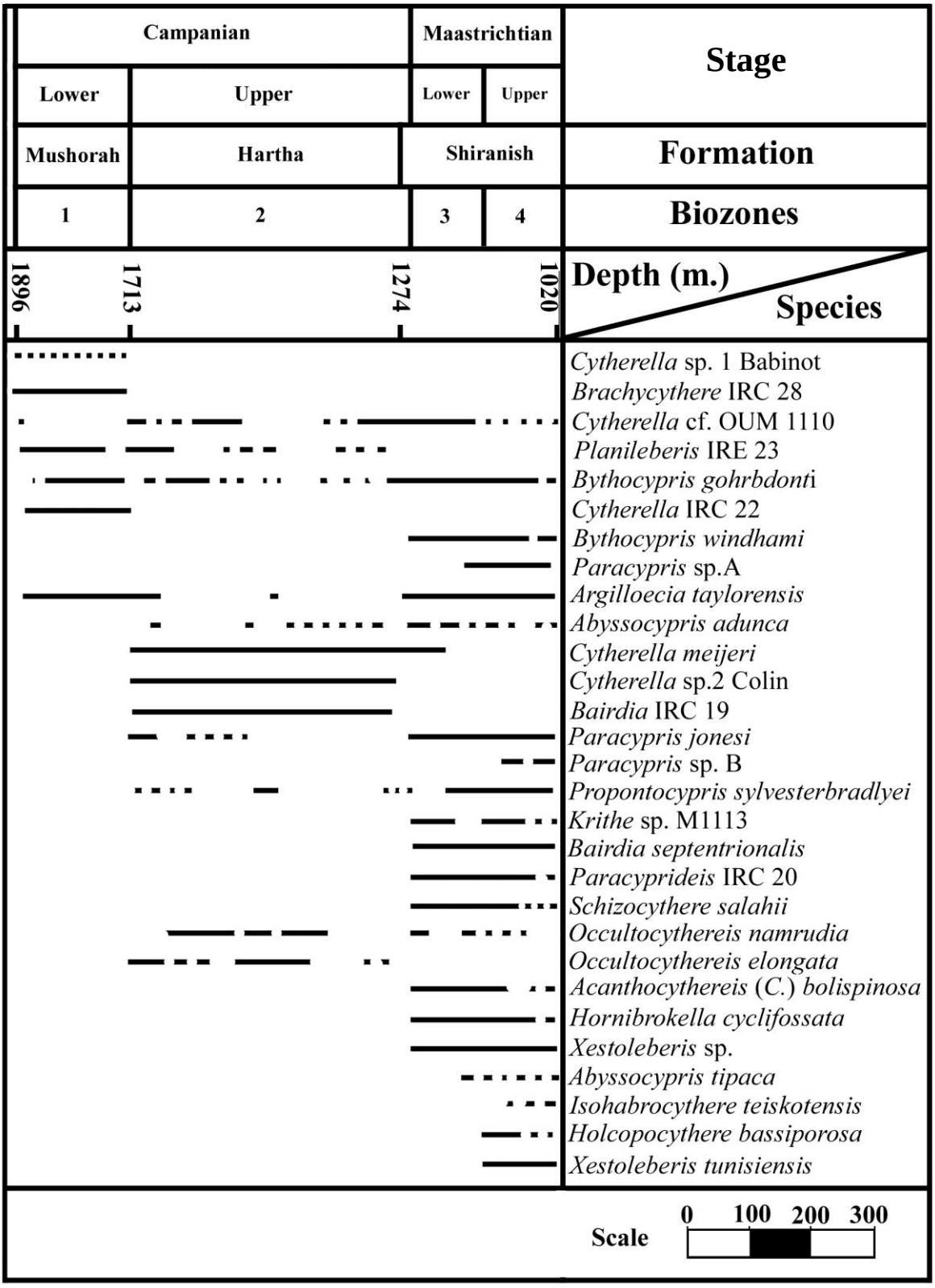


Fig. 8 : Range Chart of Ostracode Species in the Studied Formations in Borehole *C*

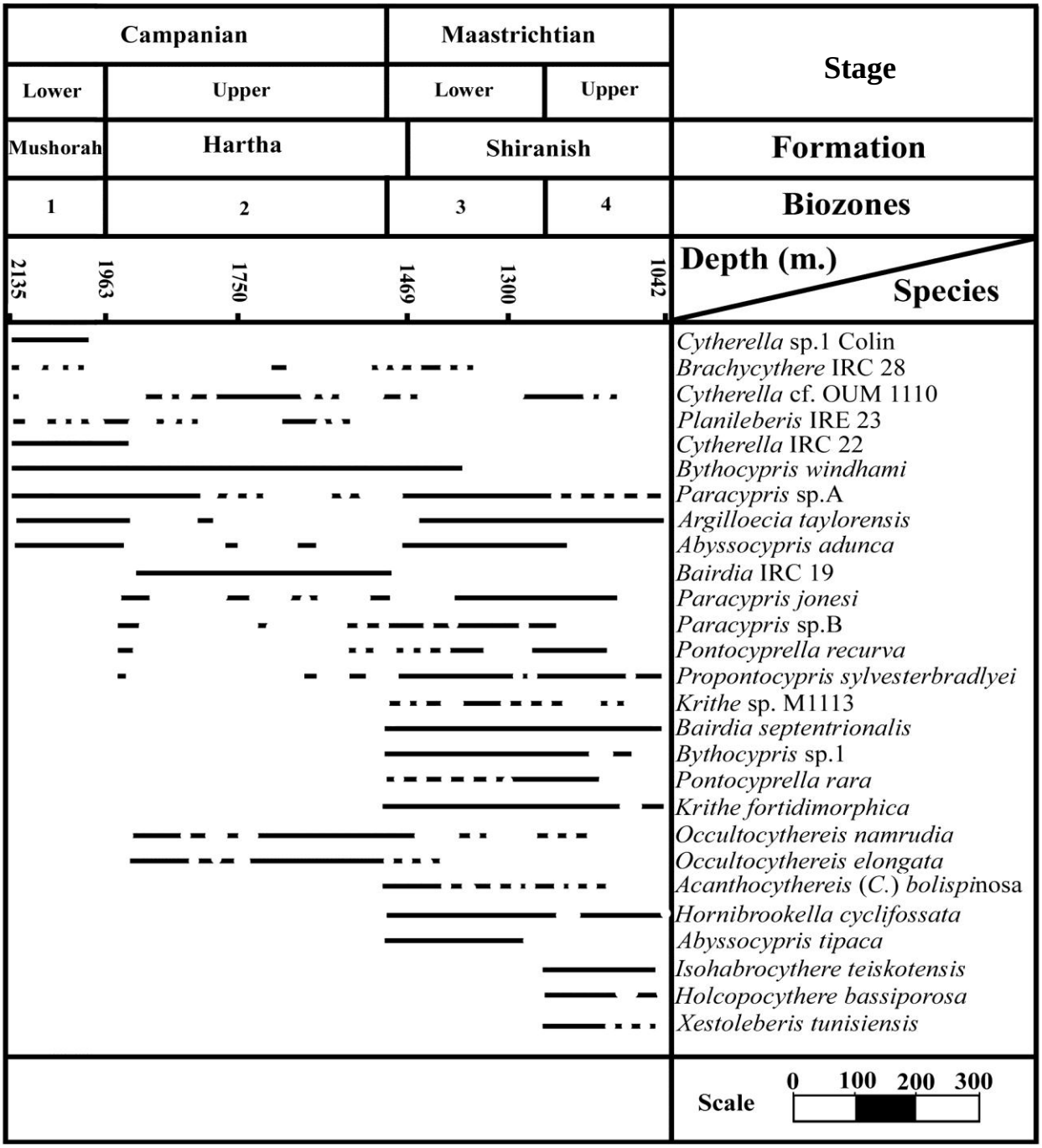


Fig. 9 : Range Chart of Ostracode Species in the Studied Formations in Borehole ***D***

Figure (10) shows the comparison scheme between the ostracode biozones of the present study with foraminifera biozones and other previously recorded ostracode biozones from Iraq, Arabian Gulf and Levant which is very important as a zoogeographical subtraction area (Martens, 2002).

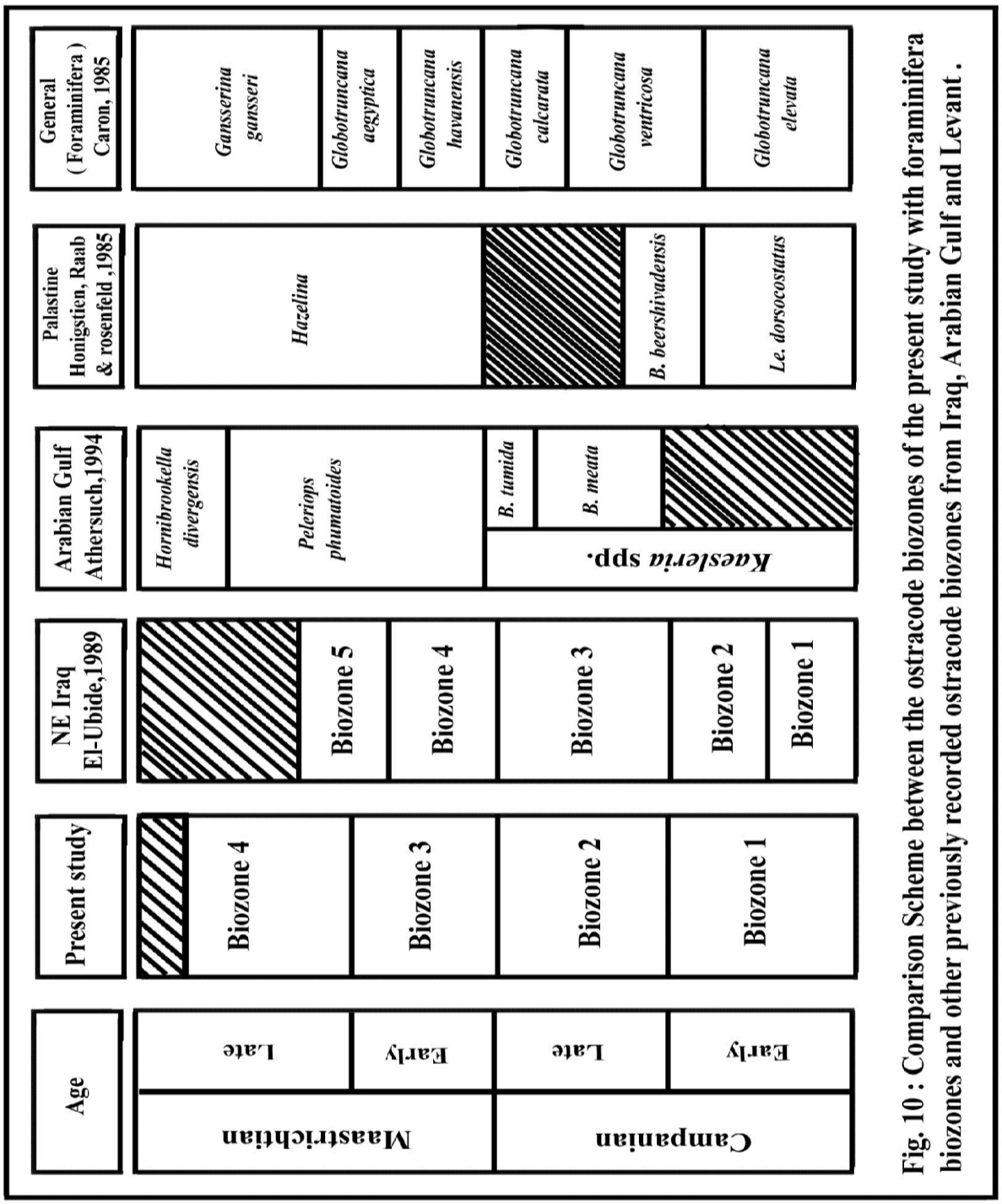


**Fig. 10 : Comparison Scheme between the ostracode biozones of the present study with foraminifera biozones and other previously recorded ostracode biozones from Iraq, Arabian Gulf and Levant .**

## BIOZONES

**Biozone 1:** ***Cytherella*** **IRC 22 Interval zone.Definition:** Interval zone represents the restricted range between the first appearance of ***Cytherella*** **IRC22 (**Grosdidier, 1973) and the first appearance of ***Occultocythereis elongate*** (Al- Sheikhly, 1982).

**Age:** Early Campanian

**Boundaries:** The base of this zone is defined by the first appearance of ***Cytherella IRC22*** (Grosdidier, 1973) whilst the top of this zone is marked by the first appearance of ***Occultocythereis elongata*** (Al- Sheikhly, 1982) coeval with disappearance of the following species: ***Cytherella*** **sp.1** Babinoti *et al*., (1988 ),

***Cytherella* sp.1** Colin *et al*., ( 1982 )**, *Brachycythere* IRC28** Grosdidier (1973 ). **Associated species:** The following species make their first appearance in this zone and extended into the overlying zones: ***Bythocypris gohrbdonti*** Esker ( 1968)**, *Bythocypris windhami*** Butler and Jones (1957)**, *Paracypris* sp.A** Esker (1968)**, *Argilloecia taylorensis*** Alexander (1935**)** and ***Abyssocypris adunca*** Esker (1968).

Other species which occur in this zone and make their last appearance within it but were also recorded from the lower zones are: ***Cytherella* sp.1** Babinoti *et. al*., (1988). ***Cytherella* sp.1** Colin *et al*., (1982 ) and ***Brachycythere* IRC28** Grosdidier, ( 1973).

Only one species ***Cytherella cf.* OUM 1110** Grekoff (1969), was recorded from this zone although it also occur in the overlying and underlying zones.

**Other faunas:** Planktonic foraminifera **(*Globotruncana elevata*),** Benthonic foraminifera **(*Sulcoperculina deckersoni*), *Hartella inflatotriangularis, Hartella triangularis.***

**Distribution and thickness:** This zone is recorded in all the studied boreholes and as follows:

| Borehole | Thickness (m) | Extending of the zone |
|---|---|---|
| ***B*** | 42 | Mushorah Formation |
| ***C*** | 183 | Mushorah Formation |
| ***D*** | 172 | Mushorah Formation |

**Correlation:** This biozone is equivalent to the biozone 1and 2 of Al-Ubide,(1989) from NE Iraq. Regionally, This zone is equivalent to the ***Leguminocythere dorsocostatus*** biozone and ***Brachycythere beershivadensis*** biozone of Honigstein *et al*., (1985) from Palestine.

In comparison with foraminifera, This zone is equivalent to ***Globotruncana fornicata, Globotruncana elevata*** and ***Globotruncana stuartiformis*** biozone of Al-Jassim *et al*., (1989 ) from North Iraq. It also equivalent to ***Globotruncana elevata*** biozone or ***Globotruncana stuartiformis*** of Hammoudi, (1995) from Central and South of Iraq.

In the present study the occurrence of ***Hartella inflatotriangularis*** and ***Hartella triangularis*** in this zone makes it is equivalent to the ***Problematicum* Ms1** biozone of Falhe *et al*., (1987) from North Iraq. ***Problematicum* Ms1** Hart is synonymous with ***Hartella inflatotriangularis***, therefore this zone is also equivalent to ***Hartella inflatotriangularis*** zone of Al-Eisa and Al-Fassola, (2011) from NW Iraq.

**Biozone 2: *Occultocythereis elongata* Interval zone**

**Definition:** Interval zone represents the restricted range between the first appearance of ***Occultocythereis elongata*** Al- Sheikhly, (1982) and the first appearance of ***Krithe* sp. M1113** Donze, ( 1973).

**Age:** Late Campanian

**Boundaries:** The base of this zone is characterized by the first appearance of ***Occultocythereis elongata*** Al- Sheikhly, (1982) whilst the top is marked by the first appearance of ***Krithe* sp. M1113** Donze, ( 1973).

**Associated species:** Ostracode species ***Cytherella* sp.2** Colin *et al.*, (1982) and ***Bairdia* IRC19** Grosdidier, (1973) makes their first appearance in this zone and they are restricted to it.

The following species make their first appearance in this zone and extend their ranges into the overlying zones: ***Cytherella (C.) sylvesterbradley*** Reyment, (1963)**,** ***Cytherella meijer*** Esker,(1968). ***Paracypris jonesi*** Bonnema, (1940)**,** ***Paracypris* sp. B** Esker, (1968)**.** ***Occultocythereis namrudia*** Al- Sheikhly, (1982)**,** ***Pontocyprella recurva*** Esker,( 1968). ***Pontocypris sylvesterbradleyi*** Jain, (1975)**.** Other species recorded from this zone also occur in the overlying and underlying zones: ***Bythocypris gohrbdonti*** Esker, (1968). ***Bythocypris windhami*** Butler and Jones, (1957). ***Paracypris* sp. A** Esker, (1968). ***Argilloecia taylorensis*** Alexander (1935)**,** ***Abyssocypris adunca*** Esker, (1968) and ***Xestoleberis* sp.** Said ( 1978)**.**

**Other faunas:** Planktonic foraminifera (***Globotruncana calcarata, Globotruncana havanensis***), Benthonic foraminifera (***Orbitoides tissoti, Orbitoides medius, Rotalia skourensis*** and ***Rotalia reicheli).***

**Distribution and thickness:** This zone has been recorded in all the studied boreholes and as follows:

| Borehole | Thickness (m) | Extending of the zone |
|---|---|---|
| ***A*** | 125 | Hartha Formation |
| ***B*** | 23 | Hartha Formation |
| ***C*** | 459 | Hartha Formation and lowermost of Shiranish Formation |
| ***D*** | 454 | Hartha Formation |

**Discussion:** The restricted occurrence of ***Globotruncanita calcarata*** in the middle and lowermost of the upper part of this biozon in the Borehole ***C*** solely and within the facies of the lower parts of Shiranish Formation indicates a Late Campanian age (Robasynski *et al*., 2000). In addition, the occurrence of ***Globotruncana havanensis*** above the assemblages of ***Globotruncanita calcarata*** indicates a Late Campanian age according to Gradstein *et al*., (2004).

**Correlation:** This zone is equivalent to biozone 3 of Al-Ubide, (1989) from NE Iraq which comprises about 43 species such as ***(Cytherella (C.) sylvesterbradleyi*** Reyment, (1963). ***Cytherella* sp.2** Colin *et al.*, (1982). ***Pontocyprella recurva*** Esker, (1968). ***Paracypris jonesi*** Bonnema, (1940) and ***Bythocypris windhami*** Butler and Jones, (1957). All the foregoing species are recorded in the present study.

In comparison with foraminifera, this zone is equivalent to ***Orbitoides tissoti* - *Orbitoides medius*** biozon of Al- Mutwali, (1992).

**Biozone 3: *Krithe* sp. M 1113 Interval zone**

**Definition:** Interval zone represents the restricted range between the first appearance of ***Krith* sp. M 1113** Donze, (1973) and the first appearance of ***Holcopocythere bassiporosa*** Al- Furaih, (1980).

**Age:** Early Maastrichtian

**Boundaries:** The base of this zone is recognized by the first appearance up hole of ***Krith* sp. M 1113** Donze, (1973). with the top defined by the first appearance up hole of ***Holcopocythere bassiporosa*** Al- Furaih, (1980).

**Associated species:** Only one species ***Abyssocypris tipaca*** Van der Bold( 1974) makes its first appearance within this zone and is restricted to it.

The following species make their first appearance in this zone although they have also been found in the overlying zones: ***Bairdia septentrionalis*** Bonnema, (1941). ***Bythocypris* sp.1** Foster *et al*., (1983). ***Pontocyprella rara*** El- waer, (1992). ***Paracyprideis IRC20*** Grosdidier( 1973). ***Schizocythere salahii*** El-waer, (1992). ***Krithe fortidimorphica*** El-waer, (1992). ***Acanthocythereis (Canthylocythereis) bolispinosa*** Al-Sheikhly, (1980). ***Hornibrookella cyclifossata*** Al- Furaih, (1977), and ***Xestoleberis* sp.** Said, (1978).

Other species were found in this zone and make their last appearance within it although they also occur in the underlying zones: ***Cytherella meijeri*** Esker, (1968). ***Bythocypris windhami*** Butler and Jones, (1957). ***Paracypris* sp. B** Esker, (1968). ***Abyssocypris adunca*** Esker, (1968). ***Occultocythereis namrudia*** Al-Sheikhly, (1982) and ***Occultocythereis elongata*** Al- Sheikhly, (1982).

The following species occur in this zone but also recorded from the higher and lower zones: ***Cytherella* cf. OUM1110** Grekoff (1969). ***Cytherella (C.) sylvesterbradleyi*** Reyment, (1963). ***Paracypris jonesi*** Bonnema, (1940). ***Bythocypris gohrbdonti*** Esker, (1968). ***Paracypris* sp.A** Esker, (1968). ***Pontocyprella recurva*** Esker, (1968) and ***Argilloecia taylorensis*** Alexander, (1935).

**Distribution and thickness:** This zone has been recorded from all the studied boreholes and as follows:

| Borehole | Thickness(m) | Extending of the zone |
|---|---|---|
| ***A*** | 152 | Uppermost of Hartha Formation, lower and middle parts of Shiranish Formation |
| ***B*** | 8 | Shiranish Formation |
| ***C*** | 115 | Lower parts of Shiranish Formation |
| ***D*** | 260 | Uppermost of Hartha Formation and lower parts of Shiranish Formation |

**Correlation:** This zone is equivalent to the biozone 4 and most of biozone 5 of Al-Ubide, (1989). from NE Iraq. These biozones comprise many ostracode species which recorded in the present study such as: ***Arglloecia taylorensis*** Alexander (1935)**,** ***Bythocypris gohrbdonti*** Esker, (1968). ***Bythocypris* sp.1** Foster *et al*.,

(1983)**,** ***Paracypris*** **sp. A** Esker, (1968)**.** ***Paracypris*** **sp. B** Esker, (1968). ***Cytherella (C.) sylvesterbradleyi*** Reyment, (1963). ***Krithe*** **sp. M1113** Donze, (1973) and ***Pontocyprella recurva*** Esker, (1968).

Regionally, this zone is correlated to the ***Peleriops phumatoides*** biozone of Athersuch, (1994) from Arabian Gulf.

**Biozone 4:** ***Holcopocythere bassiporosa*** **Interval zone**

**Definition:** Interval zone represents the restricted rang between the first appearance of ***Holcopocythere bassiporosa*** Al- Furaih, (1980) and the last occurrence of ***Paracypris jonesi*** Bonnema, (1940).

**Age:** Late Maastrichtian.

**Boundaries:** The base of this zone is defined by the first appearance of ***Holcopocythere bassiporosa*** Al- Furaih, (1980), while the top is determined by the last occurrence of ***Paracypris jonesi*** Bonnema, (1940).

**Associated species:** Two species appear first within this zone and were restricted to it. These are: ***Isohabrocythere teiskotensis*** and ***Xestoleberis sp.***

The following species have been found in this zone and also occur in the underlying zones: ***Cytherella cf.*** **OUM 1110**Grekoff, (1969). ***Cytherella*** **(*C.*)** ***sylvesterbradleyi*** Reyment, (1963). ***Bythocypris gohrbdonti*** Esker, (1968). ***Bairdia septentrionalis*** Bonnema, (1941). ***Bythocypris*** **sp.1** Foster *et al*., (1983). ***Paracypris jonesi*** Bonnema, (1940). ***Paracypris*** **sp.A** Esker, (1968). ***Pontocyprella rare*** El- waer, (1992). ***Pontocyprella recurva*** Esker, (1968). ***Propontocypris Sylvesterbradleyi*** Jain, (1975). ***Argilloecia taylorensis*** Alexander,(1935). ***Paracyprideis*** **IRC 20** Grosdidier, (1973). ***Schizocythere Salahii*** El- waer, (1992). ***Krithe*** **sp. M113** Donze, (1973). ***Krithe fortidmophica*** El-waer, (1992). ***Acanthocythereis*** **(*Canthylocythereis*)** ***bolispinosa*** Al-Sheikhly, (1980). ***Hornibrookella cyclifossata*** Al- Furaih, (1977) and ***Xestoleberis*** **sp.** Said, ( 1978).

**Distribution and thickness:** This zone is recorded from the studied boreholes except borehole ***B***. It is confined to the upper parts of Shiranish formation where the thickness reaches to: 109 m, 119 m, 207m in ***A***, ***C*** and ***D*** boreholes respectively.

**Discussion**: This zone represents the youngest in the studied sections. The top of this zone is observed by the conspicuous rarity of most ostracode species and by the disappearance of ***Paracypris jonesi*** Bonnema, (1940). while the bottom is characterized by the obvious occurrence of the species ***Gansserina gansseri*** (planktonic foraminifera) beside some of ostracod species. In addition, the top of this zone is taken as are unconformity which separates Shiranish Formation (Mesozoic) from Aaliji or Jaddala Formations (Cenozoic).

**Correlation**: This biozone is equivalent to ***Hornibrookella divergensis*** biozone of Athersuch, (1994) from Arabian Gulf. According to the same author, the index species ***Holcopocythere bassiporosa*** Al- Furaih, (1980). which is recorded in the present study resembles both ***Holcopocythere bassiporosa*** Al-Furaih, (1980) and

***Holcopocythere falsosulcata*** Al-Furaih, (1980) from the Late Maastrichtian and Early Paleocene of Saudi Arabia.

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## EXPLANATION OF PLATE 1

**Fig. 1:** ***Cytherella*** **Sp. 1** Babinoti *et. al.*, 1988
Carapace [MO.1, UC.1] External left lateral view x 50, Mushorah Fm, ***B*** borehole, depth, 891 m.

**Fig. 2:** ***Cytherella cf.*** **OUM 1110** Grekoff, 1969
Carapace [MO.1, UC.3] External left lateral view x 50, Hartha Fm., ***B*** borehole, depth, 849 m.

**Fig. 3:** ***Cytherella*** **IRC 22** Grosdidier, 1973
Carapace [MO.1,UC.4] External left lateral view x 50, Mushorah Fm., ***C*** borehole, depth, 1766 m.

**Fig. 4:** ***Cytherella (C.) Sylvestebradleyi*** Reyment, 1963
Carapace [MO.1, UC.5] External left lateral view x 50, Hartha Fm., ***A*** borehole, depth, 752 m.

**Fig. 5:** ***Cytherella mejeri*** Esker, 1968
Carapace [MO.1, UC.9] External left lateral view x 50, Hartha Fm., ***C*** borehole, depth, 1391 m.

**Fig. 6:** ***Cytherella*** **Sp.1** Colin *et. al.*, 1982
Carapace [MO.1,UC.11] External left lateral view x 50, Mushorah Fm., ***D*** borehole, depth, 2017 m.

**Fig. 7:** ***Cytherella*** **Sp.2** Colin *et. al.*, 1982
Carapace [MO.1, UC.12] External left lateral view x 50, Hartha Fm., ***D*** borehole, depth, 1612 m.

**Fig. 8:** ***Bairdia*** **IRC19** Grosdidier, 1973

Carapace [MO.1, UC.14] External right lateral view x 40, Hartha Fm., ***C*** borehole ,depth, 1523 m.

**Fig. 9:** ***Bairdia septentrionalis*** Bonnema, 1941
Carapace [MO.1,UC.15] External right lateral view x 40, Shiranish Fm., ***B*** borehole , depth, 834 m

**Fig. 10:** ***Bythocypris gohrbdonti*** Esker, 1968
Carapace [MO.1,UC.17] External right lateral view x 50, Mushorah Fm., ***D*** borehole, depth, 2026m.

**Fig. 11:** ***Bythocypris windami*** Butler and Jones, 1957
Carapace [MO.1,UC.18]External right lateral view x 50, Mushorah Fm., ***B*** borehole, depth, 891 m.

**Fig. 12:** ***Bythocypris*** **Sp.1** Foster *et. al*., 1983
Carapace[MO.1,UC.19]External right lateral view x 50, Shiranish Fm., ***A*** borehole, depth, 583 m

**Fig. 13:** ***Paracypris Jonesi*** Bonnema,1940
Carapace [MO.1,UC.20] External right lateral view x 50, Shiranish Fm., ***D*** borehole, depth, 1256m.

**Fig. 14:** ***Paracypris*** **Sp.A** Esker, 1968
Carapace [MO.1, UC.21] External right lateral view x 50, Mushorah Fm., ***B*** borehole, depth, 874 m.

**Fig. 15:** ***Paracypris Sp.B*** Esker,1968
Carapace [MO.1,UC.22] External right lateral view x 50, Shiranish Fm., ***D*** borehole, depth, 1316m.

**Fig. 16:** ***Pontocyprella rare*** El- waer, 1992
Carapace [MO.1, UC.23] External right lateral view x 50, Hartha Fm., ***B*** borehole, depth, 851 m.

**Fig. 17:** ***Pontocyprella recurva*** Esker, 1968
Carapace [MO.1,UC.24] External right lateral view x 50, Shiranish Fm., ***C*** borehole, depth, 1167m.

**Fig. 18:** ***Propontocypris Sylvesterbradleyi*** Jain, 1975
Carapace [MO.1, UC.27] External right lateral view x 50, Hartha Fm., ***D*** borehole, depth, 1866 m.

## EXPLANATION OF PLATE 2

**Fig. 1:** ***Argilloecia taylorensis*** Alexande, 1935
Carapace [MO.1,UC.28] External right lateral view x 50, Shiranish Fm., ***C*** borehole, depth, 1196m.

**Fig. 2:** ***Abyssocypris Adunce*** Esker, 1968
Carapace [MO.1,UC.29] External right lateral view x 50, Mushorah Fm., ***D*** borehole, depth, 2102m.

**Fig. 3:** ***Abyssocypris Tipaca*** Van der Bold, 1974
Carapace [MO.1, UC.30] External left lateral view x 50, Shiranish Fm., ***A*** borehole, depth, 619 m.

**Fig. 4:** ***Paracyprideis*** **IRC 20** Grosdidier, 1973
Carapace [MO.1,UC.31] External right lateral view x 50, Shiranish Fm., ***C*** borehole, depth, 1217 m.

**Fig. 5*: Schizocythere Salahii*** El- waer, 1992
[MO.1,UC.32] External right valve lateral view x 50, Shiranish Fm., ***C*** borehole, depth, 1156 m.

**Fig. 6 :** ***Isohabrocythere teiskotensis*** Apostolescu, 1961
Carapace [MO.1,UC.33] External right lateral view x 50, Shiranish Fm., ***D*** borehole, depth, 1127m.

**Fig. 7:** ***Brachycythere*** **IRC 28** Grosdidier, 1973
Carapace [MO.1,UC.36] External left lateral view x 50, Mushorah Fm., ***C*** borehole, depth, 1752 m.

**Fig. 8:** ***Krithe*** **Sp. M1113** Donze, 1973
Carapace [MO.1, UC.39] External right lateral view x 50, Hartha Fm., ***B*** borehole, depth, 852 m.

**Fig. 9:** ***Krithe fortidmophica*** El-waer, 1992
Carapace [MO.1,UC.40] External right lateral view x 50, Shiranish Fm., ***D*** borehole, depth, 1327m.

**Fig. 10:** ***Occultocythereis namrudia*** Al- Sheikhly, 1982
Carapace [MO.1,UC.42] External right lateral view x 50, Shiranish Fm., ***A*** borehole, depth, 579 m.

**Fig. 11:** ***Occultocythereis elongata*** Al- Sheikhly, 1982
Carapace [MO.1,UC.43] External right lateral view x 50, Shiranish Fm., ***A*** borehole, depth,1263m.

**Fig. 12:** ***Acanthocythereis (Canthylocythereis) bolispinosa*** Al-Sheikhly(1980)
Carapace [MO.1,UC.47] External left lateral view x 50, Shiranish Fm., ***A*** borehole, depth, 613m.

**Fig. 13:** ***Holcopocythere bassiporosa*** Al- Furaih, 1980
Carapace [MO.1,UC.45] External left lateral view x 50,Shiranish Fm., ***C*** borehole, depth, 1319 m.

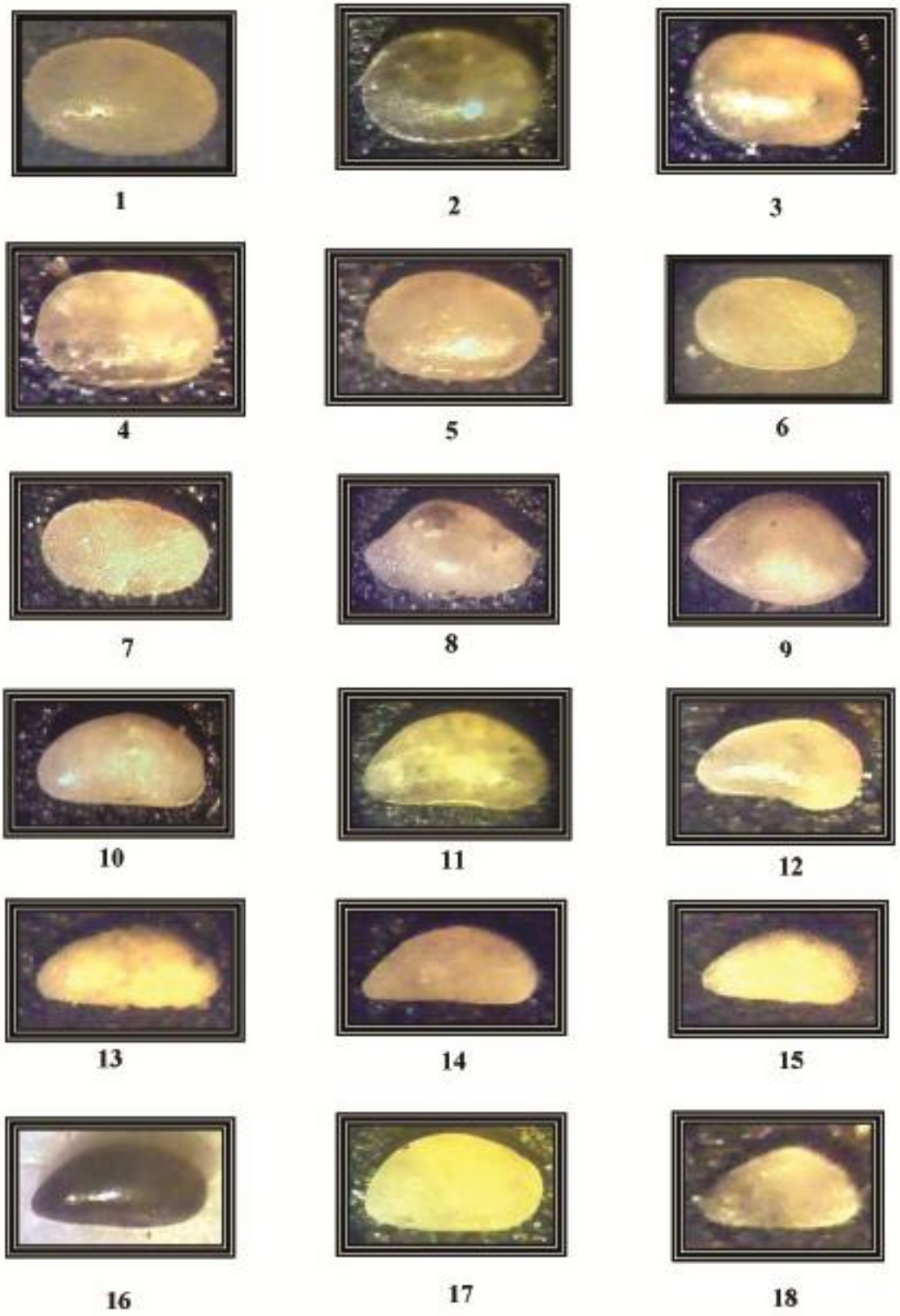
**Fig. 14:** ***Hornibrookella cyclifossata*** Al- Furaih, 1977
[MO.1, UC.46] External right valve lateral view x 50, Shiranish Fm., ***A*** borehole, depth, 622 m.

**Fig. 15:** ***Planileberis*** **IRE 23** Grosdidier, 1973
Carapace [MO.1,UC.48] External right lateral view x 50, Mushorah Fm., ***C*** borehole, depth, 1784m.

**Fig. 16:** ***Xestoleberis tunisiensis*** Esker, 1968
Carapace [MO.1,UC.50] External right lateral view x 50, Shiranish Fm., ***D*** borehole, depth, 1137m.

**Fig. 17:** ***Xestoleberis*** **Sp.** Said, 1978
Carapace [MO.1,UC.51] External left lateral view x 50, Shiranish Fm., ***C*** borehole, depth, 1242 m.

**PLAET 1**



**PLAET 2**