CAMBRIDGE
Cambridge University Press & Assessment
978-0-521-51960-1 — Island Environments in a Changing World
Lawrence R. Walker , Peter Bellingham
Excerpt
More Information

1

Introduction to island environments and cultures

1.1 STEREOTYPES AND REALITIES

Our goal in writing this book is to examine relationships between island environments and people. We explore how these dynamic relationships have changed both the natural history of islands and the interactions between humans and nature. We approach this goal primarily from our perspective as ecologists who have lived and carried out research on islands. Humans both exploit and conserve natural resources, and human culture influences the attitudes of humans toward their environment. Recent surges in human populations on islands and the loss of the historical isolation of islands have removed many traditional restraints to over-exploitation of island resources. As a result, island ecosystems are extremely vulnerable to further damage. If the struggle to reconcile human use of resources and the maintenance of natural systems can be managed on islands, within their limited areas, then models developed here might guide those attempting to restore mainland systems.

Our image of islands is part stereotype, part reality. One popular stereotype is that of an ideal vacation spot. Often included in this idyllic vision are balmy temperatures, gorgeous sandy beaches, crystal-clear, turquoise water, and palm trees fluttering in the warm breezes. Colorfully clad tourists sit in wicker chairs in open-air bars and are served piña coladas by laid-back locals, while sensual music and the muffled sounds of surf fill the air. The implication of this stereotype might be that there is a freedom of knowing that we can visit, enjoy the experience, be relieved of all worries, and then return home. A second stereotype is a place of mysterious, often illegal action. This stereotype is filled with thoughts of pirates, drug runners, and action heroes chasing villains on narrow roads through coconut groves or

© in this web service Cambridge University Press & Assessment www.cambridge.org

CAMBRIDGE
Cambridge University Press & Assessment
978-0-521-51960-1 — Island Environments in a Changing World
Lawrence R. Walker , Peter Bellingham
Excerpt
More Information

across tranquil bays to secret hideouts. Inevitably, the locals speak some kind of pidgin and cavort with both the villains and their pursuers, but all action stops for the evening fish fry, cocktails, and languid dancing at sunset. The implication is that any shenanigans are local, perhaps temporarily exciting, but ultimately unimportant to visitors and therefore ephemeral. A third stereotype conjures islanders as out-of-touch, little-interested in modern intellectual or cultural pursuits, and still vaguely associated with a history of cannibalism and tribal warfare. In this view, island cultures are as isolated from modern culture as islands are physically isolated from the mainland. At worst, they are perceived as cultural backwaters or oddities, with few experiences worth sharing or valuing other than as curiosities. Generally implicit in each of these stereotypes is a harmony between humans and a benign natural world. There is plenty of local food, fresh water, entertainment, and space. Island realities share some features with these three stereotypes, at least on those islands that are tourist destinations. Certainly, many islands, including non-tropical ones, earn their reputations as lovely blends of quiet, natural beauty, friendly inhabitants, positive attitudes, and exotic cultural experiences (Fig. 1.1).

A different kind of stereotype is of culturally isolated islanders who develop a high degree of self-assurance, and believe that their society is more civilized than that of mainlanders. This attitude is encapsulated by a headline in an English newspaper declaring “Fog in

Fig. 1.1 Pier at Cromer, a seaside holiday destination in Norfolk, England.

© in this web service Cambridge University Press & Assessment www.cambridge.org

CAMBRIDGE
Cambridge University Press & Assessment
978-0-521-51960-1 — Island Environments in a Changing World
Lawrence R. Walker , Peter Bellingham
Excerpt
More Information

Channel – Continent Isolated" or the term that Hawaiians have for the city of Las Vegas, Nevada (USA): "our ninth island." The island-based cultures of the British Isles and Japan transformed such self-assurance into political and ecological influences on a global scale. Implicit in this stereotype of islands and islanders is a lack of harmony between humans and nature. Nature is seen as an impediment that, like an enemy, needs to be dominated or destroyed before progress can be made. In this view, the natural world is a distraction or obstacle to be overcome. This perspective has been demonstrated by those who see islands as convenient places to mine, conduct weapons testing, construct military bases, build real estate empires, or otherwise invest in the artificial features of island communities (e.g., Hong Kong, Singapore).

Regardless of the stereotype, problems abound for islands and islanders. Human inhabitants of islands have always dealt with natural disturbances such as volcanoes, earthquakes, cyclones, tsunamis, and landslides; however, modern civilizations are exacerbating some of these disturbances and creating new ones. Agricultural runoff, over-fishing, and silt erosion from the land after deforestation degrade near-shore ecosystems. Intentional or inadvertent introduction of alien species (see Glossary for definition of terms) have severely depleted populations of many native island plants and animals. The natural world that used to supply water and food in abundance is being polluted and island aquifers are being overdrawn. Rising sea levels resulting from climate change have already rendered some low-lying atolls uninhabitable. Paradise is an illusion; the reality of islands less enticing. The response of many islanders has been to emigrate. How those islanders who remain address present-day realities and how they choose to deal with increasingly urgent environmental problems will be illustrative for all of humanity as it strives to live more sustainably.

1.2 SPECIAL FEATURES OF ISLANDS

Islands are by definition geographically isolated from other land masses and their limited geographical area is clearly defined. Many ecological and cultural characteristics follow as a consequence. Populations of plants and animals that do colonize islands eventually become limited by finite resources. They also evolve in isolation from larger gene pools and sometimes become richly divergent from the original invaders. The Galápagos Islands in the eastern Pacific Ocean are a famous example of how a wondrous variety of organisms has evolved in

© in this web service Cambridge University Press & Assessment www.cambridge.org

CAMBRIDGE
Cambridge University Press & Assessment
978-0-521-51960-1 — Island Environments in a Changing World
Lawrence R. Walker , Peter Bellingham
Excerpt
More Information

isolation from mainland habitats. The combination of isolation and geographical finiteness of islands provides an excellent laboratory in which to study links between humans and the natural world. Isolation and finiteness, however, leave island ecosystems extremely vulnerable to outside influences. In this chapter, we introduce each of these themes (isolation, finiteness, vulnerability, and evolutionary experiments) and examine them in more depth in subsequent chapters.

1.2.1 Isolation

The degree of isolation has a direct bearing on which species of plants and animals can colonize them and on the subsequent evolution of those colonizers. Continental islands were once a part of a mainland and are less isolated than oceanic islands, which have never been in contact with a continent. Islands are also not permanent geological features, but instead emerge and submerge and are shaped and reshaped by tectonic activity. Most terrestrial organisms rarely cross large bodies of water, so colonizing newly formed oceanic islands can take decades to millennia, depending on the degree of isolation. Typically, continental islands are more easily colonized. Remote islands can be colonized by birds and insects that can fly thousands of kilometers. Certain spiders and spores can be blown equally long distances. Some islands are colonized by organisms arriving on rafted plant matter or by terrestrial animals that swim. For marine organisms such as plankton, corals, algae, fish, eels, seals, or whales that utilize the marine habitats around island shores, colonization may be less problematic than for terrestrial organisms. Nonetheless, not all of these aquatic organisms are long-distance dispersers, so newly formed islands are only slowly colonized. For successful colonists that establish healthy populations on a previously uncolonized island, a rapid population expansion can occur, followed by evolutionary divergence into many new species. The future lineage, for those individuals that arrive without potential mates or that do not adapt easily to the island habitat, is more limited, with local extinction a common fate. Furthermore, those successful colonists now face the myriad challenges of subsequent human impacts (see Section 1.3).

1.2.2 Finiteness

Island size is finite and well-defined at large spatial scales by the shoreline and surrounding ocean. At smaller spatial scales, this boundary

© in this web service Cambridge University Press & Assessment www.cambridge.org

CAMBRIDGE
Cambridge University Press & Assessment
978-0-521-51960-1 — Island Environments in a Changing World
Lawrence R. Walker , Peter Bellingham
Excerpt
More Information

Fig. 1.2 Cliff meets ocean at Waipiʻo Bay on the Island of Hawaiʻi. Waipiʻo Valley was the largest and most fertile valley on the Island of Hawaiʻi, once supporting thousands of people. A tsunami in 1946 and a flood in 1979 discouraged residents and currently only about 50 people live there.

between terrestrial and aquatic habitats can be sharp, as when cliffs meet the ocean (Fig. 1.2), but the boundary is more often fuzzy because habitats such as tidal pools, mangrove swamps, salt water marshes, and coral reefs complicate definitions of terrestrial and marine habitats. Such complex shorelines are often areas of rich biodiversity because of the many habitats they provide. However, the terrestrial and coastal marine habitats are limited. Therefore, populations of organisms, including humans, have clear limits to their growth.

When populations surpass their natural carrying capacity they can crash. A classic example of this occurred on St. Matthew Island in the Bering Sea. In 1944, the United States Coast Guard introduced 29 reindeer to provide an emergency food source for stranded sailors. With no predators and ample food, the reindeer population grew rapidly to about 6000 individuals until resources became limiting, the reindeer starved, and the population crashed (Fig. 1.3). Only 42 reindeer were alive in 1966. Survival for animals depends on keeping total resource consumption and population levels at or below the carrying capacity of the system. When that carrying capacity is exceeded, animals typically starve to death or die from other causes until the

© in this web service Cambridge University Press & Assessment www.cambridge.org

CAMBRIDGE
Cambridge University Press & Assessment
978-0-521-51960-1 — Island Environments in a Changing World
Lawrence R. Walker , Peter Bellingham
Excerpt
More Information

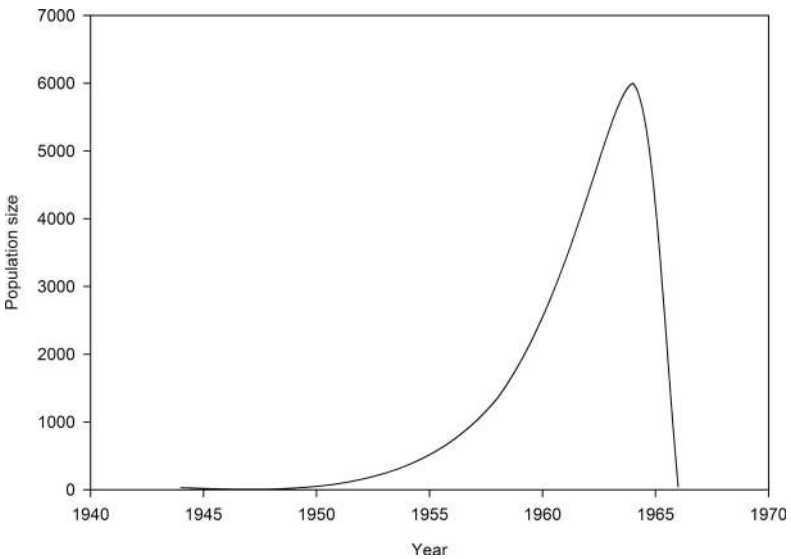

Fig. 1.3 Population size of the reindeer herd on St. Matthew Island, Alaska. See text for details on how this introduced population grew and then crashed when it ran out of resources. Redrawn from Klein (1966).

number of animals remaining utilizes the resources more sustainably. Under such conditions, local consumption must be reduced, either by intentional, organized means (including hunting, water and food rationing, sterilization, and more emigration than immigration) or by uncontrolled and chaotic events such as famine. Human populations are subject to the same limits to growth. Many islands now support human populations well beyond the carrying capacity of the island ecosystem because of a heavy dependence on imported resources.

1.2.3 Vulnerability

Island communities are particularly vulnerable to natural disturbances because of their finite physical extent and lack of escape routes for inhabitants. Volcanic islands can erupt, destroying all life, as happened on Krakatau, Indonesia in 1883. Earthquakes and huge, earthquake-induced landslides can cause parts of islands to collapse into the ocean. Cylones can damage forests and tsunamis can inundate coastal communities. When total destruction occurs, colonization depends on long-distance dispersal of organisms. Total destruction, however, is

© in this web service Cambridge University Press & Assessment www.cambridge.org

CAMBRIDGE
Cambridge University Press & Assessment
978-0-521-51960-1 — Island Environments in a Changing World
Lawrence R. Walker , Peter Bellingham
Excerpt
More Information

rare and most islands have remnant populations of plants and animals that can expand into the damaged areas. Large-scale, natural disturbances are the normal challenges that island organisms face.

People cause disturbances that often resemble natural disturbances (such as pavement surfaces that resemble lava) or trigger disturbances identical to those caused by natural phenomena (both road cuts and rain induce landslide formation). Many anthropogenic disturbances (those caused by people) augment the destructive power of natural disturbances. For example, it is likely that human effects on global climate have increased shoreline erosion due to sea level rise and increased cyclone intensity due to warmer oceans. However, some disturbances (including mine wastes, dynamiting of reefs by fishermen, or nuclear explosions) are so novel or are so toxic that organisms have no history of evolving in response to them.

Organisms evolve defenses only to survival problems. Unnecessary defensive traits are often lost (or never acquired) during long periods of evolution on isolated island ecosystems. Flightless, ground-dwelling birds have evolved on many islands (such as Tonga, Hawai'i, and New Zealand) where there were few predators. Island plants often lack protective features, such as spines or thorns, which are an adaptation to herbivores not found on islands. When egg predators, bird hunters, or herbivores eventually arrive, native species often cannot cope and become extinct. Humans can be the direct predators (as were hunters of moa in New Zealand). Alternatively, the predators can be introduced inadvertently (the Norway rat came to Hawai'i on European ships) or with a specific purpose, such as for biological control (stoats to control rabbits in New Zealand). Both inadvertent and purposeful invasions have occurred and continue to occur on many islands around the world. Similarly, human cultures on islands are also vulnerable to the invasion of new influences initiated by contact with the outside world.

1.2.4 Evolutionary experiments

Biological evolution

Islands can be seen as experiments in biological evolution and the closely allied process of cultural development. When a newly exposed island surface is initially colonized, biological diversity is low because those species that colonize an island are only a subset of the potential colonists from the nearby mainland. Over time, new species evolve

© in this web service Cambridge University Press & Assessment www.cambridge.org

CAMBRIDGE
Cambridge University Press & Assessment
978-0-521-51960-1 — Island Environments in a Changing World
Lawrence R. Walker , Peter Bellingham
Excerpt
More Information

on islands, eventually developing plants and animals unique to that island or island group. Organisms on neighboring islands or island groups can develop independently because isolation keeps genetic mixing to a minimum and the natural selection pressures that drive species evolution can differ between islands. The total diversity is limited by the finiteness of islands but promoted by their isolation and diverse habitats.

Habitat diversity on islands can be astounding and can change over time through such mechanisms as the formation, weathering, and the erosion of soils. Rugged topography (especially on volcanic islands) can also provide many niches for evolutionary divergence. By some accounts, the islands of Hawai'i contain 23 of the Earth's 24 terrestrial biomes. The prevailing trade winds on most mountainous tropical islands bring high rainfall to the windward sides while drying out the leeward sides. Varied climates promote diverse plant life that in turn favors many evolutionary adaptations by animals.

Cultural evolution

Human cultures on isolated islands have a parallel development of a rich variety of unique behaviors and attitudes. Sometimes these cultures provide insights into unusual attitudes toward the natural world, perhaps derived from the finiteness of resources and space or from diverse climatic conditions. For example, Hawaiian tribes were allotted slices of land from the shoreline up into the mountains, a clear recognition that each tribe needed resources that came from the entire elevational gradient. In another example, the crops that Māori settlers in New Zealand were able to grow depended on the latitude at which they settled. Cultural diversity is therefore as closely related to the natural history of islands as is biological diversity.

1.3 HUMAN IMPACTS

Human impacts on island ecosystems derive from our capacity to exploit many environments, our rapid population growth, and our energy- and resource-intensive lifestyles. Humans are highly capable of destroying natural habitats and habitat destruction is the most common cause of species extinction. We destroy habitats intentionally when we grow crops (Fig. 1.4), log forests, or fill in marshes to build resorts and parking lots. We also destroy habitats inadvertently

© in this web service Cambridge University Press & Assessment www.cambridge.org

CAMBRIDGE
Cambridge University Press & Assessment
978-0-521-51960-1 — Island Environments in a Changing World
Lawrence R. Walker , Peter Bellingham
Excerpt
More Information

A

B

Fig. 1.4 (A) Sugar cane fields and the north flanks of the limestone ranges of the Cockpit Country, Trelawny, Jamaica; (B) derelict sugar mill on the Rio Cobre, St Catherine, Jamaica. Sugar cane has been a widespread agricultural introduction to tropical islands but has often followed a boom and bust cycle of production.

© in this web service Cambridge University Press & Assessment www.cambridge.org

CAMBRIDGE
Cambridge University Press & Assessment
978-0-521-51960-1 — Island Environments in a Changing World
Lawrence R. Walker , Peter Bellingham
Excerpt
More Information

when we trigger forest fires, introduce invasive species that alter ecosystems, or cause the sedimentation of streams and reefs from the erosion of cropland soils. Urbanization and its associated activities (transportation and transmission corridors) now cover more than 5% of the Earth's surface and some islands, such as Puerto Rico, are highly urbanized. Increased wealth for islanders, whether derived from natural resource extraction, tourism revenue, or remittances sent home from family members living abroad, increases the ecological footprint of communities that adopt a higher standard of living. The associated increases in consumption of imported luxury goods and of electricity, water, and space (for roads, houses, schools, or hotels) generally offset all but the most comprehensive of conservation initiatives. In some cases, however, wealth can reduce local ecological footprints, such as in Puerto Rico, where urbanization since the 1950s has resulted in abandonment of farmland and regrowth of forests. Human impacts on islands reflect human impacts on mainlands; but islands, unlike mainlands, do not have the physical space or resource base needed to buffer the rapid environmental changes that humans introduce. Efforts to avoid or mitigate human impacts on islands include conservation, management of invasive species, and restoration. These efforts are both aided and constrained by the finite space and resources available on islands. On the one hand, removal of invasive species from an entire island and restrictions on entry of new ones is easier to achieve on small island land masses than on continents. On the other hand, islands have limited populations of rare organisms and a lack of alternative habitats for organisms to move to when disturbed.

1.3.1 Conservation

Early human colonists of islands have a poor record of conserving native plants and animals. For example, Neolithic agriculture, wherever it was practiced, destroyed many local resources, often within only decades of its introduction. Even today, most islanders derive their food either from intensive, industrial-scale agriculture and aquaculture or from imported food products, so their link to natural ecosystems is tenuous at best. There are many reasons to conserve species and habitats, which could include a developing sense of direct dependence on the land, but often involve broader-scale issues such as global rarity of a species, clean air, or clean water. The physical aspects of islands focus conservation issues in many ways. On the positive side, there are unique plants and animals that may garner worldwide

© in this web service Cambridge University Press & Assessment www.cambridge.org