Archaeology of Overshoot and Collapse
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Introduction
-as both term and concept 'overshoot' has entered the public sphere, taking on new meanings
-while some argue our species has overshot the carrying capacity of one or more resources, others argue such concerns are not important to economic systems since market signals lead to innovation and a shift in resource use
-the above leads to academic discourse having political connotations
-the concept is often traced to Malthus's argument that population (that grows exponentially) would overshoot food supply (that grows linearly)
-it bases its thesis upon carrying capacity that considers the maximum population that can be supported indefinitely by a habitat
-for humans, both population numbers and consumption are of concern regarding resource overshoot

-'collapse' has similarly entered public discourse with a variety of meanings
-Tainter points out that many academics fail to define the term, thus assuming the reader knows their particular version
-Diamond defines it in terms of population and social complexity, with the former most salient
-the popularity of Diamond's work suggests the public perception is that collapse is primarily a result of overshoot
-others also hold this perspective
-Tainter reviews the pre/historic record for evidence of societal collapse due to ecological overshoot as a result of surpassing habitat carrying capacity
-he suggests overshoot may be considered beyond the variables of population and consumption, and be the result of exorbitant tax/labour demands, transportation and/or communication capabilities (i.e., "a province too far"), costs exceeding ability to pay

Studies in Overshoot and Collapse
-looking at the collapse of the Maya lowlands, initial research (1931) identified ecological factors as the culprit (e.g., soil erosion, land scarcity, drought), as did some later studies (1962; e.g., depletion of soil due to swidden agriculture)
-others argued that it was a growth system that required intensive agriculture that resulted in soil erosion and declining fertility, leading to continual labour demand but was undermined by war and monumental architecture construction

-ancient southern Mesopotamia (Ur dynasties) has been accepted as an archaeological example of overshoot with its growing population and settlements losing its resource base due to over irrigation and increasing salinity

-the loss of its resource base destabalised the political system and as a result irrigation maintenance suffered
-diminishing returns on intensification of agriculture eventually resulted in collapse
-as crop yields crashed, lands were abandoned with population not rebounding for centuries, when the Abbasid Caliphate arose
-as the state grew it began to tax peasants beyond their ability to pay leading them to intensify their agricultural practices
-irrigation systems grew in size and complexity overcoming local capacity to maintain them and increasing dependence upon government systems
-salinisation issues again arose, leading to a loss of local reserves and eventual peasant revolts that further hampered government systems
-government revenues collapsed, state control diminished, and agricultural difficulties multiplied
-populations were greatly reduced and most urban life disappeared

-Chew (2001) utilised World Systems Theory to examine ecological degradation over the past 5000 years
-he argues that cultures tend to exploit Nature with collapse being a common outcome; a societal transformation followed by an environmental interlude (a Dark Age that restores ecological balance)
-he believes excess consumption led to environmental degradation and eventual collapse for Bronze Age Mesopotamia and the Indus Valley

-wood requirements caused deforestation in northern Mesopotamia
-this combined with overgrazing to cause siltation of the irrigation system
-the required canal maintenance suffered when unrest occurred, leading to agricultural decline
-overconsumption due to peripheral elites attempting to emulate ore elites exacerbated the situation
-on top of these societal factors was a decline in precipitation over 2000 years
-agricultural intensification continued in attempts to counter these changes but production declined nonetheless leading to collapse in the south and power shifting to the north

-the Indus Valley's Harappan Civilisation experienced similar conditions to southern Mesopotamia
-wood demand caused deforestation, precipitation declined, water was diverted by tectonic forces, and theses combined with overcultivation, overgrazing, salinity buildup, and flooding to result in a decline of urban centres and small towns
-Chew perceives the Minoan and Mycenaean collapses in the same light: wood demands result in deforestation, leading to erosion and flash flooding, over-exploitation of resources due to capital accumulation, urbanization, intense land use, and population growth led to constraints on continued expansion and "a downscaling of material and cultural lifestyles"

-he also suggests deforestation was common across the Roman Empire but fails to link this to their decline

-Huges (1975), however, argues Rome's lack of balancing their environment with their socioeconomic system contributed to their decline
-deforestation led to erosion, mining encountered diminishing returns, overgrazing occurred, and agricultural production fell
-food shortages resulted in population decline and the empire eventually collapsed

-the American Midwest Cahokia fall has also been blamed on deforestation
-this led to increased water runoff, flooding, and soil deposition, especially where bluff-zone forests were cleared

-Diamond (2005) uses a model of overshoot followed by ecological degradation and collapse
-recognising the complexity of the situation, his model also incorporates local ecology, hostile neighbours, social responses, climate, and trade partners
-ultimately, however, environmental degradation was the foundational cause of collapse
-of the six cases Diamond draws upon for evidence, Tainter argues several (Pitcairn and Henderson Islands) are places subsistence producers could not have survived for long due to their small, remote locations and lack of resources, and are thus not good examples of ecological overshoot and collapse
-similarly, Norse Greenland cannot teach us much as the resources to support and medieval European society were absent; it also experienced a rare adverse climate fluctuation during its time (Little Ice Age)
-McGovern (1994) suggests the Norse colony need not have failed had they adopted alternative subsistence strategies like the Inuit who lived in the area
-thus this is not a simple overshoot example but perhaps a limited case of it due to extreme conditions

-Diamond's account of the Anasazi/Chakoan collapse discusses various changes in the environment, population numbers, and resource decline concluding human impact and drought were the ultimate cause (but may have been survivable at lower population levels)

-his view of the Maya included them damaging their environment, fighting over farmland, and emphasizing monumental architecture and war over solving fundamental problems
-Classic Maya collapse occurs at a time of significant drought
-Diamond's conclusion is that the Maya collapse was brought about by population overshoot that led to deforestation followed by erosion; people also fought over declining resources while the elite ignored the problematic issues
-Tainter suggests his analysis/conclusion is similar to that of the Norse Greenland and Anasazi (population and consumption overshoot combined with political complexity to cause collapse), but could have also been averted had rare, adverse conditions not arisen

-Diamond's best case for overshoot, resource degradation, and collapse is Easter Island
-many have come to view it this way and serves as a preview of the modern world's fate
-an island is a useful example for study since many variables are somewhat 'controlled'
-it appears that the island was initially settled in the first couple of centuries AD

-it was not rich in resources like other Oceania islands, with a somewhat cooler climate than most of Polynesia (limited marine fauna as no coral reef); occupation (with the help of introduced rats) destroyed nesting bird diversity
-deforestation (especially of large palm) plays a dominant role in overshoot-collapse narratives regarding Easter Island
-it is estimated the population reached as high as 15,000 in the 16th century but had fallen to less than 2000 by 1722
-Diamond argues this reflects 'collapse'
-archaeologists have found changes in subsistence, and socio-cultural/-political/-economic spheres during this time (simplification); particularly after about 1500
-this can be viewed as collapse given the loss of organisational capacity
-conflict over land characterised the late occupation with defeated peoples being enslaved or dispossessed
-many lived in fortified caves, and middens held fractured and charred human remains (many of juvenile age–interpreted as evidence of cannibalism)
-statue construction ceased and many were toppled
-cored deposits show the island was forested but deforestation began around 1000 A.D.; soil erosion began to occur around 1200 A.D. and increased along with more deforestation from 1200-1650
-several researchers suggest this deforestation kicked off a cascading set of events: decline in fishing and farming, increase in warfare and insecurity, settlement pattern shifts, population decline, and sociopolitical collapse
-"Easter Island, in this account, is the paradigmatic case of overshoot and collapse, the prototype Spaceship Earth" (p. 67)

Evaluating Overshoot and Collapse in Archaeology
-whether Malthusian overshoot has caused previous collapse of complex societies is hotly debated
-and regardless of improved data and models, past collapses cannot provide a clear map regarding our future
-evaluating past assessment of overshoot and collapse for societies via archaeological evidence follows

-Meggar's (1954) environmental limitation theory never gained traction and a number of societies displayed complexity beyond what her theory suggested was possible
-Cooke (1931) and Sanders (1962) research regarding the consequences of low-production swiddening is not supported for leading to overshoot and collapse as the landscape permitted high agricultural yields
-Culbert (1988) argued the Maya population collapse was due to agricultural failure because of poor decisions, but then compares it to Mesopotamia concluding resource degradation was the ultimate cause suggesting the collapse was due to elite-driven intensification leading to resource degradation and not due to population overshoot

-Ur's Third Dynasty and the Abbasid Caliphate may be the best candidates for assessing population overshoot, resource degradation, and sociopolitical collapse
-Powell (1985) questions the role of salinisation in contributing to collapse
-Tainter argues both examples provide limited understanding as neither show Malthusian overshoot, nor one brought on by excess production (today's primary concern)
-elite mismanagement contributed to agricultural issues
-of primary importance, then, is why rulers would undermine the very important agricultural system
-the Caliphate tax policy to fund frequent wars was problematic; it was also a costly society as urban sites expanded significantly; the capital was moved frequently and built anew
-in this case, overshoot seems to have been due to faulty feedback loops; failure of information regarding deteriorating agricultural harvests to get back to the governing bodies and thus react
-instead of a negative feedback to help correct the issue, a positive one occurred whereby more production was pursued and the problem grew worse and helped to expedite collapse

-Chew's (2001) analysis of Bronze Age societies is not strongly supported by the empirical evidence
-the extent of erosion following deforestations is exaggerated and/or lacks data; future paleoenvironmental research may eventually support
-despite consuming significant quantities of coal, deforestation did not cause the Roman collapse and, in fact, forests were regrowing in late imperial times
-Cahokia collapse was not caused by deforestation or flooding; the capacity to relocate and/or mobilise labour to construct preventative earthworks–higher ground was also nearby if required

-Diamond's use of Pitcairn and Henderson Islands as well as Norse Greenland demonstrate his misunderstanding of collapse as none of these experienced a loss of sociopolitical complexity–populations left or died with no transition to a 'simpler' society
-his attempts to show environmental carrying capacity overshoot and degradation followed by collapse in the Southwestern U.S. and Maya were undermined by impacts from various factors including climate changes–these did not involve Malthusian overshoot; they may demonstrate overshoot due to extreme climatic conditions
-a number of questions regarding ecological conditions on Easter Island remain
-while Diamond focuses on the loss of trees as a primary cause of its collapse, some point to forest remnants in volcanic craters lasting into the 19th century
-palm seeds that have been found show evidence of rat gnawing, suggesting the tree may have succumbed to the rats with human use speeding their demise
-Diamond's claim that the loss of the palm led to the loss of deep sea canoes is not supported by evidence, but deep sea catches do seem to have fallen off over time; this, could have been the result of the Polynesian practice of tapu (taboo) limiting such food for most of the population
-while erosion was an issue, it does not seem to have had a negative impact upon agriculture; occupants dug pits, erected windbreaks, and used lithic mulch to offset erosion while soil fertility could have been enhanced by chicken and humanure

-all of Easter Island was arable but agriculture was limited in scope, perhaps due to water constraints, but could have been intensified if need be (and evidence suggests it was when required)
-statue making appears to have proceeded at an undiminished rate until it simply cease abruptly, suggesting this was not due to deforestation and a loss of trees to help in transportation but some other as yet to be determined factor
-Tainter argues “Easter Island may not qualify as a case of overshoot and collapse” (p. 71)
-it appears the rates the original settlers brought had as much or more to do with deforestation than the humans (as well as climatic and soil conditions); and deep sea fishing and long-distance travel was still possible without large trees; agriculture may have been somewhat negatively affected by deforestation but Islanders responded by intensifying production

Conclusions
-the archaeological literature contains few cases that suggest population and/or mass consumption overshoot followed by environmental degradation and sociopolitical collapse
-proponents of human overshoot tend to fall outside the discipline of archaeology

-Tainter argues “[s]ome overshoot interpretations are not credible…or have been proven wrong…are untested…cannot explain collapse…prove to be overshoot in extreme conditions” (p. 71)
-while Ur and the Abbasid Caliphate appear to be overshoot but the cause seems to have been due to elite mismanagement and lack of proper feedback as opposed to mass consumption or population overshoot (Maya collapse shows similar aspects)
-the case of Easter Island is in question due to contradictory evidence
-Tainter concludes that “[t]here does not presently appear to be a confirmed archaeological case of overshoot, resource degradation, and collapse brought about by overpopulation and/or mass consumption” (p. 71)
-Tainter asks why there are no pre/historical examples and does this mean human societies are reprieved from the predicament of overshoot?
-overshoot is a teleological concept (as if humans could actually set and meet a population and/or consumption limit) and denies human abilities to adapt, particularly in terms of agricultural intensification
-greater resource production always appears possible via capital and technology application, labour, knowledge intensification, and/or energy subsidies
-increasing mechanisation, irrigation, fertilisation, and/or labour have all resulted in increased production–proving Wallace, Erlich, Jevons, and Malthus wrong
-societies may also choose to simplify to a less costly organisation and/or reduce consumption; this is what the Byzantine Empire chose in the 7th-century AD when it lost its wealthiest provinces (Tainter notes this “may be history’s only example of a large complex society systematically simplifying” (p. 72)
-Tainter wonders whether our modern world can continue to intensify production indefinitely escaping a Malthusian fate
-neoclassical economists argue markets will always uncover new resources so overpopulation and/or overconsumption is not ever a concern

-“The contrary view is well known. We must reduce our ecological footprint or eventually collapse. The neoclassical argument is based on faith that markets will always work and denial of diminishing returns on innovation. Should we base our future on faith and denial, or on rational planning?” (p. 720)