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Fossil Collecting Codes of Conduct on the Jurassic Coast World Heritage Site - practical management connecting fossil collectors, land owners / managers, researchers and museums with the needs of the Site.

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Abstract

Fossil collecting along parts of the Dorset and East Devon Coast World Heritage Site is managed via codes of conduct. This paper provides an outline of their terms, an account of how they operate in practice, and a discussion on how best to manage such a popular open access site of great paleontological importance. Both codes operate on rapidly eroding coastlines; such conditions require and support open collecting but subject to a degree of control afforded by the codes. They function as a series of practical considerations, recognizing the value gained by the recovery of fossils prior to damage by natural processes. Adherence to the codes and participation in the recording schemes is a condition of the transfer of ownership. The recording schemes provide a local record of scientifically important fossils and establish a mechanism for requesting access to specimens and a point of reference regarding potential acquisitions. The sustained recording of scientifically important fossils shows that the codes remain effective. The authors conclude that, taking account of all the circumstances specific to this Site, and subject to amendments that may be agreed occasionally, the codes provide the best practical means to manage this important but vulnerable paleontological resource.

Keywords: Fossil Collecting Code, Geoconservation, Jurassic Coast, Fossil Acquisition

Introduction

There is a long history of fossil collecting and managing fossil collecting practices in the UK, supported by the fostering of collaboration between fossil collectors, land owners / managers, the research community and museums. Successful management requires a balance between different stakeholders with an interest in the subject, careful consideration of different views, and a mutual understanding of the ambitions and concerns of others. Any approach to management is governed by, and must also therefore be considered in terms of, legislation and the landowner's preferences. In recent years this has been widely debated and documented (e.g. Crowther and Wimbledon 1988; Norman 1992; Bassett *et al.* 2001; Larwood 2001, 2007; Larwood *et al.* 2022; Edmonds *et al.* 2005; Sole 2007; Page 2018; Page and Wimbledon 2008;

Ulph 2018; Underwood and Ward 2018; Crofts *et al.* 2020), resulting in the development of practical and widely-shared guidelines focusing on responsible collecting practice (e.g. Townley and Larwood 2012a; Townley and Larwood 2012b; Townley and Larwood 2012c). These principles have been adopted in a number of site-specific settings, most notably the Dorset and East Devon Coast World Heritage Site.

The Dorset and East Devon Coast World Heritage Site, more commonly known as the Jurassic Coast, is one of Britain's most high-profile and popular fossil collecting localities, integrating high levels of tourism, a widespread interest in casual collecting by residents and visitors, an active community of professional and commercial fossil collectors, and ongoing scientific interest and research at a global level. Granted World Heritage status in 2001 for its geological, geomorphological and paleontological attributes, the geology of the Jurassic Coast spans approximately 185 million years of Earth's history - a near-continuous sequence of Triassic, Jurassic and Cretaceous rocks that represents almost the entirety of the Mesozoic Era. The coastline continues to reveal new fossil discoveries and inspire future generations of Earth, ocean and climate scientists, as well as being an important area historically and culturally for the development of the science of paleontology,

The current approach taken towards fossil collecting on the Jurassic Coast is generally consistent with the relevant Natural England Technical Information Notes, specifically TIN111 (Townley and Larwood 2012a), TIN112 (Townley and Larwood 2012b) and TIN114 (Townley and Larwood 2012c). It recognizes that responsible fossil collecting, defined as the collecting of fossiliferous resources in such a way that conserves their scientific, educational, and cultural potential for future generations (e.g. Larwood and King 2001; Townley and Larwood 2012b), contributes positively to paleontological site conservation (e.g. Larwood 2001). UNESCO's protection and management requirements of the Site determined that the management of ongoing fossil collection, research, acquisition and conservation was and remains a key issue. To support the sustainable management of fossil collecting on this coastline and in anticipation of the World Heritage nomination, the West Dorset Fossil Collecting Code of Conduct was developed in 1998. Both the West Dorset Fossil Collecting Code and, more recently, the Axmouth to Lyme Regis Undercliffs National Nature Reserve Fossil Collecting Code (referred to hereafter as the Undercliffs NNR Fossil Collecting Code) adopt and build on more general principles of best practice and operate where pressure from fossil collecting is particularly high.

The fossil collecting codes are tools to support the management of the protected sites upon which they operate, including the Site of Special Scientific Interest (SSSI), National Nature Reserve (NNR) and UNESCO designations, by promoting responsible and sustainable collecting. The aim of the codes is to provide practical guidance as to what this involves in their specific contexts. Each code is driven by the wish to enable the successful recovery of fossils avoiding their loss to rapid coastal erosion, whilst maintaining the stratigraphic and paleontological value of the coastline. The view that responsible fossil collecting on the Jurassic Coast has a positive impact and that its management is appropriate has been debated (e.g. Edmonds *et al.* 2005; Edmonds and May 2007; Page 2006, 2018; Page and Wimbledon 2008; Larwood 2007; Larwood *et al.* 2022; Larwood and Prosser 2019; Sole 2007; Underwood and Ward 2018). In this paper, we reflect on how the practice of fossil collecting, as well as the processes of site conservation and specimen acquisition, function with respect to the fossil collecting codes of conduct. Further, the practical link with museum collections, display and research are explored as

important components of successful management. It is not our intent to provide a critical evaluation of the fossil collecting codes, but to examine both their positive influence and limitations.

The Fossil Collecting Codes of Conduct and Recording Schemes

As tools to encourage and promote responsible fossil collecting, both the West Dorset and Undercliffs NNR fossil collecting codes have similar objectives. Here, comparable objectives from the two codes have been merged or grouped together; for the precise wording, please refer to the original documents: www.charmouth.org/chcc/wp-content/uploads/2023/05/West-Dorset-Fossil-Collecting-Code-of-Conduct.pdf and www.charmouth.org/chcc/wp-content/uploads/2023/12/Undercliffs-fossil-collecting-code-Version-2-FINAL.pdf. Adaptations within the more recent Undercliffs NNR Fossil Collecting Code reflect differences in geology, land ownership status and statutory SSSI and NNR designations.

The objectives of the West Dorset and Undercliffs NNR fossil collecting codes are to:

1.Promote responsible and safe fossil collecting - West Dorset

To encourage responsible and safe fossil collecting (in line with SSSI legislation) as well as to help manage public perception of collecting activity - Undercliffs NNR

2.Restrict the excessive digging or 'prospecting' in situ for fossils along fossil-rich strata - West Dorset

To set out circumstances for ex situ and in situ collecting - Undercliffs NNR

3.Clarify ownership of the fossils - West Dorset & Undercliffs NNR

4.Promote better communication between all those with an interest in fossils from the coast - West Dorset & Undercliffs NNR

5.Promote the acquisition of key scientifically important fossils by recognised museum collections - West Dorset

To encourage the acquisition of scientifically important fossils by museums and other recognized public collections - Undercliffs NNR

An additional two objectives are set out in the Undercliffs NNR Fossil Collecting Code (see below). Although not expressed as specific objectives in the West Dorset Fossil Collecting Code, they are implicit outcomes generally supportive of that code.

6.*To encourage recording and reporting of important fossil finds*

7.To support the management and monitoring of both the NNR and Jurassic Coast WHS as well as to maintain the scientific value of the NNR and its fossil resource

The West Dorset Fossil Collecting Code of Conduct

The West Dorset Fossil Collecting Code of Conduct was introduced in 1998, with subsequent revisions in 2013 and 2023; the latest version of the code is available at www.charmouth.org/chcc/wp-content/uploads/2023/05/West-Dorset-Fossil-Collecting-Code-of-Conduct.pdf. The code applies to land owned by Charmouth Parish Council and the National Trust between Lyme Regis and Hive Beach at Burton Bradstock in Dorset, part of the West Dorset Coast SSSI (Fig. 1). It is important to note that there are areas within this stretch of coastline that are not covered by the code (Fig. 1), including land owned by the Crown Estate and other private landowners.

The main geological sequence exposed here spans the Early Jurassic Blue Lias Formation to the Middle Jurassic Inferior Oolite Group (Fig. 1). In plac-

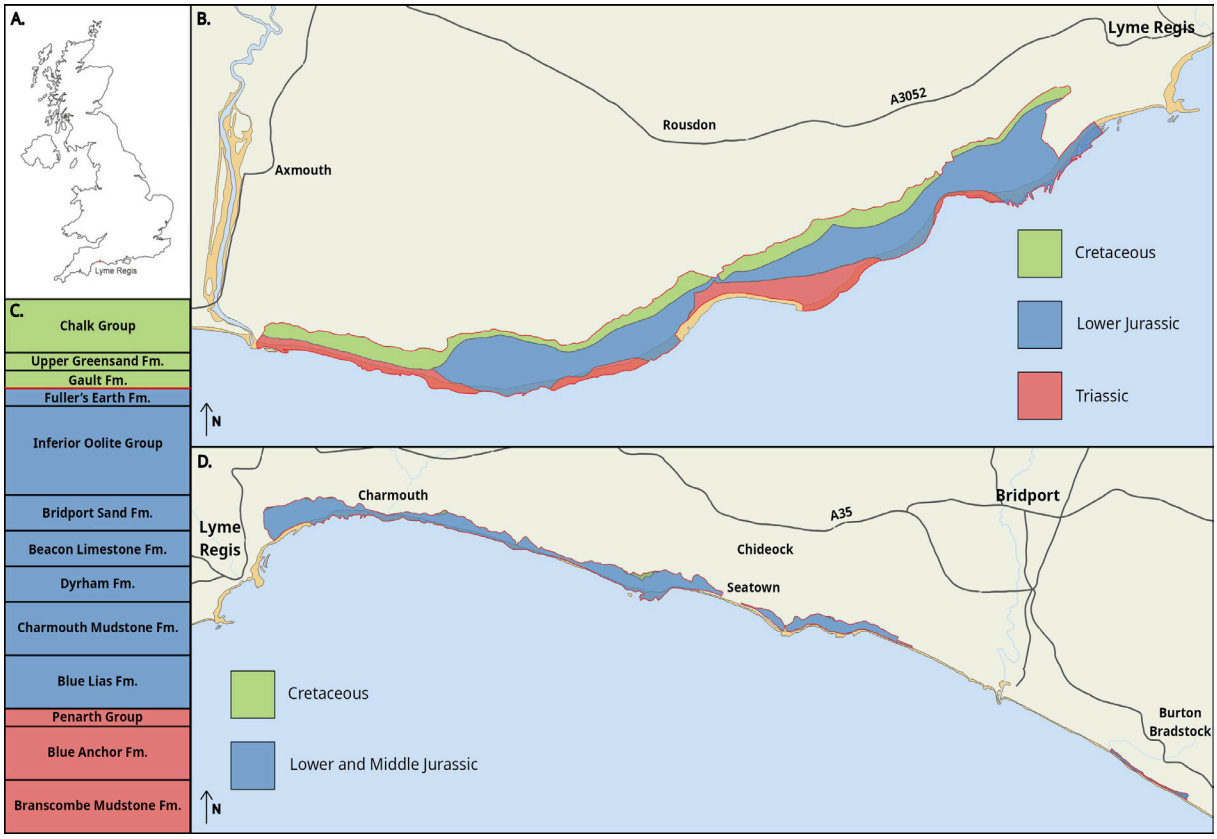

Figure 1. A) Outline map of the UK highlighting the study area. **B)** Map of the area that incorporates the Axmouth to Lyme Regis Undercliffs National Nature Reserve Fossil Collecting Code. The boundary of the Axmouth to Lyme Regis Undercliffs National Nature Reserve is highlighted in red. The geology of this area is mapped. **C)** Stratigraphic column detailing the strata present in areas covered by the two fossil collecting codes. **D)** Map of the area that incorporates the West Dorset Fossil Collecting Code. The areas covered by the code, specifically land owned by Charmouth Parish Council and the National Trust between Lyme Regis and Hive Beach at Burton Bradstock, are highlighted in red; the landward boundary is drawn at the break in slope at the top of the most landward cliff-scarp as is consistent with the boundary of the World Heritage Site. The geology of these areas is mapped. The details given on these maps are approximated and for illustrative purposes only.

es, the Cretaceous Gault and Upper Greensand formations sit unconformably atop Jurassic strata (Fig. 1). The Jurassic rocks are the main interest of this collecting code and associated recording scheme, although it applies to fossils from all geological units regardless of age. There are a number of Geological Conservation Review (GCR) sites (non-statutory designations of features of national and international importance that define the scientific criteria of the SSSI designations) within the area covered by the West Dorset Fossil Collecting Code; a list of these sites, as well as those present within the Undercliffs National Nature Reserve, is given in Table 1.

The Undercliffs National Nature Reserve Fossil Collecting Code of Conduct

The Undercliffs NNR Fossil Collecting Code of Conduct was launched in 2019 and revised in 2023; the latest version of the code is available at: www.charmouth.org/chcc/wp-content/uploads/2023/12/Undercliffs-fossil-collecting-code-Version-2-FINAL.pdf. The code operates on the Axmouth to Lyme Regis Undercliffs National Nature Reserve, approximately 6 miles of land slipped undercliffs and foreshore between Axmouth, East Devon and Lyme Regis, Dorset (Fig. 1). The entire area covered by the code is also part of the Axmouth to Lyme Regis Undercliffs SSSI. There are areas

Table 1. Geological Conservation Review (GCR) sites present in the areas covered by the West Dorset and Undercliffs NNR fossil collecting codes. Heading definitions: GCR Number = administrative number assigned to the GCR site; GCR Name = name of the GCR site; Block Name = name of GCR block (blocks are subdivisions of the GCR series which represent distinct areas of geoscience to maintain parity between subject areas in site selection); Name (Chapter) = name of the chapter in the associated GCR report for the site; Associated Collecting Code = collecting codes associated with the GCR site.

GCR Number	GCR Name	Block Name	Name (Chapter)	Associated Collecting Code
800	Axmouth to Lyme Regis, Devon to Dorset	Mass movement	Mass-movement sites in Jurassic strata	Undercliffs NNR
1263	Culverhole Point, Near Axmouth, Devon	Rhaetian	British Penarth Group sites	Undercliffs NNR
1264	Pinhay Bay, Devon	Rhaetian	British Penarth Group sites	Undercliffs NNR
2952	Lyme Regis coast (Pinhay Bay to Charmouth)	Mesozoic - Tertiary Fish/Amphibia	British Jurassic fossil fishes sites	Undercliffs NNR & West Dorset
51	Burton Cliff and Cliff Hill Road section, Dorset	Aalenian - Bajocian	The Middle Jurassic stratigraphy of Wessex	Burton Cliff only - West Dorset
87	Pinhay Bay to Fault Corner, Dorset	Hettangian, Sinemurian and Pliensbachian	The Wessex Basin (Dorset and central Somerset)	Undercliffs NNR & West Dorset (part)
252	Seatown to Watton Cliff, Dorset	Toarcian	The Wessex Basin (Dorset and central Somerset)	West Dorset (part)
794	Charmouth to Pinhay Bay, Dorset	Palaeoentomology	Mesozoic fossil arthropods	Undercliffs NNR & West Dorset
916	Lyme Regis (Pinhay Bay to Charmouth), Dorset	Jurassic - Cretaceous Reptilia	British Early Jurassic fossil reptile sites	Undercliffs NNR & West Dorset
1321	Black Ven, Dorset	Mass movement	Mass-movement sites in Jurassic strata	West Dorset
2109	Golden Cap to Lyme Regis, Dorset	Coastal Geomorphology of England	Coastal Geomorphology	West Dorset

within this stretch of coastline, albeit outside of the NNR and/or SSSI designation, that are not covered by the code, including land owned by the Crown Estate and Lyme Regis Town Council (Fig. 1).

Stratigraphically, this section spans the Upper Triassic Mercia Mudstone and Penarth groups to the Early Jurassic Blue Lias and basal Charmouth Mudstone formations; the Cretaceous Gault and Upper Greensand formations sit transitionally and unconformably atop Triassic and Jurassic strata from west to east, capped by the Chalk Group (Fig. 1). The code and associated recording scheme apply to fossils from all of the Reserve's geological strata regardless of age. A list of GCR sites present within the Undercliffs National Nature Reserve is given in Table 1.

Fossil Recording Schemes

Associated with both the West Dorset and Undercliffs NNR fossil collecting codes are fossil recording schemes. Under these schemes, relevant

fossils can be classified either as Category 1, specimens of key scientific importance, or Category 2, specimens of some (but not key) importance. Category 1 includes new species or fossils likely to represent new species as well as specimens that are extremely rare or exhibit exceptional preservation. Category 2 is not strictly defined, introducing an element of flexibility in assessing significance that reflects the broad paleontological interests covered by the codes. Category 2 can include plants, vertebrates, such as fishes and reptiles, and invertebrates, for instance, ammonites and other molluscs, insects and echinoids. When assessing potential Category 2 fossils, consideration may be given to rarity, completeness, taxonomy and taxonomic fidelity, stratigraphic provenance, unusual or atypical anatomical features, the potential to contribute to our understanding of paleoecology and the potential to increase our understanding of the stratigraphic range of certain fauna and flora. More detailed terms of reference are provided in the West Dorset Fossil Collecting Code. It is not expected that all fossils will fall into one of these categories; most fossils collected are common and recording is not necessary or recommended.

At the time of writing, there was a total of 563 specimens recorded under the West Dorset Fossil Recording Scheme, of which 132 were Category 1 specimens. A total of 50 specimens have been recorded for the Undercliffs NNR Fossil Recording Scheme, of which 11 are Category 1 specimens.

Fossil Collection and Recovery

Fossil collecting on the Jurassic Coast, particularly around Charmouth and Lyme Regis, became increasingly popular throughout the late eighteenth and nineteenth centuries (see review by Sharpe 2024). The legacy of this practice, and the potential for those who collect fossils to contribute to our understanding of the science of paleontology, irrespective of their background or formal training, is embodied by the fossil collector Mary Anning (1799-1847). In modern times, as it always has been, fossil collecting is a common pastime and can be driven by scientific interest, education, recreation, commercial purposes, or as is often the case, a combination of different factors.

Both the West Dorset and Undercliffs NNR fossil collecting codes operate on rapidly eroding coastlines; in terms of the Earth Science Conservation Classification (Nature Conservancy Council 1990; see review by Prosser *et al*. 2006), these are characterized as ‘exposure sites’ (Edmonds *et al.* 2005; Prosser *et al.* 2018). The nature of an exposure site is such that the geological interest is extensive and regularly renewed (Edmonds *et al.* 2005; Prosser *et al.* 2006; Prosser *et al.* 2018). In this case, replenishment is driven by natural processes such as mass movement and coastal erosion. Based on the frequency with which material is exposed and the potential risk to specimens if left unrecovered, it is generally considered that both areas can and should support open collecting but subject to a degree of control afforded by the fossil collecting codes (Edmonds *et al.* 2005; Townley and Larwood 2012c; Larwood and Prosser 2019). Consistent with the principles of geosite conservation (*sensu* Prosser *et al*. 2018), the approach adopted here also supports the wider value of the Jurassic Coast World Heritage Site as an educational resource; its economic function within the local community; its role in enabling people to experience and learn about geodiversity; and its historic and cultural practices.

The fossil collecting codes function in terms of a series of well-reasoned and practical considerations, recognizing the value gained by the successful recovery of fossils prior to damage or destruction by the sea (Fig. 2). As an example, anecdotal evidence amongst the authors is that moderate to major damage can occur to specimens preserved in soft shales within hours of exposure in adverse weather and tidal conditions, thus neces-

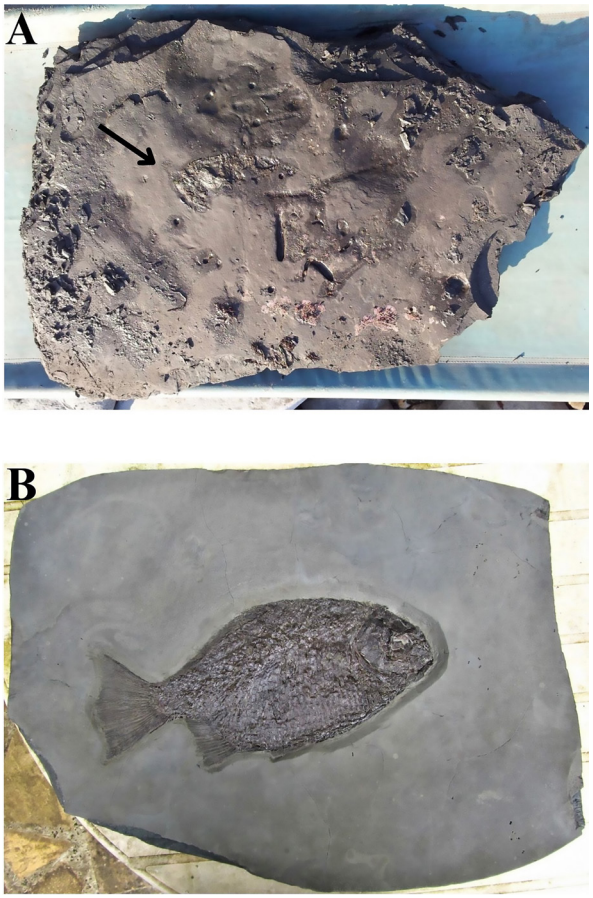

Figure 2. *Dapedium* collected from the Blue Lias Formation (Lower Jurassic) near Lyme Regis, Dorset by local collector and paleontologist Fiann Smithwick. A: Photograph of the extracted block on the foreshore. The head of this specimen is partially exposed and vulnerable to damage or destruction (arrow). B: Finished specimen prepared from the reverse. © Fiann Smithwick.

sitating specimen rescue. Rescue collecting here is almost always conducted by local and experienced fossil collectors who are 'on-site', familiar with local collecting conditions and can act in a timely manner. The codes also provide practical health and safety guidance both about permitted excavations and more general access to the coastline.

Once recovered, consideration is given to the conservation and preparation of the fossil, particularly Category 1 specimens where subsequent preparation work should only be undertaken after consultation with relevant subject specialists unless clearly straightforward or where the fossil is at risk of deterioration. For example, in certain instances, the fossil may be susceptible to pyrite oxidation or, in the case of specimens preserved in soft shales that have been exposed to the sea, vulnerable to shrinkage and cracking of the matrix during drying and may require more immediate stabilization. Then, as appropriate, the relevant research and museum communities are made aware of the specimen via the associated fossil recording schemes and the collector can be encouraged to make suitable provision for the future of that fossil. The management of each stage of this process works best where trust is built between different stakeholders to achieve open communication and collaboration.

Irresponsible fossil collecting can damage the scientific integrity or potential of a paleontological site (Edmonds *et al.* 2005) and *in situ* sequences can be particularly vulnerable. In West Dorset and on the Undercliffs National Nature Reserve, the codes require prior permission from the landowner and/or land manager to undertake *in situ* excavations except in situations where the fossil is clearly at risk of damage or destruction, in which case retrospective permission must be sought. The careful management of *in situ* collecting, particularly prospecting in fossiliferous concretionary layers (notably in the West Dorset cliffs), is intended to maintain the integrity of the Site for scientific purposes. Consequently, excepting natural obscuration or access limitations, the Site's stratigraphic and paleontological interests remain readily accessible *in situ*. A previous review of the West Dorset Fossil Collecting Code (Edmonds 2011) affirmed that the introduction of a code of conduct had significantly reduced *in situ* digging and it is generally accepted that this has been sustained. The requirement to seek permission increases communication between landowners, site managers and fossil collectors, improving awareness of actions undertaken and understanding of the active state and conservation needs of the Site. Moreover, irresponsible collecting can damage

public perception of the practice, has clear safety implications, and can negatively impact relationships between stakeholders. In recent years, there have been several isolated instances of the unauthorized use of power tools to extract fossils and efforts are being made to address this challenge.

From 2007 onwards, an educational wardening service has operated on the beaches around Charmouth and Lyme Regis. This role continues to be delivered during busy holiday periods by the Jurassic Coast Trust's fossil wardens and is jointly funded by the Jurassic Coast Trust, Natural England and the National Trust, as well as Charmouth and Lyme Regis councils; the post-holders are hosted by Charmouth Heritage Coast Centre. The wardens have a particular focus on discouraging irresponsible behavior; encouraging responsible and safe collecting practices; and raising awareness of health and safety issues among visitors and tourists. The fossil warden's role is not to police breaches in the fossil collecting codes, but to promote and encourage best practice since they are not in any position to forcibly prevent a person from acting in an unsuitable manner. The number of visitors engaged directly by the fossil wardens is significant and emphasizes the importance of an on-the-ground presence to promote responsible fossil collecting; reinforce information that exists in signage and via interpretation at Charmouth Heritage Coast Centre; and keep site managers up-to-date to address areas of concern promptly.

As management tools, the fossil collecting codes are not legislative. Those individuals who collect fossils are nonetheless incentivized to cooperate since both make clear that participating landowners have reasserted their right to ownership over fossils found on their land and will only subsequently transfer ownership to the collector on the condition that they follow the relevant code of conduct and record key scientifically important fossils. Evidence to support that the codes of conduct are working is generally anecdotal but such experience amongst site managers is not without value and suggests that there are very few incidents of non-compliance with the code by collectors. Having been made aware of the benefits associated with following the codes of conduct and their contribution to addressing the conservation needs of the Site via the promotion of responsible collecting, most fossil collectors have taken on the role of advocate; moreover, an element of self-policing and reporting of breaches in the code has been fostered within this community. Evidently, there is a heavy reliance on positive and open relationships that are dependent on working with fossil collectors as opposed to legislating against their activities. Not only is this approach to management consistent with the principles of geosite conservation in England (Larwood and Prosser 2019) and appropriate given the environmental characteristics of the Site, it takes into consideration the difficulties associated with policing a coastline benefitting from open access rights, a lack of available resources to attempt to do so and the consequent lack of practical alternatives.

Recording

The fossil recording schemes are intended to provide a record of scientifically important and rare fossils found in the area; establish a mechanism for requesting access to specimens for scientific study; and provide a point of reference for museums regarding potential priority acquisitions. In many ways, the recording schemes are the most important part of the collecting codes, providing a unique opportunity and impetus for linking the Site and collectors with other stakeholders, particularly the museum and research communities. The fossil recording schemes are administered by Charmouth Heritage Coast Centre on behalf of Natural England and the Jurassic Coast Trust.

In terms of Category 1 fossils, participation in the recording schemes is a condition of the transfer

of ownership; collectors are under no obligation to record Category 2 fossils. The recording process is intentionally simple. It documents key metadata such as taxonomy, location of the find and stratigraphic horizon (if known) as well as more practical information including the finder's name, contact details and intended provision for the specimen e.g. to be retained by the collector or made available for donation or sale. A key factor in the successful delivery of the fossil recording schemes is their administration by Charmouth Heritage Coast Centre - a local charity that, in terms of the fossil collecting codes, functions as an on-the-ground link to the collecting community. Specialist and experienced staff can provide expert insight regarding the potential scientific importance of fossils brought to them and know who best to consult on any rare occasions when more specialist advice may be needed. The accessibility of the recording schemes, fostered by staff in the center, is undoubtedly a contributing factor to its widespread adoption. Likewise, staff regularly monitor key social media pages and engage directly when necessary.

The number of fossils recorded under each scheme varies significantly, and on a yearly basis, as does the ratio of Category 1 and Category 2 fossils. This variability reflects several different causal factors including:

- the size of the collecting area and potentially protracted timeframe required to recover individual specimens collected in many pieces;
- preparation time enabling appropriate specimen categorization;
- the unpredictable nature of the coastline (for example, variability of cliff falls and landslides) and significant variation in the volume and accessibility of the collecting resource;
- reduced collecting and recording during the COVID-19 pandemic.

Nonetheless, as reflected in the statistics provided earlier, both recording schemes demonstrate positive and ongoing engagement from the fossil collecting community. The regular recording of Category 2 fossils - which is not a requirement of the collecting codes of conduct or a condition of the transfer of ownership - demonstrates widespread participation amongst collectors. The sustained recording of Category 1 fossils over recent years also shows that the collecting codes continue to be effective, both in terms of important fossils being recovered from the coastline and in requiring participation in the recording schemes. As noted in the previous West Dorset Fossil Collecting Code review (Edmonds 2011), it is possible that a small number of fossils are not being registered but that there is no appreciable reason to avoid doing so.

Next steps

Both recording schemes employ a simple categorization system that distinguishes Category 1, for key scientifically important fossils and Category 2, for fossils of some (but not key) importance. That is to say, significance is attributed exclusively to the potential scientific value of a fossil, reflecting in part the underlying protection imperative for Sites of Special Scientific Interest. As a result, there is a residual category of fossils that although not of scientific importance, and therefore not necessarily recorded, possess a socio-cultural importance (i.e. related to the tradition of collecting and/or having aesthetic and educational value) which is also appreciated, especially in the context of a World Heritage Site. Also, the current categories were defined over 20 years ago and over this period the science of paleontology, new investigative techniques, research fields and interests, and preparation techniques have all developed, creating new and different demands on the fossil resource. In this context, it would be valuable to revisit the categories with a view to updating and rationalizing the recording schemes.

Digitization of the fossil recording schemes is a key priority and will significantly improve access to the associated records; currently, the only way to examine or utilize the recording schemes is via Charmouth Heritage Coast Centre. The public availability (subject to relevant data protection requirements and with great caution exercised regarding privacy and/or security concerns) of digital records will maximize the intended outcomes of the collecting codes and address the opportunities and responsibilities presented by World Heritage status. The staff at the Charmouth Heritage Coast Centre will remain central as an intermediary in the process, but digitization would provide a mechanism for the initial examination of these records that is more universally accessible and requires less direct intervention.

Specimen acquisition and donation

The West Dorset and Undercliffs NNR fossil collecting codes promote and encourage the deposition of scientifically important fossils within public collections. In any subsequent discussion, it is important to reflect that the codes are tools that provide for such an outcome but have only an indirect role in its attainment. Relating to specimen donation, sale or any other form of disposal, collectors are required to first offer Category 1 fossils to UK-registered museums for six months as a condition of the transfer of ownership. The Undercliffs NNR Fossil Collecting Code additionally states that in the event of no transfer being agreed upon, the collector is required to offer the fossil to relevant international museums for a further 6 months. It is only after these respective periods, and if no transfer has been agreed, that the collector may offer the fossil elsewhere, including for sale on the open market. There are no conditions placed upon the sale of Category 2 fossils.

In more practical terms, the collecting codes provide for the acquisition of fossils by establishing the legal framework in which they can be sold and purchased, including by museums. As argued by Taylor and Harte (1988), the legal situation concerning fossil ownership can be unclear, particularly in terms of specimens collected *ex-situ*. This is not the case for those areas covered by the West Dorset and Undercliffs NNR fossil collecting codes, which make clear that participating landowners have agreed to transfer legal title to the collector on the condition that they follow the relevant fossil collecting code of conduct and record Category 1 fossils. In adopting this framework, one area of uncertainty around the legal ownership of fossils has here been resolved. Not only does the transfer of good legal title incentivize fossil collectors to follow the collecting codes, but it also provides assurance to museums or other parties interested in acquiring those specimens that the collector can prove their lawful ownership.

Despite this, the overall number of fossils that have been acquired by museums is low. In the West Dorset Fossil Collecting Code review (Edmonds 2011), it was noted that less than 15 percent of Category 1 fossils had been accessioned into museum collections since the code's introduction. From 2013 onwards, an additional 61 Category 1 specimens have been recorded, with a further 9 now in museum collections. None of the Category 1 fossils entered into the Undercliffs NNR Recording Scheme have been acquired by museums. Any analysis of these statistics must, however, consider two key factors: firstly, a question of whether a collector has made their fossils available for sale or donation, including the terms under which they have done so and secondly, the context in which museums might receive or acquire these fossils.

It is widely known (e.g. Jurassic Coast Partnership Plan 2020-25) that there has long been a view held by many, particularly amongst the fossil collecting community, that there is a need for a new museum that is about and for the geology and paleontolo-

gy of the Jurassic Coast. Central to this ambition is the opportunity to celebrate the role of fossil collectors in the story of the Site. Consequently, many individuals have retained ownership of their best fossils - including those that are scientifically important and spectacular - for this purpose and so these specimens have not been otherwise offered for sale or donation. Whilst, in effect, this ambition has imposed a limit on the acquisition rate, collectors are retaining these fossils in the hope of maximizing their positive local benefit and such ambitions are laudable in the spirit of World Heritage.

The timeframe in which a collector may choose to make their fossils available for sale or donation also varies enormously and so the ratio of fossils recorded to those acquired by museums should not be considered an appropriate measure of the code's successful application; that is to say, whilst the acquisition rate is low, those Category 1 fossils which currently remain in private ownership are not lost, rather they have not yet been accessioned into a museum collection. Where collectors have determined to retain ownership of their fossils for the foreseeable future, perhaps until their death, the code encourages them to make provision for the eventual deposition of that specimen within a public collection. Ultimately, in a situation whereby the collector has good legal title to a fossil, it is considered preferable to maintain an open dialogue with that person as opposed to introducing more restrictive controls. Many collectors have made clear their openness to approaches from / dialogue with interested researchers or museum curators and this is encouraged, particularly where it may result in unanticipated and timely deposition within museum collections.

Recognizing that a fossil may represent the culmination of a lifetime's collecting activity, as well as the significant investment of time and money required to prepare that specimen, collectors are often disappointed that their fossil will not be put on public display. Understandably, however, museums do not have the space to display every object in their care and the capacity to fund, design and install new exhibits is often limited. In response, Charmouth Heritage Coast Centre has pioneered a solution that builds upon their positive relationship with the collecting community and the agility afforded by their non-museum status. The charity regularly engages with local collectors and visitors to encourage them to loan fossils as part of a 'recent finds' showcase (Fig. 3). Exhibition within this context is oversubscribed and demonstrates a desire amongst the collecting community to share their work. In several instances, this approach has been used to great success to satisfy a collector's wish to see their fossil on display, albeit for a limited period, before eventual deposition within a museum.

The current approach to acquisition is not without criticism, most notably because it places no control on the purchase price that collectors are able to set. Whilst the impact this could have on museum acquisition is clear, particularly given current sector-wide funding challenges and high market prices, site managers consider it most productive to work with collectors to help them understand these issues and to communicate other potential non-financial benefits when parties are negotiating a viable resolution. The recognition of their efforts; the furthering of scientific research and potential collaboration on relevant studies; and/or public display of their fossils is enough to encourage most collectors to consider certain concessions. In more practical terms, it is worth noting the complex nature of ascertaining the appropriate market value of fossils, recognizing the considerable time and skill required to find, recover and prepare them, and the risk that introducing increasingly restrictive controls - either by requiring mandatory sale or introducing price caps - might impact the relationship with the collecting community.

Figure 3. Photograph of one of the 'recent finds' cabinets at Charmouth Heritage Coast Centre. This display is intended to inform visitors of the fossil collecting codes of conduct and showcase specimens registered with the fossil recording schemes. © Charmouth Heritage Coast Centre.

Although funding the purchase of important fossils can be a challenge and requires a substantial increase in the financial support available for acquisition in local and national museums, there is evidence to suggest alternative factors inhibiting this outcome that also need to be addressed. The recording schemes currently identify a number of Category 1 and 2 fossils that have been made available to museums, both for donation and sale, but no progress has been made to secure them. This may be a consequence of several factors, including a lack of awareness of the recording schemes, particularly their content, purpose and terms; the recording schemes not being readily accessible to researchers and museum curators; a lack of subject-specific curators in local and national museums to identify and pursue priority acquisitions; a lack of researchers currently studying a particular field; and/or capacity restrictions in existing museums.

Nonetheless, since the implementation of the codes, several Category 1 fossils have been acquired by public collections, typically followed by scientific study. One such recent example of this is *Turnersuchus hingleyae*, a new species of early thalattosuchian (Crocodylomorpha) that was recovered by many individuals, most notably E. Hingley and P. Turner, on Stonebarrow Beach, Dorset (Wilberg *et al*. 2023). Four blocks containing the fossil were recovered over a period

of more than one year and additional loose bones were collected by members of the public and volunteers at Charmouth Heritage Coast Centre. The finds were identified and recorded by staff at Charmouth Heritage Coast Centre before all the remains were reunited and accessioned into the Lyme Regis Philpot Museum prior to the scientific description by Wilberg *et al*. (2023).

Summary

In summary, the authors conclude that the West Dorset and Undercliffs NNR fossil collecting codes remain effective management tools; that is to say, the codes succeed in promoting responsible and safe collecting whilst encouraging the recovery of important fossils prior to damage or destruction by natural processes. It should be considered a dynamic, practical approach that is limited by the complex circumstances in which it is applied, including the legislative situation regarding fossil collecting; the environmental and open access characteristics of the coastline; and a lack of available resources to police the codes. Essentially, they represent a means to use the limited resources available to create a culture of best practice rather than attempt to apply a stringent set of rules that are continually enforced at great expense. Site managers will continue to monitor the operation of the two codes to better understand what improvements may be desirable and possible from time to time, in consultation with the relevant stakeholder groups.

The value of the fossil collecting codes is not their function only as administrative techniques, but primarily as facilitators of good relationships between interested parties. From the fostering of a culture of advocacy for responsible collecting amongst fossil collectors and visitors to the building of a connection with site management via the collecting codes and staff at Charmouth Heritage Coast Centre, as well as their providing for negotiations regarding acquisition and access for researchers and museums, it is the way in which the codes and recording schemes are a catalyst for communication and discourse that has sustained them. They are limited by their circumstances but continue to be a powerful tool that, if nothing else, makes responsible collecting a driver of connection, debate and collaboration within the community surrounding the paleontology of the Jurassic Coast.

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Conflict of interest

The authors have no conflicts of interest to declare.

References

Bassett MG, King AH, Larwood JG, Parkinson NA, Diesler VK (eds) (2001). A Future for Fossils. National Museums of Wales Geological Series No. 19.

Crofts R, Gordon JE, Brilha J, Gray M, Gunn J, Larwood J, Santucci VL, Tormey D, Worboys GL (2020). Guidelines for geoconservation in protected and conserved areas. Best Practice Protected Area Guidelines Series No. 31. Gland, Switzerland: IUCN.

Crowther PR, Wimbledon WA (1988). The use and conservation of palaeontological sites. Special Papers in Palaeontology. 40: 1–200.

Edmonds R (2011). ProGEO News. http://www.progeo.ngo/downloads/PROGEO_news_2011_2.pdf. Retrieved May 23, 2024.

Edmonds R, Larwood J, Weighell T (2005). Identifying sustainable management regimes for fossil collecting on palaeontological sites. https://charmouth.org/chcc/wp-content/uploads/2017/10/Sustainable_fossil_collecting.pdf. Retrieved May 23, 2024.

Edmonds R, May V (2007). 'Jurassic Coast' Dorset and East Devon Coast World Heritage Site Update. International Subcommission on Jurassic Stratigraphy Newsletter. 34(2): 27–28.

Larwood JG (2001). Commercial fossil trade: good or bad for Sites of Special Scientific Interest? The Geological Curator. 7: 223–227.

Larwood JG (2007). Politics and fossils in the UK - another view. International Subcommission on Jurassic Stratigraphy Newsletter. 34(2): 33.

Larwood J, King A (2001). Conserving palaeontological sites: applying the principles of sustainable development. In Bassett MG, King AH, Larwood JG, Parkinson NA, Diesler VK (eds), A Future for Fossils (pp. 119–125). National Museums of Wales Geological Series No. 19.

Larwood JG, Prosser CD (2019). Managing palaeontological heritage: a brief overview of policy and practice in England. Spanish Journal of Palaeontology. 34: 57–64. https://doi.org/10.7203/sjp.34.1.15250

Larwood JG, Santucci VL, Fiorillo AR (2022). Fresh perspectives on paleontological heritage and the stewardship of non-renewable fossil resources. Parks Stewardship Forum. 38: 103–112. https://doi.org/10.5070/P538156124

Nature Conservancy Council (1990). Earth science conservation in Britain: a strategy. Peterborough, UK: Nature Conservancy Council.

Norman DB (1992). Fossil collecting and site conservation in Britain: are they reconcilable? Palaeontology. 35: 247–256.

Page KN (2006). Geoconservation Working Group. International Subcommission on Jurassic Stratigraphy Newsletter. 33: 2–25.

Page KN (2018). Fossils, heritage and conservation: Managing demands on a precious resource. In Reynard E, Brilha J (eds), Geoheritage: Assessment, Protection, and Management (pp. 107–128). Chennai: Elsevier.

Page KN, Wimbledon WA (2008). The conservation of Jurassic heritage in the UK – a critical review of the role of governmental organisations and their effectiveness. Volumina Jurassica. 6: 163–173.

Prosser C, Murphy M, Larwood J (2006). Geological conservation: a guide to good practice. Peterborough, UK: English Nature.

Prosser CD, Diaz-Martinez E, Larwood JG (2018). The Conservation of Geosites: Principles and Practice. In Reynard E, Brilha J (eds), Geoheri-

tage: Assessment, Protection, and Management (pp. 193–212). Amsterdam: Elsevier.

Sharpe T (2024). The Early Jurassic sequence of Lyme Regis, Dorset, England and its place in the history of geology and palaeontology. Geological Society, London, Special Publications. 543: 253–265.

Sole D (2007). A hostile analysis of the West Dorset (UK) fossil collecting code - was it justified? International Subcommission on Jurassic Stratigraphy Newsletter. 34(2): 24–27.

Taylor MA, Harte JDC (1988). Palaeontological site conservation and the law in Britain. Special Papers in Palaeontology. 40: 21–39.

Townley H, Larwood JG (2012a). Managing geological specimen collecting: guidance. Natural England Technical Information Note TIN 111. Peterborough, UK: Natural England.

Townley H, Larwood JG (2012b). Managing geological specimen collecting: responsible collecting. Natural England Technical Information Note TIN112. Peterborough, UK: Natural England.

Townley H, Larwood JG (2012c). Managing geological specimen collecting: Charmouth case study. Natural England Technical Information Note TIN 114. Peterborough, UK: Natural England.

Ulph J (2018). Acquiring fossils: a complex picture. The Geological Curator. 10: 657–670.

Underwood CJ, Ward D (2018). Site specific limitations on the use of palaeontological resources. The Geological Curator. 10: 617–631.

Wilberg EW, Godoy PL, Griffiths EF, Turner AH, Benson RBJ (2023). A new early diverging thalattosuchian (Crocodylomorpha) from the Early Jurassic (Pliensbachian) of Dorset, U.K. and implications for the origin and evolution of the group. Journal of Vertebrate Paleontology. 42: e2161909.