DISENTANGLING THE BALEARIC FIRST SETTLEMENT ISSUES

by Josep Antoni ALCOVER [1, 2]

Resum

Es presenten els tres models disponibles actualment (2004) sobre la primera colonització humana de les Balears, i es tabulen les seves característiques principals. El Model d'Arribada Tardana presentat per primera volta a Endins (2001) és un model original i ben diferenciat dels altres. S'avaluen diferents aspectes metodològics d'aquests models. L'evidència arqueològica que disposam a l'actualitat és consistent amb la cronologia i interpretacions suggerides pel Model d'Arribada Tardana.

Summary

The three models for the first human settlement of the Balearic Islands currently available are presented in this paper, and their main characteristics are showed in a table. The Late Arrival Model firstly presented in Endins (2001) is an original model, radically different to the other ones. Different methodological approaches for these models are evaluated. The archaeological evidence currently available is consistent with the chronology and interpretations suggested by the Late Arrival Model.

Introduction

A thorough review of the chronology of the earliest prehistory of the Balearic Islands has been recently undertaken (e.g., GUERRERO, 1999, 2000; LULL *et al*., 1999; COSTA, 2000; RAMIS & BOVER, 2000; ALCOVER *et al*., 2000; GUERRERO, 2001, 2002a; RAMIS & ALCOVER, 2001a, 2001b; ALCOVER *et al*., 2001; COLL, 2000, 2001; CALVO & GUERRERO, 2002; RAMIS *et al*., 2002, and in press; RAMIS & ALCOVER, in press). Likewise, new research on the chronology of the extinction of endemic pre-human fauna from the Balearic Islands has appeared elsewhere (BOVER & ALCOVER, 2003; QUINTANA *et al*., 2003; BOVER *et al*., submitted; McMINN *et al*., submitted), as well as relevant new datings related to the first human settlement of these islands (e.g., COSTA & BENITO, 2000; PLANTALAMOR & MARQUÈS, 2001, 2003; VAN STRYDONCK & MAES, 2001; CALVO & GUERRERO, 2002; WALDREN *et al*., 2002; VAN STRYDONCK *et al*., 2002, and in press; VAN STRYDONCK & BOUDIN, 2003).

The two models on the first human settlement proposed during the last 30 years (i.e., the "Classical Model" developed by Dr W.H. WALDREN, Donald Badell-Powell Quaternary Research Center, Oxford, and the "Early Arrival Model" mainly developed by Dr V. M. GUERRERO, Universitat de les Illes Balears, Palma de Mallorca) were reviewed by ALCOVER *et al*. (2001) and RAMIS *et al*. (2002), who showed that available evidence does not support either of them, and, alternatively, proposed a new one ("Late Arrival Model"). Recently, CALVO & GUERRERO (2002), CALVO *et al*. (2002), WALDREN (2002a), WALDREN *et al*. (2002), DAVIS (2002) and GUERRERO (2002a, b) have questioned the Late Arrival Model, opening again the debate on the Balearic First Human Settlement. Consequently, three interpretations continue available at the start of 2004 on the chronology of the first settlement of the Balearic Islands. The different approaches and interpretations provide a case-study to establish and evaluate the reliability of different research methodologies. The goal of the present paper consists of evaluating some selected features of the methodological framework of these models according to the available archaeological evidence.

The three disparate models on the chronology of the first human arrival are best illustrated comparing their defining features (see Table 1). Although the discussion introduced here concerns a small territory, the Balearic Islands, its scope is broad. First, because the Balearic Islands are a very singular territory due to its extreme isolation in the Mediterranean (e.g., GUERRERO, 2001). Second, since they were considered during a long time as the Mediterranean Islands with one of the best palaeontological and archaeological records,

1 Institut Mediterrani d'Estudis Avançats (CSIC-UIB), Cta. de Valldemossa km 7,5, 07122 Palma de Mallorca (Balearic Islands). e-mail: vieapba@uib.es

2 Research Associate, Department of Mammalogy, American Museum of Natural History, Central Park West at 79th Street, New York (USA)

	LATE COLONIZATION MODEL	CLASSICAL MODEL	NEO-CLASSICAL MODEL
	ALCOVER *et al.* (2001) **RAMIS *et al.* (2002)**	**WALDREN *et al.* (2002)** **WALDREN (2002)**	**CALVO *et al.* (2002)** **CALVO & GUERRERO (2002)** **GUERRERO (2002a,b)** **SALVÀ *et al.* (2002)** **GUERRERO & CALVO (2003)**
1. **Uncertainity period for human arrival (UPHA), in Mallorca**	3000-2030 cal BC After the new dating of Ca Na Cotxera (CALVO & GUERRERO, 2002), this UPHA should be transformed: **3000-2040 cal BC** (terminus post quem – terminus ante quem)	After WALDREN (2002: 158): **before c. 5600 cal BC and after c. 5800 cal BC**	No explicitly identified. After the reading of the papers, its terminus ante quem could be established **at 3200 cal BC (CALVO & GUERRERO, 2002: 41, 46), c.3700 - 3100 cal BC (CALVO & GUERRERO, 2002: 141), 3500 cal BC (CALVO & GUERRERO, 2002: 142) or 3900 cal BC (GUERRERO & CALVO, 2003: 97)** [with a possible later extinction of the human population], while its terminus post quem has been never explicited.
2. **Based on:**	terminus ante quem (2040 cal BC): Direct dating on introduced herbivores terminus post quem (c.3000 cal BC): • Absence of "cultural markers" defining IV millennium BC • Chronology of the vegetation change • Chronology of the last occurrence of endemic fauna • Sedimentological change	terminus ante quem (before c. 5000 cal BC): • Dating KBN-640d, claimed to belong to human bones: 5934±109 BP [5250-4500 cal BC] (c. 5600 cal BC): • Dating QL-29, claimed to belong to corraled *Myotragus*: 6680±120 BP [5810-5370]	terminus ante quem (from 3100 to 3900 cal BC, following different statements): • Chronology of the vegetation change situated by CALVO *et al.* (2002: 168) between c.4000/3700 and 3000 BC. • Datings I-5516 [4850-4350 cal BC], QL-988 [3700-3000 cal BC] and BM-1994R [4250-3700] (CALVO *et al.* 2002: 167; GUERRERO & CALVO, 2003: 97). Datings on unidentified charcoal. Applying the maximal reduction (550 years) as suggested by CALVO & GUERRERO (2002: 46), the terminus ante quem would be 3800 cal BC (based on I-5516) or 3150 cal BC (based on BM-1994R). Applying a lesser correction, earlier termini ante quem emerge.
3. **Chronology of the first human evidence, Mallorca**	Predating 2030 cal BC. After the new dating of Ca Na Cotxera (CALVO & GUERRERO, 2002), this date should be amended to: **Predating 2040 cal BC**	**Predating c. 5000 cal BC (WALDREN et al. 2002) or c. 5600 cal BC (WALDREN 2002)**	**Probably about 3200, 3500 or 3900 cal BC (e.g., GUERRERO & CALVO, 2003: 97)**
4. **Time span of the first human evidence (i.e., time interval within which the first human evidence is situated), Mallorca**	2300-2030 cal BC After the new dating of Ca Na Cotxera (CALVO & GUERRERO, 2002), this range should be amended to: **2300-2040 cal BC**	No explicitly identified.	No explicitly identified.
5. **No availability of human evidence based on acceptable precise samples, Mallorca**	**Before 2300 cal BC**	**Before c. 6000 cal BC**	No explicitly identified.
6. **Cultural attribution of the earliest archaeological evidence**	It could represent **Bronze Age** (i.e., there are no unquestionable evidence for Chalcolithic/Copper Age)	**Meso/Neolithic**	It should represent a **"pre-Chalcolithic" Age** (i.e., Neolithic presence)
7. **Chronology of the extinction of *Myotragus*, Mallorca**	It has been established in an indeterminate age **within the interval 3700-2030 cal BC**	No explicited in these paper. According to the previous papers it should be **situated c. 2700 or c. 2200 cal BC** (WALDREN 1986: 138) on the basis of dating BM 1404: 4093 ± 398 BP)	It could be **after 3700 cal BC** (CALVO & GUERRERO, 2002: 19)**,** and it should be **before c. 2500 or c. 2700** (CALVO & GUERRERO 2002: 20).
8. **Chronology of the last occurrence of *Myotragus*, Mallorca**	In an indeterminate age **inside the interval 3700 - 1600 cal BC**	No explicited by author	**3700-1600 cal BC**
9. **Chronology of the *Myotragus* extinction, Menorca**	Not considered by these authors. The available datings from 1999 allow BOVER & ALCOVER (2003) to establish that it occurred within the interval 10,000 cal BC and 1930 cal BC. QUINTANA *et al.* (2003), present new evidence placing the extinction in an indeterminate age inside the interval 3950 - 1930 cal BC	Not considered by author.	No datings available for Menorca (CALVO et al., 2002: 166)

10. **Chronology of the last occurrence of *Myotragus*, Cabrera**	Somewhere within the interval 3650 - 3380 cal BC	No considered by author.	3650 - 3380 cal BC
11. **Chronology of the *Myotragus* extinction, Cabrera**	Not considered by authors. BOVER & ALCOVER (2003), place the extinction **within the interval 3650 - 300 cal BC.**	Not considered by author.	Unclearly specified (CALVO *et al*., 2002: 166)
12. **Domestication of *Myotragus***	Not accepted	Accepted	Not accepted
13. **Chronology of the extinction of the autochthonous bird fauna, Eivissa**	Not considered by authors. The lecture of the datings furnished by ALCOVER *et al*. (2001) allow to establish that the extinction of *Rallus eivissensis* postdates 5300 cal BC, while the extinction of *Anser* aff. *erythropus* postades 4670 cal BC),	Not considered by author.	**Between c. 5300 and 4350 cal BC** (if the Holocene faunal extinction is related to human arrival; CALVO *et al*., 2002: 161)
14. **Methodological framework**	Application of criteria of methodological and chronological hygiene (i.e., tests of quality) and use of scientific method.	40 years of experience (WALDREN et al., 2002)	A peculiar multifactorial lecture of the archaeohistoric record
15. **Timing for the starts of this approach**	1998/1999	1965 (reviewed, 1982)	2002 (claimed: 1995)
16. **Chronology of the vegetation change, Mallorca**	Only roughly considered by authors. After BOVER & ALCOVER (2003), **it should postdate 5380 cal BC**	Not considered by author	Heterogeneous data: **Within the interval 5380-5040 cal BC** (CALVO *et al*., 2002: 167)
17. **Chronology of the vegetation change, Menorca**	Only roughly considered by authors. After BOVER & ALCOVER (2003), **it should postdate 2880 cal BC**	Not considered by author	Heterogeneous data: **Within the interval 4050-3760 cal BC** (CALVO *et al*., 2002: 167)
18. **First pottery**	Within the interval 2300-2040 cal BC	c. 3400 cal BC (WALDREN, 2002: 163) Before 3988 cal BC (WALDREN *et al*., 2002: 75)	Before 3000 cal BC (based on dating QL-988), and before 3700 cal BC (based on dating BM-1994-R) (CALVO *et al*., 2002: 167) or before 3900 cal BC (CALVO *et al*., 2003: 97, also based on BM-1994-R). The application of a "correction" to these dates (CALVO *et al.,* 2002: 168) would transform them to before 2450 cal BC, or before 3250 cal BC, or before 3350 cal BC.
19. **First domesticants**	Within the interval 2300-2040 cal BC	c. 3400 cal BC (WALDREN, 2002: 163) Before 3988 cal BC (WALDREN et al., 2002: 75)	Before 3000 cal BC (based on dating QL-988), or before 3700 cal BC (based on dating BM-1994-R) (CALVO *et al*., 2002: 167) or before 3900 cal BC (CALVO & GUERRERO, 2003: 97, also based on BM-1994-R). The application of a "correction" to these dates (CALVO *et al*., 2002: 168) would transform them to before 2450 cal BC, or before 3250 cal BC, or before 3350 cal BC.
20. **Chronology for the introduction of metallurgy**	It can be established previous to 2040 cal BC. Undocumented before 2300 cal BC (Based on datings at Coval Simó, COLL, 2001)	c. 2000-1800 cal BC or 1800-1400 cal BC (Based on datings from Balma de Son Matge)	c. 2500 or perhaps c. 2700 cal BC
21. **Presence of elephant ivory**	Not considered by these authors. After ALCOVER *et al.* (in prep.): Not adequately documented	Yes	Yes
22. **Start of the Mallorcan Bronze Age**	Probably before 2040 cal BC	c. 1800 cal BC	c. 1700 cal BC

Table 1. Defining features of the different models proposed for the First Balearic Islands Settlement available in 2004. Differences are obvious, and differences between the view of ALCOVER *et al.* (2001) and the previous views presented along 2000 - 2001 of the authors of the Neo-Classical model (no presented here, but see table 2) are bigger. They are still bigger for the views presented by these authors during 1995 - 1999 (not presented in this paper). The claimed continuity of the model from 1995 to present time is questionable.

Taula 1. Trets definitoris dels diferents models proposats sobre la primera colonització humana de les Balears disponibles el 2004. Les diferències són òbvies, i les diferències existents entre l'aproximació d'ALCOVER *et al*. (2001) i les aproximacions presentades durant 2000 i 2001 pels autors del Model Neo-Clàssic (no presentades aquí, però vegeu la taula 2) són encara majors. Encara hi ha diferències majors amb les aproximacions presentades per aquests autors durant 1995 - 1999 (no presentades a aquest treball). La continuïtat del model des de 1995 és discutible.

and shared with Cyprus the claimed best documentation on the contact between the first human settlers and an endemic island fauna (e.g., SIMMONS, 1999).

Given the need to refer to cultural periods, in this paper the terms Chalcolithic and Bronze Age will be used *sensu* HARDING (2000), while "Chalcolithic" and "Bronze Age" (within quotation marks) refer to the periods considered by CALVO & GUERRERO (2002) and SALVÀ *et al.* (2002) with these names.

The Models

Classical Model versus Late Arrival Model

The model by WALDREN *et al*. (2002) remains practically unchanged compared to their previous papers (e.g., WALDREN 1974, 1982, 1997, 1998; WALDREN & KOPPER 1967, 1969). It has been discarded by ALCOVER *et al.* (2001) and RAMIS *et al*. (2002). In its current version (WALDREN *et al*., 2002; see Table 1), the only novelties added are (1) the introduction of several new datings and (2) the identification of his methodological framework. Although WALDREN *et a*l. (2002) represents a refusal to the approach of ALCOVER *et al.* (2001), it totally lacks arguments rejecting the disqualifications for the Classical Model presented by ALCOVER e*t al*. (2001), and consequently they still remain.

As regard the new datings introduced by WALDREN *et al.* (2002), it should be remarked that their reliability is problematic, because sample integrity problems at Cova de Moleta (VAN STRYDONCK *et al*., in press) and the uncertain origin of the dated materials (see WALDREN *et al*., 2002, and VAN STRYDONCK *et al*., in press). Due to the high number of unjustified changes in both datings and precise location of archaeological items in the stratigraphic columns (e.g., LULL *et al*., 1999; GUERRERO, 2000; ALCOVER *et al*., 2001), we cannot accept any of WALDREN new datings while they remain invalidated by new, independent, research.

Neo-Classical Model versus Late Arrival Model

The model presented by CALVO & GUERRERO (2002), CALVO *et al*. (2002) and GUERRERO (2002b) is radically different to what was formerly defended by these authors. Although CALVO *et al*. (2002) consider that their new model was first proposed in 1995, the huge differences between their postulates of 2001 and 2002 (see Table 2), and the previous large change in statements in 1999 (GUERRERO, 1999), argue against their own claim. CALVO & GUERRERO (2002), CALVO *et al*. (2002) and GUERRERO (2002b) introduced definitely a new model for the chronology of the first settlement, developed after knowing the postulates of ALCOVER *et al*. (2001). It will be referred to here as the "Neo-Classical Arrival Model". It is based on a selection of datings obtained by the author of the Classical Model and others by them.

The suggestion (GUERRERO, 2002b: 132) that the statements of the Late Arrival Model of ALCOVER *et al*. (2001) have been published previously by GUERRERO (1999, 2000) cannot be accepted (see differences in table 1 and the chronological record of the shift in statements in the last successive papers presented by GUERRERO and co-workers in table 2). Otherwise, although differences between the Late Arrival and Neo-Classical Model are smaller compared to differences between the Late Arrival and the Early Arrival Model (developed by GUERRERO and co-workers until 2001), they are large enough as to reject an "identity of empiric proofs and results". The main differences between both models rely on the methodological approach they apply and on the results they achieve (Table 1). Differences involve at least 11 relevant points. Those affecting methodology include:

1. Lecture of ^{14}C datings. GUERRERO (2002a, b), CALVO & GUERRERO (2002) and SALVÀ *et al*. (2002: 215) emphasize the lecture of series of datings, accepting them indiscriminately without any application of criteria of "chronological and documentation hygiene" when ^{14}C datings fall in a "narrow" span (as suggested by GRAVES & ADDISON, 1995). On the contrary, ALCOVER *et al*. (2001) and RAMIS *et al*. (2002), following SPRIGGS (1989), ANDERSON (1991) and SPRIGGS & ANDERSON (1993), consider that proper lectures of ^{14}C datings must be preceded by the application of criteria of "chronological and documentation hygiene" (i.e., a qua lity test), and only depurate datings (even single datings) provide acceptable dates for archaeological interpretations (see RAMIS & BOVER, 2001; RAMIS & ALCOVER, 2001a, b). Consequently, a single dating on an adequate sample (i.e., on good qua-lity collagen of a short-life organism obtained on a well defined archaeological or palaeontological context) could provide useful chronological information, while series of datings on inadequate samples and/or uncertain stratigraphic contexts should be excluded from the analyses.

2. Distinction between "first solid available evidence" of human presence and the "time of human arrival". ALCOVER *et al*. (2001) consider that the time range covered by the different available datings does not represent the time of arrival of humans, and consequently they establish an "uncertainty period for human arrival" for each island (UPHA; see BOVER & ALCOVER, 2003). CALVO & GUERRERO (2002) and GUERRERO (2002b) do not distinguish between both concepts.

3. Distinction between "last documented occurrence" of autochthonous species and the proper time of their extinction. ALCOVER *et al*. (2001) and BOVER & ALCOVER (2003) consider that the time range covered by the different available datings does not represent the time of the extinction of endemics, and consequently they establish "uncertainty periods for extinction events" (UPEs; see BOVER & ALCOVER, 2003, for definition). CALVO & GUERRERO (2002) and GUERRERO (2002b) do not distinguish between both concepts.

4. Application of chronological hygiene criteria. ALCOVER *et al*. (2001) apply precise protocols, following SPRIGGS (1989), ANDERSON (1991) and SPRIGGS & ANDERSON (1993), while CALVO &

GUERRERO (2002) and GUERRERO (2002b) assume that deviation between actual event dates and dates derived from ^{14}C datings on wood or charcoal samples are very small, suggesting that they might be lower than 250/300 years and, unquestionably, lower than 500/550 years (e.g., CALVO & GUERRERO, 2002: 208).

5. Chronostratigraphic importance of the "artifactual markers". CALVO & GUERRERO (2002) and GUERRERO (2002b) consider the sole presence of "artifactual markers" as an indisputable basis to establish chronologies. On the contrary, ALCOVER *et al*. (2001) consider that chronologies cannot be based on the exclusive presence of materials in absence of adequate datings associated to them.

6. General methodological framework. ALCOVER *et al*. (2001) emphasize on the importance of the scientific approach, while GUERRERO (2002b) emphasizes for the acceptance of results derived from a peculiar lecture of the "historiographic background" through a "multifactorial interpretation", and simultaneously try to ridiculize the approach of ALCOVER *et al*. (2001) appealing to the "Mickey Mouse laws" (e.g., GUERRERO, 2002b: 159).

There are considerable differences between both models also with respect to key results, as follows (see Table 1):

- the chronology of the first contact event on the different islands.
- the chronology of the extinction of *Myotragus*.
- the chronology of the extinction of the autochthonous bird fauna on Eivissa.
- the chronology of the vegetation change and its putative attribution to the first human settlers.
- the cultural identity of the first settlers of Mallorca.

These controversial methodological points and results will be carefully analyzed herein to test the reliability of both approaches.

Analysis of Methodological Approaches

1.

The first methodological discrepancy between the Neo-Classical Arrival Model and the Late Arrival Model involves three aspects. First, the placement of the "chronologic and documentation hygiene criteria" in the work protocol. Second, the number of suitable radiocarbon dates needed to establish acceptable chronologies. Third, the lecture of the single point estimates of a date, 1σ extremes and 2σ extremes.

Claims against the use of criteria of chronological and documentation hygiene made previous to the analysis of the data cannot be accepted. Scientific advancement requires of adequate data bases, and these are only acceptable after having passed a quality test (e.g., PETTITT *et al*., 2003).

CALVO & GUERRERO (2002: 22) argue that only results based on series of datings are definitely acceptable, whereas conclusions derived from single datings are questionable. But they use single datings from several deposits in support of some of the key issues of their Neo-Classical Arrival Model (e.g., the only available dating from Puig de ses Torretes, Eivissa, UtC 8319, which is on the basis of their proposal of "Chalcolithic" on Eivissa at the end of the third millennium cal BC, - CALVO *et al*., 2002: 177-; or the only available dating of *Myotragus* from Cabrera, UtC-6515, being the basis of their proposal for the chronology of the disappearance of *Myotragus* on Cabrera). To surpass the problem of scarcity of datings, these authors consider that when the number of independently obtained samples is "small" the proper lecture should include the 2σ range of the calibrated age, while for greater number of radiocarbon dates the proper lecture should be the 1σ range (CALVO & GUERRERO, 2002: 22; CALVO *et al*., 2002: 184; and GUERRERO, 2002a: 209-210, 2002b). These authors sometimes consider that a radiocarbon dating implies the presence of the dated material over all the $n\sigma$ range (e.g., CALVO & GUERRERO, 2002: 27), while in other cases it implies its possible presence at some unspecified point inside the $n\sigma$ range (CALVO & GUERRERO, 2002: 19) or at some specified point inside it, such as its median value, which is eventually used as the central point estimate of the dating (GUERRERO & CALVO, 2003: 236). This disparity of criteria is extensively applied.

Although we agree with these authors that it is better to have a large number of datings, no mathematical basis exists to support their proposal for a differential use of 1σ or 2σ intervals depending on the number of independently obtained samples analyzed, and the use of single point age estimates has a problematic statistical significance. When *n* ^{14}C datings, all related with the same archaeological event of unknown duration (not with parts of the same datable object; i.e., not datings from different bones of a single specimen or from different fragments of the same bone), are available [such as a stratigraphic unity (e.g., layer α), each dating normally distributed (i.e., before calibrating), with $\bar{x}_1 \ldots \bar{x}_n$ means and $\sigma_1 \ldots \sigma_n$ values], the estimated age of the layer is not $(\Sigma_{i=1-n}\, \bar{x}_i)/n$.

If we have *n* independent ^{14}C datings, pooling of all samples to obtain smaller σ values for the event is a wrong scientific goal. First, the curve obtained through adding all individual distribution curves will not usually follow a normal distribution. Only in case that the means of the individual distribution curves were normally distributed, a new σ_τ value would be obtained. Second, even in this hypothetical case, the new σ_τ value of the distribution curve of means would be unrelated with the previous σ_1 - σ_n values. The assumption that σ_τ should be lower than the previous σ_1 _ σ_n values does not has consistence.

Likewise, $\bar{x}_i$ values, with i = 1 to n, are not stronger age-estimates when *n* increases. After calibrating, it is possible to introduce different single point estimates for a dating, but all are problematic due to the complex shape of the probability density function (TELFORD *et al*., 2004). Otherwise, *p* for single points tends towards

	GUERRERO (2000b): La colonización humana de Mallorca en el contexto de las islas occidentales del Mediterráneo: una revisión crítica. In GUERRERO, VM & GORNÉS S, "Colonización humana en ambientes insulares. Interacción con el medio y adaptación cultural". Edit: Universitat de les Illes Balears	GUERRERO, CALVO & SALVÀ (2001): La Cova des Moro (Manacor, Mallorca). Campanyes d'excavacions arqueològiques 1995-1998). Quaderns de Patrimoni Cultural 4	GUERRERO (2001a): The Balearic Islands: Prehistoric Colonization of the Furthest Mediterranean Islands from the Mainland. Journal of Mediterranean Archaeology 14: 136-158	CALVO & GUERRERO (2002): Los inicios de la metalurgia en Baleares. El Calcolítico (c.2500 - 1700 cal BC). Edit. El Tall.	CALVO, GUERRERO, SALVÀ (2002): Los orígenes del poblamiento balear. Una discusión no acabada. Complutum 13: 159-191
Chronology of the first human presence on Mallorca	p. 100: c.7500-4500? (the interrogation refers to the earliest datum)	p. 32: the earliest dating of cova de Canet could suggest human presence some millennia before the start of V millennium cal BC p. 39 (chart): before 7500, and roughly situated between 7800 and 8800 cal BC?	p. 141: 7500-4500 cal BC? (the interrogation refers to the earliest datum) p. 149 (chart): before 7500, and roughly situated between 7800 and 8800 cal BC?	Not directly considered. Ambiguously, some reference to the Neolithic presence on Mallorca appears (e.g., p. 45-46) based on GUERRERO (2000b) and (2001a)	p. 165-168: perhaps c. 4000/3700, and certainly before 3000 cal BC
Chronology of the first frequentation, without stable settlement	p. 100: c. 4500	p 32: The periodic frequentation of Mallorca could start at the starts of Vth millennium cal BC. p. 39 (chart): before 5000 cal BC, and roughly situated between 5000 and 5800 cal BC?	p. 146: 4798 cal BC (first documented human presence) p. 147: c. 4500 cal BC the human presence and activities are great enough as to affect seriously the ecosystems. p. 149 (chart): before 5000 cal BC, and roughly situated between 5000 and 5800 cal BC?	Not directly considered topic. Unambiguously, there are references to human presence at the last third of the IVth millennium cal BC (e.g.: p. 41, 46, 136, 141, 206) and to the first half of the IVth millennium cal BC (e.g.: 141, 142).	p. 165-168: perhaps c. 4000/3700, and before 3000 cal BC
Accepted datings supporting the first human frequentation	p. 140: 4840 ± 110: Human remains of Cova de Moleta 4635 ± 115: Charcoal … from Son Matge c.4620: Charcoal from Cova de Canet p. 106: 4570 cal BC: Charcoal from Cova de Canet (upper end of the 2σ range)	p. 33: 4840 ± 110: Human remains at Cova de Moleta 4635 ± 115: Charcoal … from Son Matge c.4620: Charcoal from Cova de Canet	p. 146: Dating of human remains of Cova de Moleta	p. 41: I-5516 (Son Matge): 4850-4350 2σ cal BC QL 988 (Son Matge): 3700-3000 2σ cal BC BM-1994R (Son Gallard): 4250-3700 2σ cal BC	p. 167: QL 988 (Son Matge): 3700-3000 2σ cal BC BM-1994R (Son Gallard): 4250-3700 2σ cal BC
Chronology of the first succesful stable settlement	p. 140: "c. 3500" p. 152: at the middle of IVth millennium cal BC	p. 33: last third of the IVth millennium cal BC	p. 147: first colonization assays: c. 3972 cal BC "a clearly detected colonization proccess occurred at the middle of IVth millennium cal BC"	2500/2300 or perhaps 2700	p. 168-169: 2500/2300 or perhaps 2700
Datings supporting the chronology of the first successful stable settlement	p. 151: QL 988 Son Matge (3395 ± 120 cal BC) BM1994R Son Gallard (3972 cal BC)	p. 33: QL 988 Son Matge (3395 ± 120 cal BC) BM1994R Son Gallard (3972 cal BC)	p. 147: BM 1994R (Son Gallard) QL 988 (Son Matge)	p. 27, 32, 46, 51: For 2300-2200 cal BC: Datings of Ca na Cotxera, Coval Simó and Cova des Moro For c. 2700 cal BC: Datings from Son Ferrandel	p. 169: For 2300-2200 cal BC: Datings of Ca na Cotxera, Coval Simó and Cova des Moro For c. 2700 cal BC: Datings from Son Ferrandel
***Myotragus* Extinction chronology on Mallorca (*terminus post quem*)**	p. 157: It is only possible to establish that it occurred later than 4500 cal BC	p. 33: It is only possible to establish that it occurred later than 4500 cal BC	p. 145: It is only possible to establish that it occurred later than 4500 cal BC	p. 19/138: Perhaps posterior to 3700 cal BC	p. 166: Perhaps posterior to 3700 cal BC
***Myotragus* Extinction chronology on Mallorca (*terminus ante quem*)**	p.158: Previous to 3500 cal BC ["De forma que, salvo prueba en contrario, debemos admitir que la primera colonización estable de Mallorca encontró la isla despoblada de macromamíferos terrestres"]			p. 20: Previous to 2700/2500 cal BC	p. 166: Previous to the "Chalcolithic" Period (i.e., previous to 2500 cal BC or even previous to 2700 cal BC)
Datings supporting the *Myotragus* Extinction chronology on Mallorca	UtC 5171	UtC 5171	UtC 5171	BM-1408	BM-1408
Location of the Earliest Human Remains on Mallorca	p. 107: Cova de Moleta	p. 33: Cova de Moleta	p. 146: Cova de Moleta	Cova des Moro	Cova des Moro
Start of the "Chalcolithic" on Mallorca		p. 34: 2500 cal BC		c. 2500 cal BC	p. 169/182: 2500/2300 cal BC, or perhaps 2700 cal BC

Introduction of *Capra* and *Ovis*	p. 153: Previous to 3000 cal BC		p. 147: Before 3395 cal BC p. 148: Before 3000 cal BC	The classical domesticated stock (*Capra/Ovis/Bos/Sus*) is recorded on all archaeozoological records	
Introduction of *Bos* and *Sus*	p. 153: Postdating the *Capra* and *Ovis* introduction		p. 148: Postdating the *Capra* and *Ovis* introduction	The classical domesticated stock (*Capra/Ovis/Bos/Sus*) is recorded on all archaeozoological records	
Chronology of the vegetation change in Mallorca	p. 144: c. 4300 cal BC		p. 147: c. 4500 cal BC	p. 139: Between 5380 and 5040 cal BC	p. 167: Between 5380 and 5040 cal BC
Chronology of the vegetation change in Menorca	p. 144: 3200 cal BC		p. 147: c. 3500 cal BC	p. 139: Between 4050 and 3760 cal BC	p. 167: Between 4050 and 3760 cal BC (Cala'n Porter) Between 3910 and 3640 cal BC (Barranc de l'Algendar)
Chronology of the extinction of the bird fauna from Eivissa					p. 161: Between 5300 cal BC and c. 4350 cal BC
Chronology of the first pottery documented on Mallorca	p. 147: 3395 cal BC (Son Matge) or 3972 cal BC (Son Gallard)		p. 147: 3395 cal BC (Son Matge) or 3972 cal BC (Son Gallard)	The previous view is not disqualified	The previous view is not disqualified
Colonization phases of the Balearic Islands	p. 100: Discovery Frequentation without permanent population Stable colonización Strong anthropization of the territory		p. 139-140: Discovery Frequentation without permanent population Stable colonización Strong anthropization of the territory		p. 164: Discovery Colonization Settlement
Cultural levels recorded at Cova de Moleta	p. 110 1) Flint and pebbles industry: towards 4800 cal BC 2) Late Neolithic or "Chalcolithic" level with pottery Characteristic pottery of the Late Neolithic or of the "Chalcolithic"			p.50 The site could have had a human occupation between c.2300 and 1900 cal BC	
Earlier human-related dating from Cova de Canet	p. 106 Perhaps it is correct	p. 32 Perhaps it is correct		Discarded, without comments	Discarded, without comments
Lithic industry from Rafal des Porcs, Pont de sa Plana and Son Danús	p. 119: Flint: Associated to the first human occupation of the island (i.e., at least between 3500 and 4500 cal BC) Pebbles and stone chips: "Waiting for a more accurate situation"			Associated to the "Chalcolithic"	Associated to the "Chalcolithic"
First culture present on Mallorca	Neolithic (p. 151) or pre-Neolithic (p.142)	p. 32-33: Neolithic or pre-Neolithic		Pre-"Chalcolithic"	Pre-"Chalcolithic"
Coval Simó	p. 155: A perfect continuity since an indeterminate time within the Late Neolithic to a "Chalcolithic" level seems evidenced at this rock shelter			p. 46: "Chalcolithic" p.47: It could have had a frequentation previous to 2300/2200	"Chalcolithic"
Cova de sa Tossa Alta	"Pottery associated to Neolithic evidence"			Out from the discourse	Out from the discourse

Table 2. Main differences between the Neoclassical Model of GUERRERO & CALVO (2002) [last two columns] and some of their immediate previous views. Other papers (e.g., GUERRERO & CALVO, 2003) include different statements for the analyzed topics. A sharp shift in the views has been introduced after the publication of ALCOVER *et al.* (2001) (here indicate by three vertical lines). The paper of ALCOVER *et al.* (2001) is cited by CALVO & GUERRERO (2002) and CALVO *et al.* (2002), authors that changed numerous points of their previous models.

Taula 2. Diferències principals entre el Model Neo-Clàssic de GUERRERO & CALVO (2002) [dues darreres columnes] i algunes de les seves aproximacions immediatament anteriors. Altres treballs (e.g., GUERRERO & CALVO, 2003) inclouen nous enunciats per als tòpics analitzats. Després de la publicació d'ALCOVER *et al.* (2001), indicada aquí per tres línies verticals, apareix un canvi radical en les aproximacions d'aquests autors. El treball d'ALCOVER *et al.* (2001) és citat per CALVO & GUERRERO (2002) i CALVO *et al.* (2002), autors que han canviat nombrosos punts dels seus models previs.

zero. The age estimate for the stratigraphic unit with a sole dating (n = 1) falls somewhere between the lower and upper end of the 2σ interval of the calibrated dating. When *n* > 1, the available date estimate falls somewhere between the lowermost end of the 2σ interval of the lowermost dating and the uppermost end of the 2σ interval of the uppermost dating. The *actual* span for the age of the all layer could be longer or shorter than the difference between these two extreme dates. If the *n* 2σ intervals overlap, the resolution capacity of the datings is only as reported above. But, if some of the 2σ intervals do not overlap, then the minimum duration of the deposition of the layer will be at least as the time span between the uppermost end of the 2σ interval of the lowermost dating and the lowermost end of the 2σ interval of the uppermost dating. This will be the minimal documented duration of the layer. If α ... ω layers have been dated, the minimal documented span for each layer (e.g., layer γ), together with the stratigraphy of the deposit, can be used to get information on the age of the contiguous layers (e.g., layers γ + 1 and γ - 1), assuming that the identified layers are realistic and obviously their minimal documented age range estimates do not overlap.

The same kind of chronological approach is valid to analyze, instead of a stratigraphic layer, the available datings on cultural periods (like the "Chalcolithic": the chronology of its limits and its duration should be based on the proper lecture of 2σ intervals of the extreme acceptable datings) or events (like the chronology of the first human arrival: its chronology should be based on the proper lecture of the upper end of the 2σ interval of the earliest dating).

In our view, inadequate ^{14}C lectures based on 1σ intervals can produce wrong archaeological interpretations, and the proper lecture of datings should be based on the extreme values of the nσ intervals (being n ≥ 2). The intercept of the radiocarbon age with the calibration curve is not informative by itself, and besides they are not the median, mode and mean values. No single central-point values can adequately describe the shape of a calibrated radiocarbon probability density (TELFORD *et al*., 2004), and the 1σ intervals deliver insufficient information. As an enlightening example of this, MacPHEE *et al*. (1999) introduced datings of 3 *Rattus rattus* bones from the same stratigraphic unit in Monte Culo de Maco (La Hispaniola). One of the datings (Beta-108153: 480±60 BP) is particularly informative. Its intercept is 1435 cal AD, while its 1σ interval is 1330-1480 cal AD (calibrated data through OxCal Program). Following the criteria of CALVO & GUERRERO (2002), and since the sample size of *Rattus rattus* in Monte Culo de Maco is exactly the same as Ca Na Cotxera (n = 3, i.e., enough as use the 1σ interval according to these authors), it could be concluded that Black Rats were in La Hispaniola before the arrival of Columbus. Nevertheless, this 1σ lecture of the dating has clear limits: the p value for the 1σ interval is 68.3%, and consequently we have a probability of near 1/3 for the dated sample to fall outside this interval. If we use the 2σ interval, the range is 1330-1630 cal AD, what agrees well with the expected age postdating the arrival of Columbus. Using the 2σ interval, the three calibration ranges of the dated bones of *Rattus rattus* from Monte Culo de Maco overlaps.

2.

The assumed identity of the "*first solid available evidence*" of human presence (i.e., the earliest solidly dated evidence of human presence) and the "*timing of human arrival*" (i.e., the actual timing of the first human presence) by CALVO *et al*. (2002) and GUERRERO (2002a, b) are the result of an inadequate lecture of the archaeological record. The number of adequate datings related to the first human contact on the Balearic Islands is very scarce. On Mallorca, these datings come from four localities: Cova des Moro (two datings potentially meaningful for the discussion on the chronology of the first contact (Table 3): UtC-7878, Beta 155645), Coval Simó (three datings: Beta 154196, KIA 14323, KIA 15726), Ca na Cotxera (two datings: KIA 17389, KIA 17390) and Cova de Moleta (one dating: Beta 135404). Although all are roughly similar, only one, the earliest one, is significant to establish the *terminus ante quem* for the first human arrival.

One of the samples of Cova des Moro (UtC-7878, GUERRERO, 2000b) was obtained from a human bone, i.e., from a species with a putative mixed diet (marine and terrestrial). The true age of this sample must be corrected to include the possible effect of the ^{14}C oceanic reservoir. Although this correction should be performed, there are no good estimates of the degree of distortion that a marine diet produces in the ^{14}C ages in the Western Mediterranean area. WIGAND & SIMMONS (1999) calculates a distortion of 334 years for datings from the Eastern Mediterranean area. The reservoir effect is estimated as 380 ± 30 years for the more common mollusc species accumulated in the mid-Holocene shell-middens from the western and southern Atlantic coast of Iberia (ZILHÃO, 2001). The values of the reservoir effect for the Western Mediterranean Sea probably lie between these two estimates. On the basis of the "usual deviation", VAN STRYDONK & MAES (2001) suggest that the true age of a bone dating from a species with a partial marine diet should be estimated about one hundred years younger than the age furnished by the Laboratory (although this estimate is only temptative, and now, at the start of 2004, these authors are thinking that the correction should be smaller; VAN STRYDONCK & BOUDIN, pers.com.). Consequently, if VAN STRYDONCK & MAES (2001) are right, the true age of this specimen (UtC 7878 dating) could be situated somewhere between c. 2370 and c. 2030 cal BC (if the correction is applied to the end values of the 2σ range, as ALCOVER *et al*., 2001 does it; if the correction is applied directly to the radiocarbon date, as suggested by VAN STRYDONCK & MAES, 2001, the new 2σ ranges would be 2440 – 2060 considering a 50-year correction factor for marine diet, or 2380 – 2010 cal BC for a 100 years correction; see Table 3).

The interpretation of the complex information stored in the archaeological and palaeontological sediments requires multi-proxy analyses. The correlation between different sites, different records, different events and different proxies is only possible with a precise and accurate chronology. The dating UtC 7878 will be considered in our analysis with some prevention because: (1) The dated specimen has not archaeological context. Its age

Site	Laboratory Number	Conventional Dating	2σ interval without correction for marine diet	2σ interval with 50-years correction for marine diet	2σ interval with 100-years correction for marine diet	Uncertainty interval (calculated for a 50-years correction)	Sample	Reference
Cova des Moro	UtC 7878	3840±60	2470 - 2130	2440 - 2060	2380 - 2010	2470 - 2060 (410 years)	Human bone (diet unknown)	GUERRERO, 2000
Cova des Moro	Beta 155645	3750±40	2290 - 2030			2290 - 2030 (260 years)	Herbivorous bone	ALCOVER *et al.*, 2001
Coval Simó	Beta 154196	3760±40	2300 - 2030			2300 - 2030 (270 years)	Herbivorous bone	COLL, 2001
Coval Simó	KIA 14323	3670±30	2140 - 1950			2140 - 1950 (190 years)	Herbivorous bone	COLL, 2001
Coval Simó	KIA 15726	3740±30	2280 - 2030			2280 - 2030 (250 years)	Herbivorous bone	CALVO & GUERRERO, 2002
Ca Na Cotxera	KIA 17389	3770±30	2290 - 2040			2290 - 2040 (250 years)	Herbivorous bone	CALVO & GUERRERO, 2002
Ca Na Cotxera	KIA 17390	3710±25	2200 - 1980			2200 - 1980 (220 years)	Herbivorous bone	CALVO & GUERRERO, 2002
Cova de Moleta	Beta 135404	3680±60	2210-1880	2190 - 1850	2140 - 1790	2210 - 1850 (360 years)	Human bone (diet unknown)	RAMIS & ALCOVER, 2001

Table 3. Available datings potentially related with the discussion on the chronology of the first contact.

Taula 3. Datacions disponibles potencialment relacionades amb la discussió sobre la cronologia del primer contacte.

overlaps largely the 2σ range of the earliest acceptable dating obtained at the same cave in a clear archaeological context (dating Beta 155645) and no evidence exists that it could predate this dating. (2) To avoid an increased and non informative range of uncertainty for the early human presence estimates (i.e., the lowermost end of the 2σ range of this dating definitely cannot be used to proof the actual human presence somewhere inside the interval 2470 - c. 2300 cal BC, because its potential inaccuracy, while its acceptance would reduce considerably the level of precision of the entire assemblage of datings of Table 3). Consequently, the lowermost part of the 2σ range of UtC 7878 is not informative, while its uppermost extreme is uncertain (see Table 3) because the lack of knowledge of the diet of the dated specimen. These criteria apply also to dating Beta135404, although this dating does not introduces additional uncertainty to the whole uncertainty range derived from the assemblage of datings obtained on collagen of herbivores presented in Table 3.

The lowermost value for the lower end of the 2σ ranges of the remaining datings in Table 3 is 2300 cal BC, while the lowermost value for the upper end of the 2σ ranges is 2040 cal BC. There is thus some evidence supporting the human presence on Mallorca at some time inside the interval 2300 - 2040 cal BC. The chronological significance of these datings allow to conclude that (1) the first documented human presence on Mallorca predates 2040 cal BC; (2) the first human presence documented on adequate bones (e.g., bones of human-introduced herbivores) post-dates 2300 cal BC; (3) the available datings do not have enough resolution capacity to establish the true age of each specimen and, consequently, it is not possible to establish what deposit contains the true earliest available evidence of human presence on Mallorca, contrary to the claim by CALVO & GUERRERO (2002: 208) and GUERRERO (2002b: 152); (4) there are currently no evidence based on adequate samples (i.e., bones of introduced herbivores or other short living samples) to support the presence of humans on Mallorca previous to 2300 cal BC, contrary to the claim by CALVO *et al.* (2002), CALVO & GUERRERO (2002a) and GUERRERO (2002b).

The second point to be remarked here is that ALCOVER *et al.* (2001) consider that the concordance between the first available evidence of human presence on Mallorca and the true first settlers is highly improbable. In other words, the earliest dated specimens probably do not represent the first settlers. The true "first contact" site and settlers have little chance to be discovered: poor archaeological/palaeontological visibility impedes delimiting this site and its concrete age, or even to delimit with a great accuracy and precision the actual time of the first contact. Again, it is possible only to introduce a *terminus ante quem* for the human presence, based on the datum when unambiguously humans were present on the island. In fact, ALCOVER *et al.* (2001), conclude that the solid evidence of human presence before 2030 cal BC gathered at two Mallorcan sites placed far apart (Cova des Moro, on the eastern

coast, and Coval Simó, on the top of the mountains) argues in favour of an earlier colonization date for the island. The new dating KIA 17389 (CALVO & GUERRERO, 2002) robustly records human presence previous to 2040 cal BC in another locality (Ca Na Cotxera). This new dating represents a small improvement (10 years) for the *terminus ante quem*. How much earlier before 2040 cal BC did the colonization occurred remains unresolved. If the true date of first human arrival is previous or posterior to 2300 cal BC (the extreme value for the lowermost end values of the 2σ ranges of the adequate datings documenting first human presence) remains also unresolved.

CALVO & GUERRERO (2002) and GUERRERO (2002b) attribute to ALCOVER *et al*. (2001) that the *first human presence* on Mallorca post-dates 2300 cal BC, when what is said in this paper is what post-dates this age is the *first adequate available evidence for human presence*. Actually, ALCOVER *et al*. (2001) have established a *terminus post quem* for the human arrival to the island, but not on the basis of the first available evidence datings, contrary to GUERRERO (2002a) assumption. This *terminus post quem* is a consensus datum, very conservative, based on zoological, botanical, sedimentary and archaeocultural evidence. The established datum (c. 3000 cal BC; ALCOVER *et al*., 2001: 50) is not as solidly supported as the datum for the *terminus ante quem* (2040 cal BC), but it is a very conservative proposal, based on different types of evidence, and its establishment represents a clear advancement in the delimitation of the timing for the first human arrival. A discussion on this concept has been also presented by BOVER & ALCOVER (2003) in relation to the chronology of the extinction of *Myotragus balearicus*. After the establishment of this highly conservative *terminus post quem* a conclusion arises: the colonization of Mallorca and Menorca has widely postdated the settlement of the rest of large Mediterranean islands (RAMIS & ALCOVER, in press). It occurred after the erection of the first Egypt pyramids, and it represents the last phase of human expansion in the Mediterranean. Mallorca and Menorca were the last large landmasses to be settled by humans in the entire Mediterranean area.

3.

As stated above, a similar situation concerns the discussion on the time of extinction of *Myotragus balearicus*. Again, the assumed identity of the "last solid available evidence" for *Myotragus* occurrence and the "timing of *Myotragus* extinction" by CALVO & GUERRERO (2002), CALVO *et al*. (2002) and GUERRERO (2002b) derives from an inadequate lecture of the palaeontological record. The number of adequate datings potentially related to the last occurrence of *Myotragus balearicus* is reduced, but it is enough as to enable the analysis of the chronology of its extinction (see BOVER & ALCOVER, 2003; QUINTANA *et al*., 2003). As in the first contact event case, the analysis of the last occurrence of *Myotragus balearicus* on each island enables the establishment of a *terminus post quem*, scientifically based on the lowermost end of the dating documenting its last occurrence and a *terminus ante quem*, logically based on the date when its extinction is deduced to have occurred (and not on the uppermost end of the dating documenting its last occurrence, as CALVO *et al*., 2002, CALVO & GUERRERO, 2002 and GUERRERO, 2002b do). Otherwise, the discussion on the chronology of the first human arrival on Eivissa introduced by CALVO *et al*. (2002: 161, 166) and GUERRERO (2002b: 138-139) is completely misleading and obviously based on the confusion between the concepts of "last solid available evidence" for presence of autochthonous birds and the "timing of bird extinction". In addition, it must be outlined that the chronological information derived from the datings involved in this discussion should exclusively be referred to the discrete bird species whose bones have been dated (e.g., McMINN et al., submitted).

4.

Another focus of the discussion concerns the reliability of datings corresponding to unidentified wood or charcoal samples. CALVO & GUERRERO (2002), CALVO *et al*. (2002) and GUERRERO (2002b) consider that the difference between these datings and the true age of the dated materials might be lower than 250/300 years (e.g., CALVO & GUERRERO, 2002: 208) and indisputably lower than 500/550 years (CALVO & GUERRERO, 2002, same page).

But, although an error of 250/300 years can be acceptable for chronologies down to 6,000 years BP, and an error of 500/550 years acceptable for chronologies down to 11,000 years ago (an error ≤ 5% is considered to be acceptable elsewhere; see PARK, 1999), these figures are totally unacceptable when the time span of the whole Mallorcan prehistory could be of only 2,000 years. Then, the magnitude of the possible error accepted by these authors would cover about 15% or even > 25% of the whole Mallorcan prehistory.

It should be remarked also that these error estimates are unsupported by evidence. ALCOVER *et al*. (2001) listed several examples of differences between ^{14}C datings based on wood and based on adequate samples. Recent papers record differences higher than 1,000 years between datings on wood and on adequate samples to establish first contact chronologies (e.g., ANDERSON & SINOTO, 2002). CALVO & GUERRERO (2002) argue that this is not the case for Mallorca. But an introduced herbivorous bone from the same level (a very thin layer) that CALVO *et al*. (2001) previously dated on the basis of charcoal (UtC-7877: 3961±42 BP, 2580-2300) has been recently dated (Beta 162615: 3420±50 BP, 1880-1530; RAMIS *et al*., in press). This new dating is 420 to 1050 years younger than the date furnished by the charcoal (see Table 4), suggesting a great inaccuracy for UtC 7877. Consequently, the total exclusion from any discussion of a key time, like the timing of the first contact, of datings based on unidentified woods, or on woods susceptible to be considered as "fossil wood", or on woods without a clear stratigraphic context, is highly recommended.

Laboratory Number	Material	Conventional dating	2σ cal BC interval	Authority
UtC 7877	Charcoal	3961±42 BP	2580 - 2300	CALVO *et al*. (2001)
Beta 162615	Domesticated caprine bone	3420±50 BP	1880 - 1530	RAMIS *et al*. (in press)

Table 4. Available datings of stratigraphic unity 106, Cova des Moro (Manacor, Mallorca). This unity is a thin layer (5 cm layer), very dark, containsng chargoal an some bones of introduced fauna.

Taula 4. Datacions disponibles de la unitat estratigràfica 106, Cova des Moro (Manacor, Mallorca). Aquesta unitat és una capa prima (estrat de 5 cm), molt fosca, que conté carbó i alguns ossos de fauna introduïda.

5.

The reliability of the chronologies established based on assumed diagnostic cultural elements ("artifactual markers") has been also a matter of dispute. Some cultural items has been used to support early dates for human presence on Mallorca (e.g., CALVO & GUERRERO, 2002: 16, 36, 53-56; CALVO *et al*. 2002a: 175; GUERRERO, 2002a: 210; GUERRERO, 2002b: 149-151). Several objections to the use of these "director fossils" or "artifactual markers" (as they are named in the literature) as solid evidence to establish chronologies should be posed. First, in early prehistory such items cannot be directly associated to any chronology without the previous acquisition of associate datings based on adequate samples (e.g., MONGE SOARES & PEIXOTO CABRAL 1990-92, 1993). This greatly constrains its application. Nevertheless, it is even more inappropriate to use artifactual markers of one region (e.g., a mainland region) to establish chronologies in another region (e.g., an island). On islands the usage of cultural items can expand for considerably longer periods than in the source mainland regions. In our view, only after knowing the accurate chronology of the time span of a cultural item on a mainland region it is possible to derive some information on the chronological range of the arrival of the item on an island, but not of the temporal span of the same item on the island. Cultural markers can be tracked to identify relationships between two cultures. Nevertheless, on Mallorca, at the current stage of knowledge, the use of artifacts is insufficiently informative to permit the establishment of accurate and precise chronologies for the early prehistory.

6.

GUERRERO (2002b) and CALVO & GUERRERO (2002a) claim for a peculiar "multifactorial interpretation" of the archaeological record in front of the positivist lecture of archaeological data postulated by ALCOVER *et al*. (2001). The GUERRERO and co-workers *modus operandi* is misleading, and I will mention only a few examples herein to support my view. One case refers to the cultural significance, and assumed chronology, of some copper and stone artefacts. *Exactly some of the same pieces* illustrated by CALVO & SALVÀ (1997: fig. 4, p. 68) and attributed by them to the "Bronze Age" with a proposed chronology between 1800 and 1400 cal BC appear again illustrated in CALVO & GUERRERO (2002: figures 38 and 39, pages 190-191), but now attributed to the "Copper Age" with a proposed chronology between c.2500 and 1700 cal BC. No explanation for the change of attribution is mentioned in the second paper. Since these attributions have no clear scientific basis and the authors are proposing a "multifactorial interpretation" as the adequate way to interpret the archaeological record of Mallorca, it must be assumed that its result consists of two disparate untestable interpretations. Seemingly, GUERRERO (1997) deduced that in Mesolithic times Mallorca should have hosted at least 175/200 inhabitants and a maximum of 500 inhabitants, the second figure to be considered as the maximum carrying capacity of Mallorca for a population of hunters-gatherers. Nevertheless, the same author (GUERRERO, 2000), based on *exactly the same evidence*, now considers that Mallorca was unable to support a stable human population in Mesolithic times. According to GUERRERO (2000: 153), the minimal human population necessary to guarantee a long-term survival should be about 150/200 people, now not reached. Again, the multifactorial interpretation of the archaeological record produces disparate multiresults. The first human colonization of Mallorca has been recently situated between c.3000 and 2040 cal BC (ALCOVER *et al*., 2001; RAMIS *et al*., 2002), and now the interpretation by GUERRERO (2002a, b) consists of not mentioning his previous Mesolithic population estimates. This kind of analysis and reasoning underlies the disparate approaches of GUERRERO and co-workers to other problematic questions, such as the chronology and cultural attribution of Cova de Betlem gravures, the chronological and cultural attribution of the pottery of Son Matge, the pottery of Coval Simó, the pottery of Cova de sa Tossa Alta, the significance of Cova de Canet datings, the estimates of colonization success for late Neolithic groups, etc.

Another key issue affected by this "multifactorial interpretation of the archaeohistoric record", *sensu* GUERRERO, refers to the accurate chronology of the Copper and Bronze Ages on Mallorca. Calibration of datings was introduced on Mallorca very late. GUERRERO (1997: 54), based on uncalibrated datings, considered that the Mallorcan "Chalcolithic" spread over 2200 to 1700 BC, situating the start of the "Early Bronze Age" at 1700 BC (GUERRERO, 1997: 63, 87). Curiously, after the calibration of datings, the same boundary, 1700 cal BC, is used for the end of the "Chalcolithic" and the start of the Bronze Age, while the start of the Mallorcan "Chalcolithic" is now established at 2500 cal BC (CALVO & GUERRERO, 2002) or perhaps even at c. 2700 cal BC (GUERRERO, 2001; CALVO & GUERRERO, 2002: 32-33). It is difficult to understand how the uncalibrated age accepted for the end of the

"Chalcolithic" and the start of the "Bronze Age" holds exactly after its calibration.

Even the lecture of the time intervals through their "multifactorial approach" methodology cannot escape to criticism. Thus, although CALVO & GUERRERO (2002) interpret the time intervals for different archaeological facts as the total time span where the archaeological fact occurs, in CALVO *et al*. (2002) the time intervals are sometimes referred to point that the dated archaeological fact occurs in an indeterminate time inside the time interval presented. Thus, for CALVO & GUERRERO (2002), the "Chalcolithic" embraces from c. 2500 (or even perhaps from c. 2700) to 1700 (i.e. perhaps c. 1000 years and at least c. 800 years), while for CALVO *et al*. (2002: 168) the arrival of the "Chalcolithic" culture to Mallorca occurs in an indeterminate moment within the interval 2500 - 2300 cal BC (spreading over perhaps 600 years, from 2300 to 1700 cal BC).

Another example of this disparated lecture consists in the chronological evidence for Ca Na Cotxera. CALVO & GUERRERO (2002: 27) on the basis of KIA 17389 and KIA 17390 datings conclude that the activity of the bell beaker pottery makers covered the entire c. 260 years from c. 2300 to at least 2040 cal BC. Later, in an annex of the same book, GUERRERO (2002: 206) conclude that these datings only allow the establishment of the date of the death of dated herbivores somewhere between the ends of the ranges, while in another paper (CALVO *et al*., 2002: 166) the occupation of Ca Na Cotxera occurs between c. 2300 and 2100 cal BC.

Again we are repeatedly facing different disparate lectures derived from the same archaeological background. The "multifactorial interpretation" as claimed by GUERRERO (2002b) produces disparate results, and there is no way to test their reliability. Obviously, the higher the number of disparate proposals, the higher the chance to achieve results or interpretations closer to the truth, but this peculiar kind of "multifactorial interpretation" does not provide the way to test them, nor the way to decide which one of the different results should be used. A determinate result can be selected at convenience. Whether one believe them or not becomes an act of faith. According to PARK (1999), "Science is the only way we have of separating truth from ideology, or fraud or mere foolishness". We claim for the scientific approach to solve the questions concerning the early prehistory of the Balearic Islands. Implementation of the scientific approach in Mallorcan Early Prehistory research should be one of the top priorities.

Analysis of Results

Differences between the Neo-Classical Arrival Model and the Late Arrival Model involve also the chronology of the first settlement, the chronology of the first "stable" settlement, the chronology of the human-mediated change of vegetation, the chronology of *Myotragus* extinction, and the cultural arrangement of the first human settlers (see Table 1). Although both theories have been built theoretically on the same archaeological and palaeoecological data, their diverging methodologies have leaded them to reach different conclusions.

Our view has been reported elsewhere (ALCOVER *et al*., 2001; RAMIS *et al*., 2002). Only one topic has been studied by ALCOVER *et al*. (2001) and RAMIS *et al*. (2002), viz. the accurate (although relatively imprecise) chronology of the first contact event, while many others (like the identity, contacts, source region and precise chronology of the first settlers; ALCOVER *et al*., in prep.) remain to be explored more deeply.

There is a last point to be remarked here. It consists in having a clear understanding of what is to be explained. Dating the initial Mallorcan colonization as Neolithic, c. 3500 cal BC (CALVO & GUERRERO, 2002: 139-141) or perhaps c. 3900 (GUERRERO & CALVO, 2003: 97) or the "first stable settlement" (preceded by an unstable Neolithic settlement) as "Chalcolithic", perhaps c. 2700 cal BC (CALVO & GUERRERO, 2002: 33, 145) or at least c. 2500 cal BC (CALVO & GUERRERO, 2002), is quite different from assigning the initial settlement to an indeterminate period (Neolithic, Chalcolithic or Bronze Age) within the interval c. 3000 and 2040 cal BC (ALCOVER *et al*., 2001), or proposing that the only solid scientific statement we can currently advance is that the first human presence on the Balearics predates 2040 cal BC, and that it could be assignable to a Bronze Age population (ALCOVER *et al*., 2001). Intending to present the results of the approach of ALCOVER *et al* (2001) as identical to those of GUERRERO (1999, 2000), CALVO & GUERRERO (2002) and CALVO *et al*. (2002) as pretended by GUERRERO (2002b), is wrong and certainly confusing.

Conclusions

1. The Late Arrival Model for human colonization of the Balearic Islands was an original contribution first published in Endins (ALCOVER *et al*., 2001), and the claims (GUERRERO 2002: 132) that the empiric proofs and results of this contribution has had been previously published by GUERRERO (1999, 2000) are lacking in basis.
2. Conclusive evidence on the use of the scientific method as the proper way to get archaeological information has been presented in this paper. Although the resolution power of Science is limited, scientifically obtained information results highly stable. Information derived from other methodological approaches is highly unstable and frequently untestable, and the hypotheses derived are changing continuously. This dance of non-scientific hypotheses produces an unserious consideration for Archaeology. In our opinion, the production of few scientific results is a much better way for improving the knowledge of the Balearic Archaeology than the production of a large amount of non-scientific results.
3. The archaeological evidence currently available is consistent with the chronology and interpretations suggested by the Late Arrival Model.

Acknowledgements

Selected portions of this paper have been reviewed by Dr Salvador ROVIRA (Museo Arqueológico Nacional, Madrid), Dr Joan Salvador MESTRES (Universitat de Barcelona), Mathieu BOUDIN (Koninklik Instituut voor Kuntspatrimonium – Institut Royal du Patrimoine Artistique, Belgium), Dr Bernard KNAPP (University of Glasgow), Dr Luis PLANTALAMOR (Museu de Menorca), Dr Miquel PALMER (Institut Mediterrani d'Estudis Avançats, Mallorca), Dr Damià JAUME (Institut Mediterrani d'Estudis Avançats, Mallorca), Pere BOVER (Institut Mediterrani d'Estudis Avançats, Mallorca), Damià RAMIS (Institut Mediterrani d'Estudis Avançats, Mallorca), Dr Rafel MICÓ (Universitat Autònoma de Barcelona). This paper is a contribution to the Research Project BTE2001-0589 "Análisis de la Evolución y Extinción de *Myotragus balearicus* Bate 1909 (Artiodactyla, Caprinae). II." of the Dirección General de Investigación, Ministerio de Educación y Ciencia (Madrid). Damià JAUME, Aina BONNER and Peter WATKINSON help me with the English. I'm very acknowledged to all them.

References

ALCOVER, J. A.; LLABRES, M. & MORAGUES, LL. (2000):Les Balears abans dels humans. *Monografies de la Societat d'Història Natural de les Balears,* 8. 78 pags. Palma de Mallorca

ALCOVER, J. A.; RAMIS, D.; COLL, J. & TRIAS, M. (2001): Bases per al coneixement del contacte entre els primers colonitzadors humans i la naturalesa de les Balears. *Endins,* 24: 5-57. Palma de Mallorca.

ALCOVER, J. A.; RAMIS, D.; COLL, J. & TRIAS, M. (In prep.): Disentangling the Balearic First Settlers Identity, Contacts and Source Region.

ANDERSON, A. (1991): The chronology of colonizations in New Zealand. *Antiquity,* 65: 767-795.

ANDERSON, A. & SINOTO, Y. (2002): New Radiocarbon Ages of Colonization Sites in East Polynesia. *Asian Perspectives,* 41: 242-257.

BOVER, P. & ALCOVER, J. A. (2003): Understanding Late Quaternary Extinctions: the case of *Myotragus balearicus* Bate 1909. *Journal of Biogeography* , 30: 771-781.

BOVER, P.; RAMIS, D. & ALCOVER, J. A. (Submitted): The Chronology of the Extinction of the Autochthonous Small Mammalian Fauna from Mallorca (Gymnesic Islands, Western Mediterranean Sea).

CALVO, M. & GUERRERO, M. (2002): *Los inicios de la metalurgia en las Baleares. El Calcolítico (c.2500 – 1700 cal. BC).* Edit El Tall, 282 pàgs.

CALVO, M., GUERRERO, V. M. & SALVÀ, B. (2002): Los orígenes del poblamiento balear. Una discusión no acabada. *Complutum,* 13: 159-191.

CALVO, M. & SALVÀ, B. (1997): El Bronze final a les Balears. La transició cap a la cultura talaiòtica. *Quaderns ARCA,* 14: 1-88.

COLL, J. (2000): Excavación Arqueológica del Coval Simó. Estado Actual y Perspectivas de Futuro. In GUERRERO, V. M. & GORNÉS, S. (eds.), *Colonización Humana en Ambientes Insulares. Interacción con el Medio y Adaptación Cultural.* Edit, Universitat de les Illes Balears: 371-400.

COLL, J. (2001): Primeres datacions absolutes del jaciment de coval Simó. *Endins,* 24: 161-168.

COSTA, B. (2000): Plantejaments per a l'anàlisi del procés d'establiment humà en petits medis insulars. El cas de l'arxipèlag balear. In GUERRERO, V. M. & GORNÉS, S. (eds.), "*Colonització humana en ambients insulars. Interacció amb el medi i adaptació cultural*": 11-71. Edit Universitat de les Illes Balears, Palma de Mallorca.

COSTA, B. & BENITO, N. (2000): El poblament de les Illes Pitiüses durant la prehistòria. Estat actual de la investigació. In GUERRERO, V. M. & GORNÉS, S. (eds.), "*Colonització humana en ambients insulars. Interacció amb el medi i adaptació cultural*": 215-317. Edit Universitat de les Illes Balears, Palma de Mallorca.

DAVIS, M. (2002): Puting Meat on the Bone: An Investigation into Palaeodiet in the Balearic Islands using Carbon and Nitrogen Stable Isotope Analysis. *British Archaeological Reports, International Series,* 1095: 198-216.

GRAVES, M. W. & ADDISON, D. J. (1995): The Polynesian Settlement of the Hawaiian Archipelago: integrating models and methods in archaeological interpretation. *World Archaeology,* 26: 380-399.

GUERRERO, V. M. (1997): *Cazadores y pastores en la Mallorca prehistórica*. Palma: El Tall.

GUERRERO, V. M. (1999): Rectificaciones y nuevos enfoques al tránsito de la caza-recolección a una economía productora en Baleares. In Bernabeu, J. and Orozco, T. (eds.), *II Congrés del Neolític a la Península Ibèrica. Saguntum Extra-2*: 565-570. València: Universitat de València.

GUERRERO, V. M. (2000a): Mito y realidad de los primeros baleáricos. *Revista de Arqueología,* 231: 16-29.

GUERRERO, V. M. (2000b): La colonización humana de Mallorca en el contexto de las islas occidentales del Mediterráneo: una revisión crítica. In GUERRERO, V. M. & GORNÉS, S. (eds.), "*Colonització humana en ambients insulars. Interacció amb el medi i adaptació cultural*": 99-190. Edit Universitat de les Illes Balears, Palma de Mallorca.

GUERRERO, V. M. (2001): The Balearic Islands: Prehistoric Colonization of the furthest Mediterranean Islands from the Mainland. *Journal of Mediterranean Archaeology,* 14: 136-157.

GUERRERO, V. M. (2002a): La cronología absoluta del Calcolítico balear. In CALVO, M. & GUERRERO, V. M., *Los Inicios de la Metalurgia en Baleares. El Calcolítico (c.2500-1700 cal. BC)*, Edit., El Tall, Palma de Mallorca: 203-223.

GUERRERO, V. M. (2002b): Bases historiográficas (sin disimulo) sobre los primeros pobladores baleáricos y otras cuestiones de enfoque, fondo y forma. *Mayurqa,* 28: 127-170.

GUERRERO, V. M. (2003): Els esmoladors o plaques perforades ("braçals d'arquer"). In GUERRERO, V. M.; CALVO, M. & COLL, J. (eds.) *El Dolmen de s'Aigua Dolça (Colònia de Sant Pere, Mallorca). Col·lecció La Deixa*, 5: 120-139.

GUERRERO, V. M. & CALVO, M.(2003): Botons i elements d'ornament personal. Estudi contextural i cultural. In GUERRERO, V. M.; CALVO, M. & COLL, J. (eds.) *El Dolmen de s'Aigua Dolça (Colònia de Sant Pere, Mallorca). Col·lecció La Deixa*, 5: 92-119.

HARDING, A. F. (2000): *European Societies in the Bronze Age*. Cambridge World Archaeology, 552 pages.

LULL, V.; MICÓ, R.; RIHUETE, C. & RISCH, R. (1999): *Ideología y Sociedad en la Prehistoria de Menorca. La Cova des Càrritx y la Cova des Mussol*. Edit. Consell Insular de Menorca, Ajuntament de Ciutadella, Fundació Rubió Tudurí Andrómaco, 698 pages. Barcelona.

MacPHEE, R. D. M.; FLEMMING, C. & LUNDE, D. P. (1999): "Last occurrence" of the Antillean insectivoran *Nesophontes*: new radiometric dates and their interpretation. *American Museum Novitates,* 3261: 1-20.

McMINN, M.; PALMER, M. & ALCOVER, J. A. (Submitted): A new species of rail (Aves: Rallidae) from the Upper Pleistocene and Holocene of Eivissa (Pityusic Islands, Western Mediterranean).

MONGE SOARES, A. M. & PEIXOTO CABRAL, J. M. (1990-1992): Cronologia Absoluta para o campaniforme da Estremadura e do Sul de Portugal. *O Arqueólogo Portugués*, Ser. IV, 8/10: 203-228.

MONGE SOARES, A. M. & PEIXOTO CABRAL, J. M. (1993): Cronologia Absoluta para o Calcolítico da Estremadura e do Sul de Portugal. *Trabalhos de Antropologia e Etnologia,* 33: 217-235.

PARK, R. L. (1999): *Voodoo Science. The road from Foolishness to Fraud*.

PETTITT, P. B.; DAVIES, W.; GAMBLE, C. S. & RICHARDS, M. B. (2003):Palaeolithic radiocarbon chronology: quantifying our confidence beyond two half-lives. *Journal of Archaeological Science,* 30: 1685-1693.

PLANTALAMOR, Ll. & MARQUÈS, J. (2001): Biniai Nou. El Megalitisme Mediterrani a Menorca. *Treballs del Museu de Menorca,* 24: 1-188.

PLANTALAMOR, Ll. & MARQUÈS, J. (2003): El sepulcre d'Alcaidús. El megalitisme de Menorca en el context de la Mediterrània occidental. *Treballs del Museu de Menorca,* 26: 1-335.

PLANTALAMOR, L. & VAN STRYDONCK, M. (1997): La Cronologia de la Prehistòria de Menorca (Noves Datacions de C14). *Treballs del Museu de Menorca,* 20:1-83.

QUINTANA, J., BOVER, P. RAMIS, D. & ALCOVER, J. A. (2003): Cronologia de l'extinció de *Myotragus balearicus* Bate 1909 a Menorca. *Endins,* 25: 155-158.

RAMIS, D. & ALCOVER., J. A. (2001a): Bone Needles in Mallorcan Prehistory: a Reappraisal, *Journal of Archaeological Science,* 28: 907-11.

RAMIS, D. & ALCOVER., J. A. (2001b): Revisiting the Earliest Human Presence in Mallorca, Western Mediterranean. *Proceedings of the Prehistory Society* , 67: 261-269.

RAMIS, D. & ALCOVER., J. A. (In press): Irrupción humana y extinción faunística en las grandes islas del Mediterráneo durante el Holoceno. In *Homenaje a Emiliano Aguirre*, Museo Regional de Madrid.

RAMIS, D.; ALCOVER, J. A. & COLL, J. (In press): Towards the definition of the Balearic early settlers. In PHOCA-COSMETATOU, N. (ed.), "Islands in the Neolithic: Initial Occupation and Survival Strategies in the Mediterranean".

RAMIS, D.; ALCOVER, J. A.; COLL, J. & TRIAS, M. (2002): Chronology of the First Settlement of the Balearic Islands. *Journal of Mediterranean Archaeology*, 15: 3-24.

RAMIS, D. & BOVER, P. (2001): The evidence for domestication of *Myotragus balearicus* Bate 1909 (Artiodactyla, Caprinae) in the Balearic Islands. *Journal of Archaeological Science,* 28: 265-82.

RAMIS, D., SANTANDREU, G. & CARRERAS, J. (In press): Resultats preliminars de l'excavació arqueològica de la cova des Moro entre 1999 i 2002. In *III Jornades d'Estudis Locals de Manacor (21-22 maig 2004)*.

SALVÀ, B., CALVO, M & GUERRERO, V. M. (2002): La edad del bronce Balear. Desarrollo de la complejidad social. *Complutum,* 13: 193-219.

SIMMONS, A. H. (1999): The Function of Akrotiri Aetokremnos and Its Place in Colonization and Extinction Events. In SIMMONS, A. H. (ed.) *Faunal Extinctions in an Island Society. Pygmy Hippopotamus Hunters of Cyprus*. Interdisciplinary Contributions to Archaeology. Kluwer Academic/Plenum Publishers, New York, pages 303-336.

SPRIGGS, M. (1989): The dating of the Island Southeast Asian Neolithic: an attempt at chronometric hygiene and linguistic correlation. *Antiquity,* 63: 587-613.

SPRIGGS, M. & ANDERSON, A. (1993): Late colonization of East Polynesia. *Antiquity,* 67: 200-217.

TELFORD, R. J., HEEGAARD, E. & BIRKS, H. J. B. (2004): The intercept is a poor estimate of a calibrated radiocarbon age. *The Holocene,* 14: 296-298.

VAN STRYDONCK, M. & BOUDIN, M. (2003): Anàlisis isotòpiques i la datació dels ossos del sepulcre megalitic d'Alcaidús. In PLANTALAMOR, LL. & MARQUÈS, J. (coords.), El Megalitisme de Menorca en el context de la Mediterrània occidental. *Treballs del Museu de Menorca,* 26: 325-327.

VAN STRYDONCK, M., BOUDIN, M. & ERVYNCK, A. (2002): Stable Isotopes (13C and 15N) and Diet: Animal and Human Bone Collagen from Prehistoric Sites on Mallorca, Menorca and Formentera. *British Archaeological Reports, International Series* 1095: 189-197.

VAN STRYDONCK, M., BOUDIN, M. & ERVYNCK, A. (In press) Humans and *Myotragus*: the issue of sample integrity in radiocarbon dating. In Proceedings of the International Symposium "Insular Vertebrate Evolution: the Palaeontological approach". *Monografies de la Societat d'Història Natural de les Balears*.

VAN STRYDONCK, M. & MAES, A. (2001): Les datacions i les anàlisis isotòpiques de Biniai Nou. In PLANTALAMOR, Ll. & MARQUÈS, J. (eds.), *Biniai Nou. El megalitisme mediterrani a Menorca. Treballs del Museu de Menorca,* 24: 163-174.

WALDREN, W. H. (1974): Evidence of the extinction of the *Myotragus balearicus*. In *Prehistoria y Arqueología de las Islas Baleares: IV Simposio de Prehistoria Peninsular. Instituto de Arqueología y Prehistoria, Publicaciones eventuales* , 24: 31-38. Barcelona.

WALDREN, W. H. (1982): *Balearic Prehistoric Ecology and Culture. The Excavation of Certain Caves, Rock Shelters and Settlements. British Archaeological Reports, International Series* ,149. Oxford.

WALDREN, W. H. (1996): The deffinition and duration of the Beaker Culture on the Balearic Islands: a Radiocarbon Survey. *Oxford Journal of Archaeology,* 16: 25-48.

WALDREN, W. H. (1998): The Beaker Culture of the Balearic Islands. An Inventory of Evidence from Caves, Rock Shelters, Settlement and Ritual Sites. *British Archaeological Reports, International Series,* 709: 229 pages.

WALDREN, W. H. (2002): Links in the Chain: Evidence of Sustained Prehistoric Contact and Cultural Interaction Between the Balearic Islands and Continental Europe. *British Archaeological Reports, International Series,* 1095: 152-187.

WALDREN, W. H., ENSEÑAT, J. & ORVAY, J. (2002): New Coals on Old Fires: the Question of Early Balearic Settlement. *British Archaeological Reports, International Series* 1095: 68-90.

WALDREN, W. H. & KOPPER, J. S. (1967): Mallorca Chronology for Prehistory based on Radiocarbon Method. *Pyrenae,* 3: 45-65.

WALDREN, W. H. & KOPPER, J. S. (1969): Informe preliminar sobre análisis de radiocarbono en Mallorca. In *X Congreso Nacional de Arqueología. Mahón, 1967*: 75-82. Zaragoza: Secretaría General Congresos Arqueológicos Nacionales.

WIGAND, P. & SIMMONS, A. H. (1999): The Dating of Akrotiri Aetokremnos. In SIMMONS, A. H. (Ed.), *Faunal Extinction in an Island Society. Pygmy Hippopotamus Hunters of Cyprus*. Interdisciplinary Contributions to Archaeology, Kluwer Academic/Plenum Publishers, New York.

ZILHÃO, J. (2001): Radiocarbon evidence for maritime pioneer colonization at the origins of farming in west Mediterranean Europe. *Proceedings of the National Academy of Sciences, USA* 98, 24: 14180-14185.