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MARIE SKŁODOWSKA-CURIE ACTIONS

Individual Fellowships (IF)

Call: H2020-MSCA-IF-2017

PART B

"FOREPAST"

« Past, present and future environmental, biological and social transitions in coastal ecosystems »

This proposal is to be evaluated as:

[EF-ST]

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Part B-1

List of participating organisations

Participating organisations	Legal Entity Short Name	Academic (tick)	Non-academic (tick)	Country	Dept./ Division / Laboratory	Supervisor	Role of Partner Organisation
Beneficiary							
- University of Barcelona	UB	X		Spain	Department of Evolutionary Biology, Ecology and Environmental Science (Section of Ecology) *	Prof. Javier Romero Martinengo	Hosting institution
Partner Organisation							
- Institut de Recerca i Tecnologia Agroalimentàries	IRTA	X		Spain	IRTA Sant Carles de la Ràpita	Dr. Carles Ibañez	Hosting secondment
- Agencia Estatal Consejo Superior de Investigaciones Científicas	CSIC	X		Spain	Centre for Advanced Studies of Blanes (CEAB)	Dr. Miguel A. Mateo	Hosting secondment

***** For simplicity henceforth referred to as Department of Ecology in Part B.

1. Excellence

1.1. Quality and credibility of the research

Introduction, state-of-the-art, specific objectives and overview of the action

In the current context of global change, understanding ecosystem response to perturbations has become an urgent necessity [1,2]. Abrupt changes, often called critical transitions or regime shifts, are common phenomena in contemporary ecological and social systems [1]. These systems can catastrophically shift from one state to another in response to sometimes only slight changes in conditions or small perturbations [3,4]. Human dependence on the services and functions these ecosystems provide urges a need to develop methods to forecast their responses to changing conditions and perturbations [2,4]. However, our understanding of the mechanisms that regulate the stability and resilience of ecosystems or that determine transitions in societies is remarkably poor [1].

Attempts to identify abrupt change have focused on examining characteristics of boundary conditions as signals of impending change [5-7]. These changes in system behaviour serve as powerful early-warning indicators foretelling major state shifts—either catastrophically [3] or more continuously [8]. Most of these indicators are based on the phenomenon of 'critical slowing down' (CSD), which means that the time needed for a system to recover from a disturbance lengthens as the system approaches a state shift [4,9]. Temporal and spatial statistical signatures of CSD have been inferred indirectly, and highly controlled experiments have provided support that the phenomenon exists in real living systems [e.g. 10,11]. However, direct measurements to test this theory in the complex setting of real-world biological and social systems, remain scarce. Hence, our understanding of early warning signals in real-world systems is still insufficient, which severely limits its application to policy decisions and management [4].

Salt marshes are globally distributed intertidal ecosystems inhabiting coastal environments at the interface between land and sea [15]. They are comprised of halophytic plants the cover of which expands seaward onto bare tidal flats during disturbance-free periods [16]. Coastal salt marshes are ideal systems for studies of resilience and regime shifts: they exhibit dramatic, tractable (i.e. easy to detect and to experiment with) shifts in area cover and distribution. In addition, salt marshes are amongst the most valuable ecosystems on earth [17], yet vulnerable to both direct anthropogenic and environmental threats (e.g. sea level rise). They have a remarkable capacity for absorbing waves and reducing flooding risks [18], which makes them of primary importance to coastal climate-change adaptations worldwide, including planning and policy initiatives in the Netherlands, UK, France and the USA, among others. European salt marshes are home to several plants that are considered natural habitat types of community interest, such as species from the genera *Spartina*, *Salicornia*, *Arthrocnemum*, whose conservation requires the designation of special areas of conservation according to the EU Habitats Directive (92/43/ECC, annex I). Salt marshes serve as nurseries for a number of fish and invertebrate marine species, which in turn attract high abundances and diversity of migrating and resident bird species [19]. For this reason, most large salt marsh complexes within the EU are included in the Natura 2000 network, under the Habitats and/or Birds directive. For their strategic importance, most EU salt marsh areas are also listed as Wetlands of International Importance by the RAMSAR convention.

The overall aim of the project FOREPAST is to investigate the drivers and patterns of past and contemporary ecological transitions in European salt marshes to learn from the past and inform the future, and facilitate management towards coastal resilience to human induced environmental change. FOREPAST also aims at assessing stakeholder perceived loss/gain when ecological transitions occur, and the trade-offs the society is willing to make to prevent (or not) these scenarios. This action will provide both relevant and interdisciplinary information for the implementation of the EU Habitats, Birds, and Marine Strategy Framework directives, specifically towards building resilience and climate change adaptation in the coast.

FOREPAST focus on the wetlands of the Ebre Delta, a microtidal delta (tides < 20 cm) on the north-western Mediterranean, which is currently part of the Natura 2000 network. Microtidal marshes are predicted to be particularly vulnerable to sea level variability given their low inundation frequency [20], which translates to low sediment inputs, a key variable for marsh persistence under current sea level rise scenarios [21-23]. Objective 1 of this action aims to identify, using paleoecological techniques, ecological transitions (from vegetated to unvegetated states and vice versa) in marshes from contrasting environmental settings. Once these transitions have been identified,

[1] Scheffer (2009) Princeton University Press, USA; [2] Millennium Ecosystem Assessment (2005) World Resources Institute; [3] Scheffer et al. (2009) Nature 461(7260):53–59; [4] van Belzen et al. (2017). Nat Comm 8:15811; [5] Andersen et al. (2009) Trends Ecol Evol 24(1):49–57; [6] Hastings & Wysham (2010) Ecol Lett 13(4):464–472; [7] Boada J, et al. (2017) Proc R Soc B 284(1851):20162814; [8] Kéfi et al. (2012) Oikos 122, 641–648; [9] van Nes & Scheffer (2007) Am Nat 169(6):738–747; [10] Dai, Korolev & Gore (2013) Nature 496, 355–358; [11] Veraart et al. (2012) Nature 481, 357–359; [13] Seddon et al. (2014) Ecology 95(11):3046–3055. [14] Williams, Blois, Shuman (2011) J Ecol 99:664–677; [15] Allen (2000) Quat. Sci. Rev. 19, 1155–1231; [16] Balke, Herman & Bouma (2014) J Ecol 102:700–708; [17] Costanza. et al. (1997) Nature 387, 253–260; [18] Möller I, et al. (2014) Nat Geosci 7:727–732; [19] Cattrijsse & Hampel (2006) Mar Ecol Prog Ser 324:293–307; [20] French (2006) Mar Geol 235(1–4):119–136; [21] Kearney & Turner (2016) J Coast Res 319(3):686–699; [22] Kirwan et al. (2016) Nat Clim Chang 6(3):253–260; [23] Ganju et al. (2017) Nat Commun 8:14156.

an assessment of their drivers and evaluation of their external (e.g. climatic, anthropogenic or both) or internal origin (e.g. ecological feedback) will be conducted, adapting the methodology described for other paleoecological records in [13] and [14]. Then the data set will be screened using different statistical descriptors that can serve as indicators of an impending transition in the paleoecological record (objective 2). These indicators will be validated, with a manipulative experiment in the field, which will be objective 3 of this action. Finally, objective 4 will assess and evaluate the social perceptions of the range of sectors with a stake at the Ebre delta, towards the ecosystem services delivered by the "natural" and degraded state of the salt marsh ecosystem.

Research methodology and approach: highlight the type of research / innovation activities proposed

WP1: Transitions in the past: saltmarsh paleoecology

WP1 addresses Objectives 1 and 2, which aim at detecting transitions, evaluating the external or internal origin of these changes and statistically identifying early warning indicators of change in the paleoecological record. **Task 1.1. Identify study sites at the Ebre Delta:** Ten study sites will be identified, along a gradient of exposure to hydrodynamic activity, controlling for anthropogenic disturbance. **Task 1.2. Obtain sediment cores:** At each site, a sediment core 75 mm in diameter x 2 m depth will be manually hammered into the soil following the methodology used by the collaborator Dr Mateo (CEAB-CSIC) in their LIFE project Blue Natura [23]. Cores will then be recovered using a jack [24] to break the cohesion forces of the soil [25]. **Task 1.3. Core paleoecological analysis:** The ten cores will then be transported to the University of Barcelona Core-Lab, where they will be cut open and photographed under visible and UV-light. They will then be scanned using an XRF-core scanner that will inform the reconstruction of paleo-environments, determine the origin of sediments within each site (using magnetic susceptibility), and identify distinct regions of interest within each core from which to subsample for specific analyses (particle size analysis, isotopic ratios, elemental analysis) [26]. All cores will be dated using ^{14}C, which is a radiometric dating technique with coarse resolution (hundreds of years). A subsample of the most informative cores (2-4) will be dated using lead-210 (^{210}Pb), which allows for an annual to decennial resolution, and will allow to assess salt marsh accretion rates (in mm of sediment per year) [26,27]. A number of these radiometric datings (which can be very expensive) could be paid for via collaboration with the Life Blue Natura project (Dr Mateo). **Task 1.4. Identification of transitions.** The framework pioneered by [14] and refined [13] to identify thresholds in the paleoecological data will be used. This framework involves three steps: Step 1 uses change point analysis to identify potential regime shifts [28] in the response variable vs. time; step 2 uses generalized nonlinear least squares to test for linear or threshold relationships between the response and environmental variables (e.g. reconstructed sea level); step 3 uses generalized nonlinear least squares to investigate trends in mean and variance in each of the variables over time, and to test for extrinsic and intrinsic dynamics (sensu ref 14). The above steps can be applied directly to the different response variables, or after a principal components analysis (PCA) has been used to reduce the dimensions of the dataset. Possible response variables are: C concentration in the soil, soil texture, grain size, magnetic susceptibility, and soil pigments (e.g. chlorophyll), all of which are known to be correlated with saltmarsh vegetated or unvegetated state [e.g. 29]. In addition, the candidate will endeavour to collaborate with other colleagues at the host institution (e.g. co-supervising an MSc) to identify the community of micro fauna (e.g. foraminifera) in the sediment cores and use it as another potential response variable to identify further transitions. **Task 1.5. Early warning signals (modelling).** Salt marshes in macrotidal settings have been recently shown to display CSD, using manipulative experiments in the field [4]. Taking advantage of these results, the time series of response variables will be assessed in search of hints of a slowing down in the rates of recovery following disturbances identified (using other proxies/studies) in the paleoecological record (e.g. storms, changes in sea level), in the form of changes in granulometry, or magnetic susceptibility (a proxy for the sediment source [terrigenous or marine]) [26]. Modelling techniques will then be used to reproduce the patterns found in the core using threshold models displaying CSD (using equations in box 2 ref. 3). For this task, Dr Alonso (CEAB) will offer training and support to the candidate.

WP2: Transitions today

WP2 addresses Objective 3, which aims at identifying transitions in contemporary ecological systems by manipulating salt marsh plots in the field. Being in a stressful environment (in terms of salinity, drought and temperature) [30], and not adapted to sea level fluctuations, the project aims to assess if the microtidal Mediterranean marshes display signs of slowing down to disturbances along a gradient of inundation stress. **Task 2.1. Identify study sites within the Ebre delta.** Five study sites with similar salinities, nutrient levels and vegetation community will be selected, via field visits and/or using data sources on the spatial distribution of salt marshes within the Ebre delta: aerial photography [google, Catalan Cartographic Insitute], expert knowledge and past study sites used by collaborators in IRTA. **Task 2.2. Sea level treatments.** A known number of plants of salt marsh species (*Spartina*,

[23] www.life-bluenatura.eu/en/blue-carbon/; [24] www.hi-lift.com/hi-lift-jacks; [25] http://esslab.tamucc.edu/tools-hilift.html; [26] Kelleway et al. (2017) J Geophys Res Biogeosciences 122:2017JG003775; [27] Marbà et al. (2015) J Ecol:1–7; [28] Rodionov (2004) Geophys Res Lett 31:L09204; [29] Shi & Lamb (1991) Sediment Geol 73(3–4):227–246; [30] Curcó et al. (2002) Estuaries 25(3):309–324.

Scirpus or *Salicornia* depending on availability in the study sites) will be transplanted at different elevations (3 levels, with 6 replicates each) as a proxy for different inundation levels, mimicking sea level rise (similar to the technique used in [31]). The elevation of treatments above sea level will be checked with a dGPS (to the nearest 10 mm). Inundation levels will be further checked using pressure sensors (Sensus Ultra; http://reefnet.ca). Sediment pins and erosion bars will be deployed near each of these patches to assess sediment accretion and erosion in each patch. **Task 2.3. Disturbance treatments.** Once each of the sea level treatment plots have rooted and appear healthy, half of the plots in each sea level treatment (3 of the 6 replicates) will be disturbed. The disturbance will consist in clipping all the aboveground biomass. **Task 2.4. Follow on measurements.** Recovery will be followed by returning to the sites every other month to check canopy heights, seed size (when present) and environmental covariates (e.g. salinity, moisture, sediment levels, etc.). The hypothesis is that those plots in lower elevations (higher inundation times) will recover more slowly compared to the ones in their optimum elevation, and some might even shift completely into a barren state. **Task 2.5. Synthesis.** At the end of the experiment (see Gantt chart) all above and belowground plant biomass will be harvested and processed. Short sediment cores will also be collected to identify whether those plots that transitioned into a bare soil state showed 'warning' signals in the sedimentological record, which would serve as a validation of the results obtained in task 1.5.

WP3: The social-ecosystem

WP3 addresses Objective 4 which aims at understanding the stakeholders' preferences and perceptions of loss/gains when wetlands shift into a degraded state in the Ebre Delta Natural Park. **Task 3.1. Stakeholder identification.** This preparatory exercise has already been partly undertaken in the last few years by the administration of the Ebre delta Natural Park, which is willing to grant me access to this data (see letter of support). **Task 3.2. Questionnaire preparation and dissemination.** The questionnaire will include general questions on public perceptions and knowledge of salt marshes and wetlands, and the types of benefit/value that people attribute to them. The questionnaire will include an analytic hierarchy process element [32], which will support pairwise comparisons to identify public preferences and priorities related to the different wetland habitats of the Natural Park. The questionnaire will be made available in Catalan, Spanish and English, and will be disseminated online and paper through partnership with the Ebre delta Natural Park. The target audience of the questionnaire will be the stakeholders identified in *task 3.1*, including: land owners and farmers, the aquaculture sector, recreational users (grouped by provenance), representatives of user groups (wild fowlers, bird watchers), local NGO representatives, local government agency representatives (e.g. staff from the Natural park), and representatives from the local community. To ensure a good response rate, the questionnaires will also be conducted in person in the form of interviews at different areas of the park (farms, hides for birdwatching, beaches, villages), to capture different stakeholders. **Task 3.3. Data analysis and synthesis.** The data collected through the questionnaire will allow public priorities to be identified. Particular attention will be paid to the difference in value (in a qualitative sense) attributed to the fully functional salt marshes as opposed to degraded systems (where there has been a shift to an unvegetated state). In this sense, we will provide a stakeholder led prioritisation (i.e. ranking) of the different wetland habitats of the delta, from the most "pristine" to the most modified (rice fields/bare sediment). The outputs from this task will be discussed with the Natural Park to develop recommendations and, eventually, inform policy.

In summary, through a combination of ecological and social data collection methods, FOREPAST takes an interdisciplinary approach to understand the patterns and sources of ecological transitions in the past (WP1), understand the exact mechanisms of the transitions at present (WP2), and thus inform future decisions. In addition, it provides the views of the society towards these transitions, and prioritises the habitat types most valued by the different stakeholders (WP3). Taken together, these results will be of importance for wetland management.

Originality, interdisciplinary and innovative aspects of the research programme

Despite repeated calls to integrate paleoecology and community ecology [33-36], and despite both disciplines being concerned with the composition and structure of biotic assemblages [33], they remain largely disconnected with relatively little engagement [33,34]. In the last decade, with the development of resilience science, community ecologists have begun to value the empirical richness and long-term perspective of paleoecology [1]. However, ecological and environmental processes occurring on timescales from decades to millennia are not yet fully incorporated into resilience science. This action addresses this knowledge gap by combining the most up to date paleoecological methods (e.g. XRF core scanning), with carefully designed manipulative field experiments to identify patterns and signals of ecological transitions in the past and the present, to inform the future. Recent interdisciplinary studies, combining proxy records, field experiments and modelling techniques have been successful in linking pattern and process in the paleoecological record [35]. In addition, this project aims to build on the growing

[31] Strain et al. (2017) J Ecol 105:1374–1385; [32] Saaty (1980) McGraw-Hill, New York. [33] Jackson & Blois (2015) Proc Natl Acad Sci 112(16):4915–4921; [34] Rull (2010) Open Ecol J 3:1–5; [35] Bakker et al. (2015) Proc Natl Acad Sci:201502545; [36] Ricklefs (2008) Am Nat 172(6):741–750.

body of research in natural systems with a broad view to include the human component. "The delineation between social and natural systems is artificial and arbitrary" [37], because both the human and the ecological dimensions share the same planet and it is virtually impossible to subtract the human component from any ecological system [38]. This is especially true in the Ebre Delta, where the intensive use of the inland systems for rice cultivation and the shallow lagoons for bivalve aquaculture have been on-going for the past century [30], with clear effects on the Delta's ecology and geomorphology [30,39,40]. Even if obvious, the social-ecological link is seldom investigated in marine studies, particularly in the Mediterranean [41]. FOREPAST is also innovative in this sense, and will address the social-ecological link to allow a natural translation of the evidence base collected, into policy and management.

Career possibilities for the experienced researcher and collaboration opportunities for the host organisation

The present proposal represents a two-way benefit transfer between the candidate, the host institution and the secondment institutions. The candidate's (Dr Jordi Pagès, henceforth, Jordi) research has primarily focussed on ecological aspects of marine macrophytes (i.e. seagrasses in the Mediterranean and salt marshes in the Atlantic). Thanks to this project the candidate will expand his current knowledge of marine ecosystems to include salt marshes in the Mediterranean Sea and gain first-hand experience of new techniques such as XRF core scanning, radiometric dating, assessment of blue carbon potential, sedimentological techniques and dynamical ecological modelling. Furthermore, through the socio-ecological aspects of the project Jordi will be introduced to social sciences and methods applied therein (WP3). These aspects will strengthen Jordi's research profile and widen his research prospects in the future. Through the candidate, the host institution will be able to establish new contacts with research institutes with whom Jordi has previously worked during national- and European-wide collaborative projects (see sec 1.2). One example of such collaborative project is the RESILCOAST: a cluster formed by the Royal Netherlands Institute for Sea Research, Swansea, Bangor and Cardiff Universities, and the Plymouth Marine Lab in the UK.

1.2. Quality and appropriateness of the training and of the two-way transfer of knowledge

Training through research for the Experienced Researcher

This project presents a broad range of training opportunities for Jordi through the multidisciplinary approaches being applied and diverse skill sets and expertise at the host organisations (see sec 1.3). **Training goal 1 (T1)**. Planning and conduction of field surveys using techniques and equipment new to the candidate: (i) paleoecological surveys involving core extraction, (ii) core subsampling, (iii) manipulative field experiments involving transplants, (iv) Mediterranean salt marsh vegetation identification and sampling, and (iv) measurement of sediment accretion rates using SET [Surface Elevation Tables, 31], marker horizons, pins and other sedimentological approaches. **Training goal 2 (T2).** Learn advanced methods for assessing the paleoecological record: (i) XRF core scanning, (ii) radiometric dating techniques using ^{14}C and ^{210}Pb and (iii) stable isotopic analysis of sediment core samples. **Training goal 3 (T3).** Learn data collection methods adopted in social sciences: (i) stakeholder analysis, as well as (ii) questionnaire survey design, to capture the social dimension of the importance of transitions in the Ebre Delta's salt marshes. In particular, the candidate will receive training on how to develop, pilot, distribute and monitor the status of questionnaire surveys. **Training goal 4 (T4).** Improve skills on advanced statistical/analytical techniques: (i) change point analysis for the detection of thresholds, (ii) generalised non-linear least square models, to complete data synthesis task for WP1, (iii) analysis and application of dynamical models with threshold-like behaviours that display CSD or other early warning indicators (WP1) and (iv) attendance to a course on "Advanced GLMM and GAMM" in the statistical package R, which runs annually across Europe, to support data analysis of WP3. **Training goal 5 (T5).** This project will convey several transferable skills to Jordi: (i) scientific writing skills – four papers in high-impact peer-reviewed journals are envisaged as scientific outputs, (ii) communication skills and organization of outreach activities – Jordi will present his findings at international conferences, scientific seminars organized on a regular basis at the UB, and the CEAB-CSIC, and participate in outreach activities organized by the UB to disseminate key research findings to the general public (e.g. press releases, public lectures) and schools (e.g. Science Week); (iii) grant writing and interview skills – Jordi will attend seminars on writing proposals for competitive (EU) funding programmes organized at UB, (iv) teaching and supervising skills – UB and specifically the Department of Ecology run a number of MSc and BSc courses, where Jordi will have the opportunity to deliver lectures, practicals and supervise his own MSc projects, (v) scientific networking – UB, CEAB and IRTA are renowned centres of international scientific excellence with established links to other researchers around the world, (vi) research and financial management – by setting up the project, actively leading and monitoring progress throughout the project, assessing and managing risks and finding mitigating solutions to problems that may arise during the project, Jordi will gain valuable experience in research project management, something he is already familiar with given his current position also has a research budget of his own. An explanation of how these training goals are beneficial to the

[37] Berkes & Folke, editors. (1998) Cambridge University Press, Cambridge, UK; [38] Folke et al. (2016) Ecol Soc 21(3); [39] Ibáñez et al. (1997) J Coast Conserv 3(2):191–202; [40] Cearreta et al. (2016) The Holocene 26(9):1438–1456. [41] Liquete et al. (2013) PLoS One 8(7):e67737.

development of the candidate's independent research career is provided in sec 2.1. These training goals will form part of the Career Development Plan for Jordi (further details in sec 1.4).

Transfer of knowledge from researcher to host organisations

Jordi will bring expertise in the field of (i) experimental ecology in marine and coastal environments, (ii) species interactions, (iii) systematic reviews and meta-analysis, a tool that is increasingly used in evidence-based scientific practice, (ii) meta-analysis of ecological data, (iii) animal movement analysis, (iv) soil ecology and erosion, (v) GIS techniques, (vi) numerical hydrodynamic and morphodynamic modelling (using Delft3d) and (vii) statistical modelling and inference using R, which he gained throughout the last nine years of his doctoral and post-doctoral work at Spanish, Indian and UK research institutions. In the past, Jordi has given lectures/tutorials to MSc/BSc students at Bangor University, UK, and has run practicals on ecological surveys in soft sediment coastal habitats. Jordi has also supervised or co-supervised six MSc students and mentored 2 PhD students at Bangor University, and provided mentoring to a number of graduates and undergraduates at the CEAB-CSIC, Spain. Jordi will aim at continuing his involvement with student projects, and there is scope for collaborative MSc's between UB and the secondment institutions (CEAB-CSIC and IRTA), which would positively impact the career prospects of the students. Jordi will also deliver a "controlled" number of lectures/practicals within the newly developed Marine Sciences degree and MSc at UB. Whilst at Bangor University, Jordi worked as WP leader for the Welsh Government-funded collaborative cluster, RESILCOAST (see CV sec 4), and led systematic reviews, experimental, and modelling-based studies on the resilience of Atlantic salt marshes to land use and environmental changes. Jordi's knowledge and expertise in this field will complement and broaden existing research on marine macrophyte resilience and functioning at the Department of Ecology at the UB. His numerical modelling skills will complement the field-based sea-level rise research conducted at IRTA (secondment institution), and his data analysis skills, community ecology and experimental background will add mechanistic detail to the mainly palaecological scope of Dr Mateo's group at CEAB-CSIC. Through his past work Jordi has forged strong links with European (UK: Bangor University, Swansea University, Cardiff University, Centre for Ecology and Hydrology, Plymouth Marine Laboratory, Surrey University; the Netherlands: the Royal Netherlands Institute for Sea Research NIOZ, Netherlands Institute of Ecology NIOO) and non-European research institutions (India: Nature Conservation Foundation, China: Northeast Normal University) with whom he plans to continue collaborating in the future through this project and further applications.

1.3. Quality of the supervision and of the integration in the team/institution

Qualifications and experience of the supervisors

Collectively, my supervisor and collaborators at the host and secondment institutions have the necessary experience and expertise required to support me when implementing my research proposal and for guiding me in my professional development as a researcher. My supervisor at the host institution (UB), **Prof Javier Romero**, is the leader of the Benthic Ecology and Biology Research Group (BEBRG), which integrates ca. 10 senior scientists and ca. 20 junior scientists and students. Prof Javier Romero is a full professor at UB (Department of Ecology), and a renowned marine macrophyte ecologist, whose expertise encompasses a wide array of fields, such as macrophyte biology and ecophysiology, coastal ecology, and general trophic and community ecology, all of them of direct relevance to the topic of this proposal. He has published over 100 papers (32 last 5 years) in international journals, plus a number of book chapters, technical reports and dissemination works. He has received ca. 4000 citations (over 1500 last 5 years) and his H-index=40. He has a great experience in post-doc and student training, as he has supervised 22 PhDs (6 in the last 5 years) and a large number of BSc and MSc projects. Prof. Romero has chaired scientific panels and commissions, at both national and international levels. His research has been funded mostly by national competitive calls, and by EU funds (MAST, FP7, COST, INCO, Interreg). He currently has two EU funding proposals under evaluation. Jordi's training will benefit from the large network of Prof. Romero, which includes more than 20 European laboratories (with a large experience in networking through COST actions – new proposal under review), plus tight contacts with USA and Australian scientists.

Dr Miguel Ángel Mateo is scientist at CEAB-CSIC. He will host Jordi during his secondment at CEAB-CSIC. He has strong interests in the biogeochemical cycles associated with marine vegetation, assessing carbon budgets, and the paleoreconstruction of past environment using marine macrophytes as proxies. He has published ~100 articles and received >3000 citations. He is currently leading a LIFE EU project (Blue Natura) whose main aim is the quantification of carbon deposits and carbon sequestration rates in wetlands of Spanish coast. This MSCA will drink from the knowledge gained and techniques learned on sediment core extraction and analysis during the first two field seasons of the LIFE Blue Natura project. He currently supervises two postdocs and four PhD students.

Dr Carles Ibáñez will host Jordi during his secondment at IRTA. He is Senior Researcher (and former Head [2005-2017]) of the Aquatic Ecosystems Program at IRTA St. Carles de la Ràpita. His expertise is in theoretical and applied knowledge of the impacts and adaptation to global change in the Mediterranean deltas and estuaries. He has

lead two LIFE EU projects (combined grant capture >5M€), of direct relevance to this research proposal, both of them focused in the same study area and focusing on wetlands: Delta-Lagoon aimed at restoration of wetlands of the Ebre Delta; and EBROADMICLIM, which focuses on climate adaptation and mitigation at the Ebre Delta, in light of projected relative sea level rise. He has published more than 70 papers in peer-reviewed journals (ca. 1200 citations), and several book chapters. He is member of the Advisory Council for Sustainable Development of the Catalan government, member of the Group of Experts on Climate Change of Catalonia, and expert reviewer of the Fifth IPCC Report on Climate Change 2013: Impacts, Adaptation and Vulnerability (Working Group II).

Hosting arrangements

UB capacity to integrate experienced researchers is reflected in its track record of hosting >80 Marie-Curie fellows in the last 5 years. The host is an endorser of the European Charter for Researchers, ensuring that the researcher will enjoy research freedom, fulfilment of contractual and legal obligations, good relations with the supervisor, and continuing professional development. The candidate will be provided with office and laboratory space as well as access to infrastructures and facilities available at UB (see sec. 5). Being Catalan, Jordi will be living in his town of origin, which will mean minimal relocation arrangements and no need for adaptation to the country.

During the fellowship Jordi will be working closely with members of the BEBRG, at UB, namely Prof Romero (UB), Prof Marta Pérez (UB). Prof Romero will be Jordi's main supervisor, and will be key in delivering T1 and the transferable skills (T5) specified in section 1.2. Given the multidisciplinary nature of this action, Prof Romero is a perfect fit, as one of his main qualities is being synthetic and with focus on generality, much needed in such a broad action. In addition, Prof Romero's is the lead PI in a project in revision on the responses of marine vegetation to stress, with particular interest on critical transitions. Prof Romero is a successful researcher, but he is also very valued among Spanish ecologists for being a great mentor. He chaired as president, the panel that assesses, selects and awards some of the most prestigious postdoctoral grant programmes in Spain (Juan de la Cierva and Ramón y Cajal) (2009-2013), which will be extremely helpful to support Jordi's career development and capacity to reach a position of maturity. The PhDs supervised by Prof Romero have had excellent employability post-PhD, specially within the Academic sector. Moreover, he and Prof Pérez have been working in the macrophyte communities of the Ebre Delta since the 1980s, with accumulated knowledge on these systems that will be useful for T1 and experimental design. The Department Ecology employs four full time research and IT technicians that will provide technical support for the field and laboratory work under WP1 and WP2. Still in the Department of Ecology, Jordi will also interact with Dr Biel Obrador and Dr Margarita Menendez, experts in coastal lagoons, sand dunes and Mediterranean salt marsh vegetation, who will support Jordi towards achieving T1. In the Department of Marine Geosciences (UB), Jordi will interact with Prof Miquel Canals and Dr Isabel Cacho, internationally recognised experts in paleosciences and sedimentological analyses that will support Jordi towards T2.

At CEAB-CSIC, Jordi will be mainly supervised by Dr Mateo. He will be the main collaborator to advance the paleoecological tasks in WP1, and will deliver part of T1 and much of T2. Jordi will interact closely with the entire team of Dr Mateo, but specially with Elena Díaz-Almela, who is a postdoc and an expert in using sediment cores for environmental reconstructions. Also at CEAB-CSIC lies the rest of the BEBRG that Prof Romero leads from UB, namely Dr Teresa Alcoverro and Dr Rohan Arthur. Dr Alcoverro has a large experience in community ecology, and, specifically in studying the functional ecology of marine systems using manipulative field experiments, which will support Jordi in the development of WP2 and in achieving part of T1. Dr Arthur has led pioneering studies on the social component of biological conservation, with ample experience in conducting social questionnaires and interviews to support his research. Dr Arthur will support Jordi in achieving T3 and developing the questionnaires for WP3. Still at CEAB-CSIC, Jordi will benefit from collaborating with Dr David Alonso, a theoretical ecologist with ample dynamical modelling expertise. Dr Alonso has been increasingly collaborating with empiricists with fruitful results (published in Ecology Letters, Proceedings of the Royal Society B), which has led him to collaborative funding bids. Dr Alonso's expertise in modelling will support Jordi towards achieving T4 and task 1.5 (WP1).

While seconded at IRTA, Jordi will be supervised by Dr Ibáñez but will closely interact with other researchers and technicians of the Aquatic Ecosystems Program. Dr Ibáñez and Dr Rosa Trobajo and the technicians Lluís Jornet and David Mateu will offer Jordi further support towards achieving T1 and T2, especially the radiometric dating and the assessment of paleoecological records. Dr Ibáñez and Dr Nuno Caiola will advise Jordi during the stakeholder analysis (T3). Dr Carles Alcaraz will support Jordi in improving skills concerning T4 (GLMM and GAMM in R).

All members of the research teams mentioned above have already been approached in person by Jordi and agreed to collaborate towards different aspects of the project. The host and secondment institutions have a number of active research projects of direct relevance to the topic of this proposal, providing Jordi with complementary knowledge (i) on the role of warming in precipitating critical transitions in marine communities (RECCAM, PIs: Prof Romero and Dr Alcoverro), (ii) on using paleoecological techniques to assess the carbon sink capacity of marine ecosystems (Life Blue Natura, PI: Dr Mateo), (iii) on climate mitigation and adaptation in the Ebre delta, by assessing the capacity of the Delta to retain sediment and adapt to relative sea level rise (Life EBROADMICLIM, PI: Dr Ibañez) and (iv) on fishermen-coral reef protection conflict in the Indian ocean (Pew foundation, Dr Arthur). Through interactions with

scientists on these projects Jordi will have ample opportunities to get integrated in the development of research ideas and grant proposals to further his career after the MSCA. Further, the BEBRG also works in close collaboration with centres beyond UB and CEAB, e.g. Institute of Oceanography (IEO), which will expand Jordi's network even more.

1.4. Capacity of the researcher to reach or re-enforce a position of professional maturity/independence

The diversity of topics addressed during the candidate's research career, including plant-animal interactions, disturbance ecology, animal movement, functional ecology and landscape ecology in multiple study systems (seagrass, macroalgal and salt marsh ecosystems) in different environmental settings (temperate, tropical) and in different countries (Spain, India, United Kingdom) show that he is able to address complex and multidisciplinary research questions. Importantly, Jordi was successfully awarded several research grants, including that to carry out his PhD and a postdoc (Juan de la Cierva, see CV), and has previously applied for competitive calls such as MSCA2014 (89.0, not funded), Human Frontier Science Programme, NERC. Over the past years Jordi has been organising field work seasons to work underwater or on the intertidal every summer, showing his organizational, logistical and project management skills. These experiences establish a strong foundation and demonstrate the candidate's predisposition to continue improving and enhancing aspects of his research and professional skills at the host and secondment institutions. Through this fellowship and the hosts, Jordi will broaden his ability to design, conduct and analyse data from different nature to that previously dealt with. Particularly, complex statistical approaches based on paleo data, radiometric dating techniques and statistical and analytical modelling of critical transitions will enlarge the candidate's skills. Working with social perceptions will be the other key training goal of this action, as well as enlarging his network of contacts. In order to re-inforce a position of professional research, Prof Romero at the host institution (UB) together with Jordi, will formulate a Personal Career Development Plan that will define the mentoring scheme and the availability of the supervisor and host's services, description of the short and long-term objectives for career development such as: publications, conferences, training, tutoring, teaching research management or other funding applications (e.g. Ramón y Cajal fellowship).

2. Impact

2.1. Enhancing the potential and future career prospects of the researcher

The training resulting from this MSCA will contribute to Jordi's career development by: (1) acquiring advanced skills in ecological and social sciences that will provide a notable improvement to his multidisciplinary background and diversification of research expertise; (2) gaining knowledge in ecological and geophysical techniques commonly used in field observational and manipulative studies in deltaic and coastal systems (vegetation surveys, Surface Elevation Tables, sediment traps, marker horizons); (3) acquiring research expertise in paleoecological techniques, radiometric dating, isotopic signatures, and advanced statistical and analytical modelling approaches, thereby increasing his toolbox of technical skills and placing him in a better position to participate in and supervise a wider array of research projects in the future; (4) gaining an understanding of all the sectors with a stake on the wetlands of the Ebre Delta, and of the management actions and trade-offs that affect salt marsh vegetation, thus acquiring a socio-ecological perspective that will be beneficial for Jordi in future European-wide collaborative projects in which he may participate or lead; (5) gaining experience in interacting with the non-academic sector, through the social science questionnaires and collaboration with the Ebre Delta Natural Park administration, thereby making Jordi a better communicator and disseminator; (6) strengthening his project management skills, presentation skills at international conferences, as well as writing skills through preparation of high level scientific papers, thus increasing his competitiveness for future employment and grant capture; (7) integrating Jordi in research centres outside of UB (e.g. IRTA, CEAB-CSIC, IEO), thus increasing his chances of participating in future collaborative projects. In the short to medium term, this will provide the candidate with a greater number of employment possibilities within Europe, and a high scientific profile necessary to develop innovative and integrative projects and to apply for national funding schemes for other post-doctoral fellowships and European funding schemes such as ERC grants and Horizon 2020. The aforementioned benefits will reinforce Jordi's professional maturity, diversity of ideas, independence and competiveness, thus significantly increasing his chances of attaining a permanent academic position in which to establish his own research group at a European research institution. Further, by bringing in new expertise and gaining complementary competencies highlighted in sec 1.2, the candidate will be able to be considered for a more permanent integration, through potential tenure-track positions that might become available at the host institution in the near to mid-term future, given that some Professors with a marine science background in the Department of Ecology are expected to be retiring in the next few years and the UB prepares a new Marine Science degree (BSc).

2.2. Quality of the proposed measures to exploit and disseminate the action results

Dissemination of research results among potential end-user groups

Scientific community: The findings arising from this fellowship will translate into the publication of at least four scientific peer-reviewed papers (one for each WP, plus a synthesis paper) in open-access journals to facilitate

dissemination and ensure the widest possible readership. Publications will be advertised on ResearchGate, LinkedIn and posted on Twitter (Jordi has ~600 followers, 5000-10000 monthly audience). Target journals: Nature Climate Change, Journal of Ecology, Proceedings of the Royal Society-B, Ecology & Society. Further, the candidate will present project outcomes in 3 international conferences; the European Geophysical Union meeting (EGU April 2019, to present data from paleoecological analyses WP1), the Resilience conference 2020 (August 2020, to present results from WP3) and the British Ecological Society annual meeting (BES, December 2020 to present a synthesis of the entire MSCA results). This last conference might lie outside the fellowship duration. Project findings will also be presented in at least two research seminars at UB and CEAB-CSIC.

- *Agriculture, aquaculture and tourism industry:* An end-of-project workshop is envisaged to take place with the rice farmers and people working in the tourism and aquaculture industry, where results from WP3 will be discussed and recommendations by these stakeholders to the policy making sector will be invited.
- *National government authorities and NGOs:* A non-technical summary report highlighting the main findings and recommendations for the persistence of wetland habitats in the Ebre Delta will be produced at the end of the project and emailed and/or posted to the relevant policy makers and management authorities (e.g. Generalitat de Catalunya) and local NGOs (e.g. Plataforma en defensa de l'Ebre). The Ebre Delta Natural Park has already expressed its commitment to this proposal, which will make communication to the non-academic sector easier. If requested, a seminar open to scientists, government authorities, farmers and NGOs to discuss results and recommendations will also be organized at IRTA, which is located in the Ebre Delta itself.

Exploitation of results and intellectual property

The results produced from this project are envisaged to be used as background for future internal research by the host institutions, as well as collaborative research projects between the hosts and other research institutions. The candidate with help from the supervisor at UB will produce a Data Management Plan at the start of the fellowship, highlighting meta-data and data structure of data generated by the project and data repositories where datasets will be made available (open access, CC BY) upon the publication of papers. The strictest standards for data annotation (e.g. INSPIRE Directive) to make datasets interoperable and to allow data exchange between researchers will be followed. UB, in accordance with the European Charter for Researchers, confirms that the researcher will secure the benefits of the exploitation of research results through legal protection and, in particular, through appropriate protection of Intellectual Property Rights (IPR), including copyrights. According to the host's practice, National Legislation and the recommendations of the European IPR Helpdesk, upon commencement of the Fellowship, along with the researcher's Work Contract, a specific Agreement on Collaboration and IPR will be prepared. This will specify: (i) the foreground and background intellectual property entailed and the relevant ownership and access rights of the researcher and the hosts, (ii) the identification and protection of results, (iii) the routes of further exploitation, which for this project will be through 'internal research projects' and 'Collaborative research projects'. Issues regarding confidentiality of data collected in WP3 are addressed in sec 6.

2.3. Quality of the proposed measures to communicate the action activities to different target audiences

The main public engagement activity carried out throughout this fellowship is the questionnaire survey that will be disseminated online, but that will also include interviews in person at the Ebre Delta Natural Park office, farms, beaches and hides for birdwatching. Through this, the candidate and collaborators will have the opportunity to inform the public on the role of salt marshes in maintaining the functioning of the Delta, keeping pace with sea level rise, and as a nursery habitat for a number of vertebrate and invertebrate species, both terrestrial and aquatic, and also to raise a sense of stewardship towards wetlands. Additional activities to increase communication and public engagement include: (i) the Delta Birding Festival: an annual event at the Ebre Delta attracting each year >2000 people interested in birds, but also in nature in general. Jordi will showcase the ecosystem services salt marshes provide (e.g. coastal protection, accretion) using a LEGO model and astroturf as plant mimics; (ii) Science Week: a series of events organized every November by the Catalan Government to bring science closer to the general public. Jordi will participate by organising a lecture on the dynamic nature of coastal ecosystems and with a practical session on how to "read" the paleoecological record by showing the public the differently coloured and textured layers of a transparent sediment core; (iii) Press releases: Project findings will be disseminated through press releases prepared with the support of the UB Communications team that have access to a distribution network including more than 300 journalists and ca. 1000 subscribers that relay the information to regional and national media. Press releases feature at UB homepage, with an average of 60000 visits/day; (iv) Young people's science ambassador: At high school level, Jordi will offer to help students in developing their end of year science research projects related to the marine environment. At university level, in conjunction with UB, Jordi will organise talks to promote his research field to students and to motivate them to pursue careers in science, (v) Social networking: UB, IRTA and CEAB-CSIC have a well-established social media platform, Twitter, Facebook, LinkedIn and YouTube Channel. Jordi will use these platforms to communicate activities and findings as they arise, (vi) Multimedia releases: Videos using footage from

the project will be posted on UB YouTube channel. Jordi will have the support of UB Communications Team who has ample experience in public dissemination and engagement.

3. Quality and Efficiency of the Implementation

3.1. Coherence and effectiveness of the work plan

Different tasks under each of the 3 WPs are specified in the Gantt chart (below). A detailed explanation of each work package and task is given in sec. 1.1. **Milestones:** M1. Completion of Contingency/Risk Management Plan (C/RMP), Personal Career Development Plan (PCDP), Intellectual Property Right plan (IPR), Data Management Plan (DMP) and Financial Management Strategy plan (FMS); M2. Start of the manipulative field experiment (WP2); M3. Complete list of stakeholders (WP3); M4. Completion of field data collection (WP1); M5. Completion of sample processing in the lab (WP1); M6. Completion of modelling tasks (WP1); M7. Completion of data collection (WP3); M8. End of manipulative field experiment (WP2); M9. Completion of sample processing in the lab (WP2). **Deliverables:** D1. Mid-term report to REA; D2. WP1 manuscript; D3. WP3 manuscript; D4. WP2 manuscript; D5. synthesis manuscript; D6. non-technical report of findings; D7. Periodic report & final report to REA. **Training:** Detailed information for T1-T4 is provided in sec 1.2. T5 is an ongoing learning-process gained throughout the entire project. **Dissemination:** Conferences, seminars, manuscript and non-technical report are all part of the dissemination strategy. Manuscript & non-technical report are included among deliverables. **Conferences and seminars (Conf. & Sem):** S1. Project presentation at UB; S2. Research seminar on project findings at UB; S3. Research seminar at IRTA with the option of inviting non-academics. **Conferences:** C1. EGU; C2. Resilience conference; C3 BES (sec 2.2). **Public engagement:** DB. Delta Birding Festival; NP. News & press release; SA. Science Ambassador; SW. Science Week. Social networking and multimedia releases will be done throughout the duration of this action.

Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Project management	C/RMP PCDP IPR DMP FMS			P&R		Adv.		P&R		P&R		Adv.		P&R		P&R		Adv.		P&R		P&R		Adv.	
WP1		1.1	1.1		1.2	1.2	1.3	1.3	1.3	1.3	1.4	1.4	1.4-5	1.5	1.5	1.5									
WP2		2.1	2.1	2.2-3			2.4			2.4			2.4			2.4			2.4		2.5	2.5	2.5		
WP3				3.1	3.1				3.2	3.2	3.2						3.3	3.3	3.3	3.3					
Secondments				irta	irta					irta			ceab	ceab	ceab										
Milestone		M1		M2	M3		M4				M5					M6	M7				M8	M9			
Deliverable												D1					D2			D3			D4	D5-6	D7
Training				T1-3	T1-3	T1	T1	T2	T2-3	T2-3	T4			T4	T4		T4	T4			T1	T1			
Conf. & Sem.		S1											S2		C1				C2				C3	S3	
Public engag.			SA		NP					DB		SW		SA			NP							NP	

3.2. Appropriateness of the allocation of tasks and resources

Month 1–2: start-up meeting where the arrangements highlighted in M1 (sec 3.1) will be discussed. At this stage, Jordi will apply for fieldwork permits. Month 2–3: identify study sites and design field experiment for WP1-2 (Tasks 1.1, 2.1). Month 4–6: (i) start core extraction (Task 1.2), (ii) start the manipulative experiment (M2, WP2) (establish inundation (Task 2.2) and disturbance treatments (Task 2.3)), (iii) and stakeholder identification (M3). Jordi will spend months 5-6 on secondment at IRTA, which will ensure training is received from Dr Ibáñez group during the establishment of the manipulative field experiment (T1). Dr Mateo's group (CEAB-CSIC) will join Jordi when extracting soil cores, to ensure it is done according to paleoecological standards (T1) and in a timely manner. In parallel, Jordi will be in close contact both with the Ebre Delta Natural Park and with Dr Arthur (CEAB-CSIC) to ensure T3 is achieved. Month 7–10: (i) core-scanning the sediment cores at UB core-lab, where Jordi will achieve T2, (ii) subsample the regions of interest identified by the core scanner with help from Dr Mateo's group, (iii) send samples to UB spectrometric and radiometric services, all these are under task 1.3. Also, (iv) check the recovery in disturbed plots from the manipulative experiment (task 2.4), (ii) design and disseminate the social-science questionnaires, with support from Dr Arthur, Dr Ibáñez and Ebre Natural Park (task 3.2), taking advantage of being seconded at IRTA for another month. By Month 11: all data for WP1 will have been collected and processed (M5), the questionnaires sent and WP2 experiment well under way, all of which will be reported on in the mid-term report to the EU (D1). Month 11–16: (i) identify transitions in the paleoecological data set obtained from the cores (task 1.4), (ii) taking advantage of being on a secondment at CEAB-CSIC, Jordi will benefit from Dr Mateo expertise to finish paleoecological analysis and Dr Alonso who will provide training and support for the modelling task (task 1.5). After this, he will write up and submit WP1 manuscript (D2). Month 17–24: data analysis and synthesis, manuscript writing (D3 – D5), communication and dissemination of results through the non-technical report (D6), a

seminar (S3), conferences (C2, C3) and other public engagement (NP). The periodic and final report to the EU (D7) will be delivered in month 25.

3.3. Appropriateness of the management structure and procedures, including risk management

Organisation and management structure

Decision-making on the scientific and technical aspects of the project will be done by the candidate after discussing and agreeing on the best way forward with the main and secondment supervisors and collaborators. Ultimately, the candidate will be in charge of the overall management and coordination of the project. The host institution (UB) has a dedicated unit (OPIR) with experienced staff in the management of EU research projects (incl. MSCA), which will handle IPR plan and Financial management strategy plan at the start of project. The management of purchases of consumables during the project will also be done by the OPIR. The candidate will have bimonthly meetings with the supervisor to monitor the candidate's overall progress with respect to the scientific and training goals specified in the Career Development Plan. These meetings will have the additional aim to identify any potential problems, so that any issues can be addressed from the start. The candidate will also meet with an advisory group consisting of the supervisor, Prof Romero, and main collaborators on the project every 6 months, with the aim of providing advice and feedback on the scientific work so as to ensure that quality outputs are produced. Progress monitoring and risk management meetings are labelled as P&R in the Gantt Chart, whereas advisory group meetings are labelled as Advis. Meeting frequency will be increased if the circumstances require so.

Research and/or administrative risks and contingency plans

With the help of the supervisor, Jordi will develop a risk management and contingency action plan (C/RMP) within the first 2 months of the fellowship. No major risks that would prohibit achieving the set-out objectives are envisaged. However, a list of potential problems and contingency measures are listed below: (1) Permits to access and carry out field work: they will be requested early - Park has shown commitment with this action. Risk = very low. (2) Field work and data collection in the field will be done mostly during year 1 of the action, in case additional data needs to be collected in year 2. Also, field work is planned to take place during late spring-early summer months when winds, river and sea-levels are stable for long periods of time. Risk = low. (3) Instrument failure: in the event of equipment (e.g. dGPS) damage and/or failure, equipment and facilities will be replaced by and/or borrowed from any of the institutions involved in this action, at no detrimental cost to the progress of the work. Risk = low. (4) Identifying transitions in the paleorecord: by working closely with Dr Ibáñez group, with long term experience, and published literature on the paleocommunities of the area [40], Jordi will minimise the risk of taking sediment cores from stable areas (where no transitions would be found). Risk = low. (6) Early warning indicators in the paleoecological record (e.g. CSD, flickering): not finding indicators of change is considered to be unlikely, given that salt marshes experience changes in the granulometry, sediment provenance, nutrient levels, etc. before shifting into alternative states [26]. Risk=low. (7) Slow recovery and accretion rates in disturbance experiment: Mediterranean marshes are not very productive and do not accrete sediment at fast rates, therefore to allow them enough time to recover and accrete, the candidate will start the experiment at the beginning of the action. According to collaborators, 18 months should produce 2-4 cm of sediment accretion, which will be enough to find signals in the short cores that will be taken at the end of the experiment. Risk = medium, but considered high gain. (8) Questionnaire participation: IRTA and the Natural Park hold well established links and good relations with the different sectors of the Ebre Delta, therefore very low risk is envisaged. Nevertheless, if number of participants for Task 3.2 is too low, direct interviews will be conducted with some stakeholders. Risk = Low. (9) Budget: The research budget provided by the MC fellowship is envisaged to cover the research costs associated with this project comfortably (main costs are: lab and field consumables, radiometric datings, core scanner). Risk = Low.

3.4. Appropriateness of the institutional environment (infrastructure)

As a fellow of the Department Ecology and Environmental Science in UB, Jordi will have access to a wide range of facilities: desk, access to computing, internet, software support, all of this together with in-house expertise and training in their use. UB researchers have free access to all of the University's libraries, and online access to over 22000 scientific journals. Jordi will enjoy similar infrastructure during his secondments (see section 5). A dedicated European Team at the UB International Research Projects Office (OPIR) offer administrative support, assistance in completing the grant agreement and all reporting requirements, assistance with HR issues, national insurance registration, payroll and pension. There is also a unit to assist with obtaining ethical clearance. The UB Learning Institute offers training to researchers in research and transferable skills such as leadership, project management and computer software, completely free of charge. There is a frequent flow of visitors and academic speakers through the Department and the hosting research group, providing further opportunities to discuss my work, gaining external input from scientists from different traditions and areas of expertise. It will also provide opportunities for academic networking and collaboration.