14. IMPACTS OF CLIMATE CHANGE IN GUERNSEY

Andrew Casebow

Figure 14.1 *Global warming is already having an impact on wildlife. On the land and in the air it is affecting plants, animals, insects, and birds. Images copyright C David, Guernsey Biological Records Centre. Little Egret copyright Mike Roger.*

From left to right: Humming-bird hawk moth, Gazania, Laminaria ochroleuca, seaweed, Little Egret and Cabbage Palm.

Climate change is occurring here, in Guernsey. Air temperatures are noticeably increasing, there are few really cold days during the winter months and we are becoming used to a mid-summer drought in most years. Sea temperatures are also increasing. Although the rise in sea water temperatures take much longer to occur due to the huge mass of sea water that needs to be warmed, the surface temperatures near our shores warm much more quickly.

Global warming is already having an impact on wildlife. On the land and in the air it is affecting plants, animals, insects, and birds, and if sufficient information was available I am sure that we would find that it was affecting almost all species to some extent. This seems to be caused not just by the increasing temperatures but also by the breakdown of established seasonal weather patterns.

The scientific study of the first dates of flowering or leafing of trees and wild plants; the first sighting of swallows and other migratory birds; the timing of egg laying and breeding; the first frogspawn in our ponds; and all the indications that spring is arriving are recorded in the study of phenology. Everyone is encouraged to record their own sightings each year and, if they wish, to contribute these to a national phenology website at www.naturescalendar.org.uk. In the autumn, the dates when the last migrants leave the island, when the leaves of different trees fall, and all the other indications of autumn can also be recorded. This has shown that in recent years the flowering dates of many wild flowers are becoming earlier, the arrival dates of migrating birds and insects, and the breeding dates of many birds are all becoming earlier, but autumn is also becoming later. We are seeing greater numbers of what were very unusual or only occasionally visiting birds, butterflies and moths; and some have become resident and breed within our island.

Within the sea and among the creatures that live on the shoreline, climate change is also causing dramatic changes. The plankton that lives in the sea, which is at the base of the marine 'food chain' for many species, is affected by water temperatures and is moving northwards particularly during the summer months, as it prefers cooler waters. The creatures that rely on it as a food source are also moving northwards following the cooler nutrient rich waters. Other southern species are also moving northwards into new territory. Species such as spider crabs, certain species of limpets and barnacles, and even our native ormer, that are on the northernmost extent of their range, are moving northwards and eastwards as the water warms sufficiently further north. Fish, too, are moving in their range and there have been far greater catches of bass and red mullet in recent years, but as so little is known about these marine species it is not possible to say whether this is due to climate change or to other cyclical factors.

A few dedicated people have been collecting information on the flowering dates, arrival dates, or movements of different species, but very little of this was initially collected to observe climate change. This section is the result of much 'detective work' in tracking down the various people who have recorded information over the years, and then of analysing it. Whilst I have enjoyed much of the detective work I am very indebted to Tim Sparks of the Centre for Hydrology and Ecology in England who has collated and analysed the data to provide evidence of the impacts of climate change on wildlife in Guernsey.

In this section we have gathered together information that shows some of the effect that warming is having on farming and wildlife. Since 1985, Nigel Jee has been noting down the dates each year when wild plants in his Castel garden have come into flower; whilst Charles David, the late Bridget Ozanne, and Jamie Hooper of the Guernsey Biological Record Centre have been collecting their own detailed records on insects, plants and birdlife. Mark Lawlor, recorder for the La Société Guernesiaise Bird Section, has collated lists of the first sightings of migrant birds and, at the old Horticultural Advisory Service Station at St Martin's (now part of the Commerce and Employment Department), daily records of moths have been recorded since 1973.

On marine life, the Sea Fisheries Section of the Commerce Department has recorded weekly seawater temperatures in St Peter Port that closely match those recorded at Cherbourg. At the same time the Marine Biological Association (from Plymouth) has been recording shoreline creatures on our coastline and the SAPHOS organisation has been collecting data on the movements of plankton within the Channel. It all makes fascinating reading.

15. IMPACT OF RISING SEA TEMPERATURES

Andrew Casebow

Figure 15.1 *Spider crabs are in decline in local waters as they migrate north to escape rising sea temperatures.*

Sea water temperatures have been recorded each week in Guernsey since 1980. These are surface water measurements taken at the Signal Station in St Peter Port harbour. As such, the water temperature can be affected by sunshine and rainfall, although readings are taken in the shade and avoiding heavy rainfall in an attempt to minimise these effects.

The mean annual temperature has fluctuated from a minimum of 11.5°C in 1991 to a maximum of 13.6°C in 1999. In 2006 the mean annual sea temperature was 12.7°C. A cold late winter resulted in this figure being the lowest since 1996, although Guernsey's mean annual sea temperature has not fallen below 12°C since 1992.

There has been an overall increase in surface seawater temperature of about 1.7°C over the 26-year period, mirroring an increase in the recorded water temperature of the North Atlantic of about 1°C in the past 30 years. Similar results have been recorded at Cherbourg on the French coast, and a graph showing fluctuations in the mean annual sea surface temperature for the coastal waters of the English Channel since 1870, is shown in chapter 17, page 44.

Guernsey is very special. It is situated on the convergence of Boreal (cold temperature) and Lusitanian (warm temperature) marine bio-geographical regions. The overlap of these regions promotes increased species richness in our waters. Cold-water species at their southern limit are likely to lose their 'climate space' and migrate northwards as temperatures rise in the future. Other, warm water, species are likely to spread into island waters from France or from further south.

Fish stocks and sea creatures are at the forefront of this change because there is no natural division between landmasses to restrain their movement, and also because many species are naturally mobile. There has been a marked increase in the abundance of bass (a warm water species) in recent years, replacing other white fish in Guernsey waters. In the 1960s bass was a rather unusual catch but in recent years over 100 tonnes per annum have been landed. There has also been a big increase in the abundance of black sea bream. However, sea bream populations tend to be cyclical and as a result the return of black sea bream after 30 years (they were last abundant in the 1970s) is not necessarily caused by climate change. Some species which were formerly common, such as red sea bream, are now rarely caught.

Douglas Herdson of the National Marine Aquarium in Plymouth notes, "Angling records prove that some species have become more common. There have been range extensions, and some species have begun breeding in British waters". Local fishermen have had to adapt, perhaps faster than ever before, to changes in fish stocks. It is now more profitable to fish for bass than, for example, crabs. David Wilkinson, Technical Officer in the Guernsey Sea Fisheries Department (part of the States Department of Commerce) notes that there has been a decline in the number of spider crabs caught locally over the past 5 years as their distribution has extended northwards.

The impact of climate change on the sea plankton population and seashore species are discussed in the following chapters.

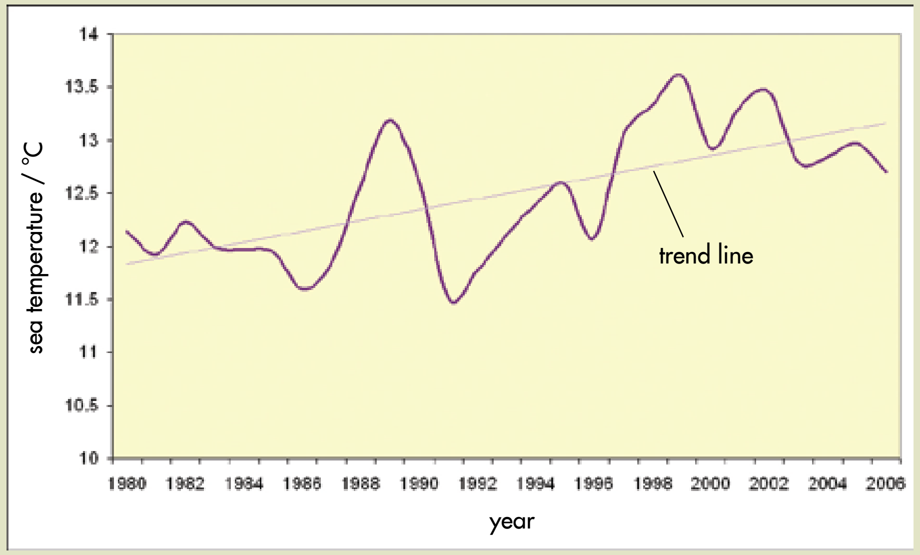


Figure 15.2 *Surface water temperature taken from St Peter Port Harbour 1980 - 2006. There has been a warming trend with an increase of about 1.7°C since 1980.*

Figure 15.4 *A catch of bass aboard a Guernsey fishing boat. Bass landings have risen substantially in recent years as the abundance of bass has increased in Bailiwick waters, particularly during the winter pre-spawning and spawning period.*

Figure 15.3 *The warming seas may be encouraging warm water species, such as bass, to migrate to Guernsey waters in greater numbers. These line caught fish from the Bailiwick are exported to France.*

Further information:

www.national-aquarium.co.uk/.

www.sealordphotography.net/.

16. INDICATORS OF CLIMATE CHANGE IN THE PLANKTON COMMUNITY

David G Johns and M Edwards.
Sir Alister Hardy Foundation for Ocean Science (SAHFOS) [1].

Relevance

The plankton community, with both plant (phyto-) and animal (zoo-) constituents, represents the base of the marine food web, and thus any changes can influence higher forms of marine life (such as fish). Zooplankton consist of not only permanently planktonic organisms, such as small crustacean called copepods (Figure 16.1), which provide an extremely important food source for larval fish, but also temporary members, such as the larval stages of crabs and lobsters. Long term (1958 to present day) sampling by the Continuous Plankton Recorder (CPR) survey has enabled the study of changes in abundance, community composition, and peaks in seasonal timings, which can all impact higher up the food chain, and are often attributed as indicators of climate change.

Here we discuss changes in the abundance and distribution of zooplankton in recent years, and show the results for one species, the copepod Clausocalanus, which is indicative of warmer, more southerly waters. The long-term changes of Clausocalanus (Figure 16.2) show that it has increased six-fold during the past 15 years.

Sensitivity to climate and other factors

Zooplankton, being near the very bottom of the food web and having a rapid generation time, can respond to climate change quicker than many higher organisms. They are therefore good indicators, and have been used in previous studies. Many are of economic importance, either directly as the larval stage of exploited species, or indirectly as the food of exploited species.

Figure 16.1 *A copepod, a small crustacean that is a primary source of food for larval fish.*

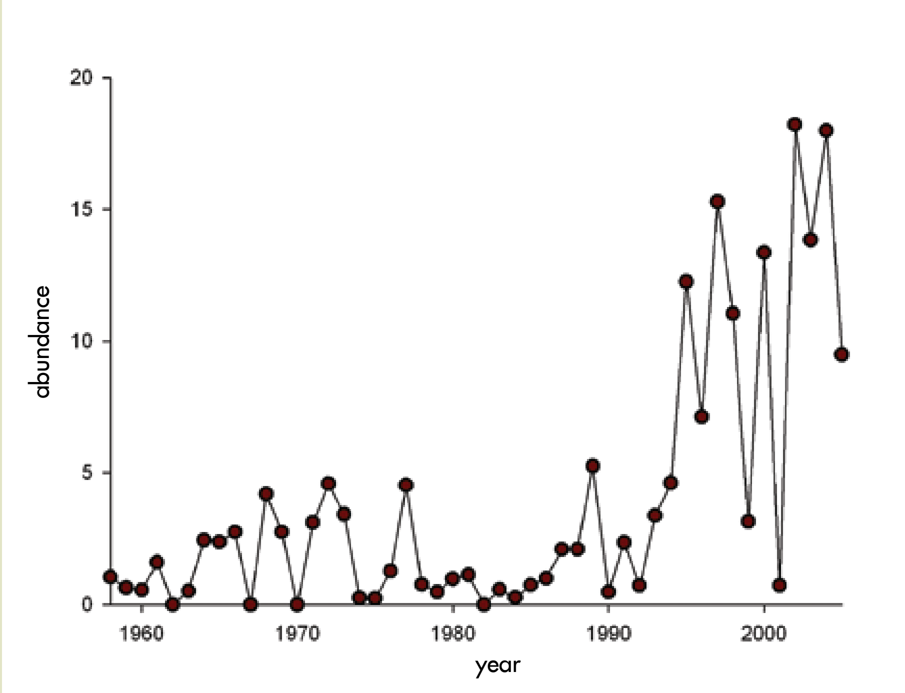


Figure 16.2 *Plot of long term abundance of Clausocalanus, an indicator of warm water.*

Change over time and likely impacts to Guernsey

Analysis of long-term plankton data for the English Channel and Channel Islands has shown the following changes in response to climate warming:

- Changes in temperature have affected the lowest elements in food webs, and this has propagated upwards.
- Copepod species have shifted 10° northwards in latitude, due to increased sea temperatures.
- Increased temperatures have allowed successful invasion by warm water species. These have moved further northwards as waters warmed, or been introduced via the ballast water in ships.
- There has been a change in one of the most abundant and important copepods, Calanus, with the colder (previously more abundant) species declining and the warmer water species increasing. But, the combined number of both species has dropped, meaning there is potentially less food for larval fish.
- The start of seasonal cycles have changed, getting earlier, potentially causing a mis-match between inter-dependent organisms.
- An increase in the occurrence of Noctiluca scintillans, a potentially harmful (to fish and invertebrates) phytoplankton species.

These trends are likely to continue, due to an increase in warming, and will have an effect on which fish species (both fin- and shell-) can be commercially harvested in the future.

References
1. The Sir Alister Hardy Foundation for Ocean Science (SAHFOS) is an international charity that operates the Continuous Plankton Recorder (CPR) survey. The Foundation has been collecting data from the North Atlantic and the North Sea on biogeography and ecology of plankton since 1931. http://www.sahfos.ac.uk/.

17. THE EFFECTS OF CLIMATE CHANGE ON INTERTIDAL SPECIES

Nova Mieszkowska [1], R Leaper, J Hill, A.J Southward & S.J Hawkins.
Marine Biological Association of the UK [2].

Relevance

Intertidal animals and plants live at the margin between the sea and the land and so these organisms are subject to changes in both environments. They can therefore serve as early warning indicators for the impacts of climate change. The larval stages of many species can be indicative of changes occurring in offshore waters. Low intertidal and subtidal kelp beds are nursery grounds for juvenile fish, and are also an important part of the near-shore community. Long-term data sets exist for intertidal invertebrates around the coast of the British Isles, including data collected in Guernsey during the 1950s, 1970s, 1980s and, more recently since 2000s. These data allow the responses of species to fluctuations in the climate to be determined.

Sensitivity to climate and other factors

Intertidal species are subject to wide fluctuations in temperature, and are often already living close to their thermal tolerance limits. Rapid warming of the climate that has occurred in the English Channel over the last 2 decades (Figure 17.1) has altered the environmental regime of the intertidal zone and species that are fixed to rocks or move only small distances are being forced to adapt or die.

Change over time

Analysis of data from the 1950s, 1960s, 1980s and 2000s showed the following changes to intertidal species in the English Channel in response to climate warming:

- Warm water 'southern' species of topshells, limpets, barnacles and seaweeds have extended their eastern range limits in the English Channel by up to 120km.
- Population abundances for southern topshells have increased six fold as sea temperatures have warmed. Similar changes have occurred in southern barnacles.
- Cold-water 'northern' species of limpets, barnacles and seaweeds have shown reductions in abundance and some retraction in their southern limits.
- These changes in northern species are not as marked as the increases recorded in southern species.

Experimental research showed that these changes appear to be driven by increased reproductive success of adult organisms as spring and summer temperatures have risen, and increased over-winter survival of juveniles for southern species in response to milder winters. In addition, indirect effects of climate change occurring via competition are affecting the relative abundances of northern versus southern species of barnacles and limpets.

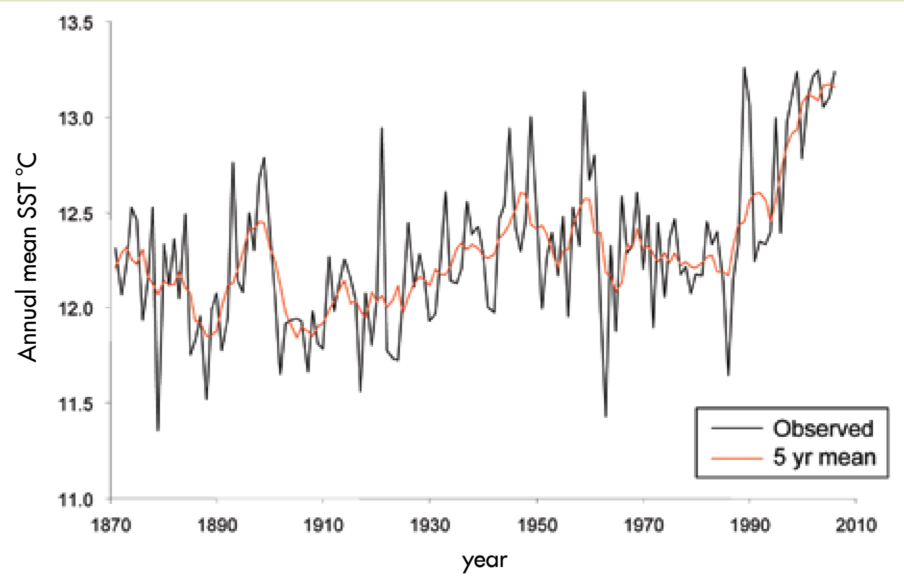


Figure 17.1 *Mean annual sea surface temperature for the coastal waters of the English Channel. Note that the off-shore surface temperature is very similar to that recorded in St Peter Port harbour (Figure 15.2, page 41), but showing the same upward trend. Data kindly supplied to the MarClim project by kind permission of the British Atmospheric Data Centre.*

A major study of the impacts of climate change on marine biodiversity in Britain and Ireland over the last 50 years (the MarClim project [3]), has been undertaken with a view to predicting likely future climate impacts . The MarClim team has predicted the following changes:

- Further pole-wards expansion of warm water species.
- Continued contractions in the southern range limits and abundance of northern species.
- Increased invasions of non-native species are likely to occur, and expand their range if already established.
- A short-term increase in biodiversity may occur followed by a longer-term decline in biodiversity as native species of northern, cold water origins are lost from an increasing number of shores.
- There is the potential for huge changes to British marine inter-tidal ecosystems within the next 50-80 years, and Guernsey will not be exempt from this.

Likely Impact in Guernsey

The shores in Guernsey host southern, warm-water species of intertidal species including the topshell Gibbula pennanti that are not currently found on the British mainland. Such species are predicted to colonise shores in southwest England as future climate warming opens up new regions of suitable thermal habitat. The island is thus an important 'stepping stone' for the spread of non-native species onto the British mainland. Northern cold-water species that are currently present on the island, including kelps that provide nursery grounds for juvenile fish are predicted to decline in abundance as temperatures continue to increase. Non-native species including the Japanese seaweed Sargassum muticum (Figure 17.2) and Australasian barnacle Elminius modestus (Figure 17.3) have already invaded Guernsey and are predicted to increase in abundance as the climate continues to warm.

Figure 17.2 *The invasive Japanese seaweed Sargassum muticum, transported to British coastal waters in the ballast water of international ships.*

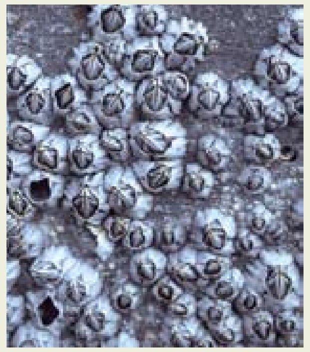


Figure 17.3 *The invasive Australasian barnacle Elminius modestus, transported to British coastal waters in ballast water of international ships.*

Figure 17.4 *Limpet counts are randomly estimated by means of a quadrant.*

References
1. Prof. Steve Hawkins, Nova Mieszkowska & Rebecca Leaper of the Marine Biological Association have been regular visitors to Guernsey, Jersey and the English Channel coastlines of England and France carrying out research on intertidal species.

2. Marine Biological Association of the UK - http://www.mba.ac.uk/.

3. Marine Biodiversity and Climate Change (the MarClim project) http://www.mba.ac.uk/marclim/.

18. THE IMPACT OF THE CHANGING CLIMATE ON AGRICULTURE

Andrew Casebow

Figure 18.1 *Heifers grazing in a St Saviour's wet meadow.*

Changes in the climate have had a dramatic effect on agriculture and the growth of crops, and this will cause greater change in the future.

Increasing winter soil temperatures

When the soil temperature is above 3°C, bacteria break down organic matter in the soil to compounds of nitrogen and carbon. Some of these compounds are used for plant growth, such as nitrates, whilst others, such as nitrous oxide and carbon dioxide, are released into the atmosphere. These are greenhouse gases and are part of a natural release as soils warm, but which, as part of a positive feedback loop, may contribute to further warming. The trend towards warmer soil temperatures in shown in Figure 18.2

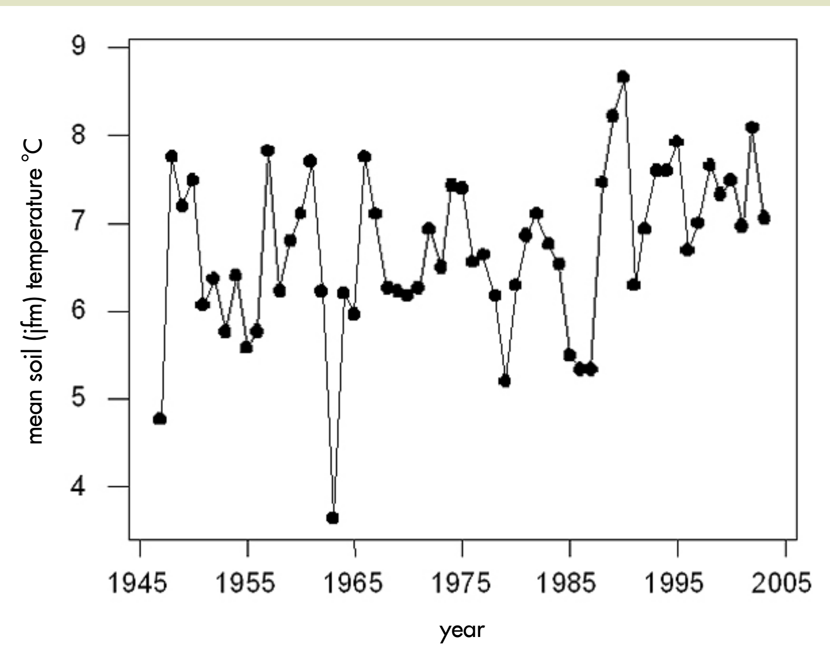


Figure 18.2 *Graph showing the mean soil temperature (in degrees C) during January, February and March (jfm) of each year since 1947.*

Warmer soils also mean that crops continue to grow throughout the winter. Grass growing in our gardens often needs cutting throughout the winter months, but grass is one of the main farm crops grown in Guernsey, specifically for the feeding of cattle and other livestock. The grass is either grazed by cattle in the fields or mechanically harvested and taken back to the farmyard to feed the animals that are housed there.

Wetter soils

As well as becoming warmer the climate has become wetter in the winter months. This means that although grass may continue to grow, the soil in the fields tends to be wetter and may flood. In some fields the soil structure cannot bear the weight of cattle grazing or machinery, and so the fields may become 'poached'.

The soil on the southern plateau in Guernsey is much more free draining than the soil in the north of the island, and so here cattle can often go 'out to grass' earlier than they did before, and also stay out much longer in the autumn before needing to be housed as the weather becomes colder (Figure 18.3).

As long as they have adequate natural shelter, a good coat and plenty of food, cattle are often healthier outside than in winter housing. The warmer soils mean that sown seeds may germinate earlier; but crop pests and diseases are often able to survive the winter as there are fewer frosts to kill them.

New crops

Some crops that could not be successfully grown in Guernsey 30 years ago are now commonplace. Part of this is due to improved crop breeding but also due to warmer winter and spring temperatures. Maize is grown as a fodder crop since it needs a long growing season to successfully form cobs but the summer is not yet long or hot enough for the cobs to ripen into grain (Figure 18.4). This crop is regularly grown south of the Loire valley in France, and so with warming it is only a matter of time before grain maize could be harvested in Guernsey.

Figure 18.4 *Forage maize has become a common sight in Guernsey over the past 20 years.*

Loss of Markets

Crops such as early potatoes and daffodils that were grown much earlier in the Channel Islands, or in the Isles of Scilly, than was possible in England, can now be grown just as successfully in Cornwall and in parts of Southern England. This means that these crops have lost their market 'edge' and can no longer be sold just on their earliness of production and must be marketed on other characteristics, such as tradition, flavour and quality.

Figure 18.5 *After milking, dairy cows on this St Saviours farm eat silage (preserved grass) before going back to the fields in the summer.*

Summer drought

Guernsey is particularly prone to summer drought conditions caused by a lack of rainfall, which seems to affect the island most during August. The growth of plants is significantly reduced by a lack of moisture. A summer drought therefore means that dairy cattle that rely on a large daily supply of fresh grass often need to have extra food provided for them during very dry weather. Many cows are now fed conserved food (such as grass silage) throughout the summer (Figure 18.5).

Potatoes

The yield and quality of potatoes is also affected by rainfall during the mid-summer period. Potatoes are often an irrigated crop in England and drier summers could lead to an increase of irrigation in the future, but water resources are not adequate to permit that in Guernsey.

Figure 18.3 *Cows 'out at grass' overlooking Kings Mills in December.*

19. INTRODUCED SPECIES OF PLANTS

Bridget Ozanne [1]

Figure 19.1 *The Giant Echium (Echium piniana), although indigenous to the Canary Islands, is found growing throughout the islands of Guernsey.* Image copyright C David, Guernsey Biological Records Centre.

The Channel Islands have long been known for the many attractive and colourful flowering plants that have arrived from foreign parts, perhaps with other cargoes, some perhaps on purpose for gardens, whilst many others have naturalised into the wild areas and become part of the Flora. In Guernsey, horticulture has always been an important part of the economy due to the mild climate compared with most of mainland Britain, so many flowers and plants have been cultivated in the island, both under glass and in nursery gardens for several centuries. Some of these have escaped and are now naturalised successfully in appropriate areas. They have been able to survive here whereas on the mainland a hard winter would have destroyed them. A lot of these species have gradually migrated north and colonised areas of southwest Britain, and many are reaching further, particularly over the last decade or two.

It is very difficult to assess how much of this spread can be attributed to climate change. However, it has become more obvious over the last twenty years or so that many of these novice plants can survive the winters, whereas in earlier years populations would have been severely checked, if not wiped out.

Of course, over time floras change anyway, sometimes without the intervention of man, and plenty of these new arrivals are welcomed as additions to the local communities. Problems occur when alien species become a nuisance. They can become very invasive, as their native predators are not present to check them, and this can cause them to out-compete smaller, rarer native species.

An example of this is the South African succulent species (Figure 19.2), which have increased dramatically in the last twenty years or so, due to milder winters. The Kaffir Fig, and other species of Mesembryanthemums, now cover large areas of the cliffs. They completely cover some of our native Guernsey specialities such as Dwarf Pansy, Sand Crocus and Small Cudweed, as they are far larger and form dense mats of vegetation.

Figure 19.2 *South African succulent species. (a) Kaffir Fig (Carpobrotus edulis), and (b) Rosy Dew-plant (Lampranthus roseus) on cliffs at Le Gouffre.*

Figure 19.3 *(a) New Zealand native Wire Plant (Muehlenbeckia complexa), and (b) Wire Plant covering hedge at Les Fontenelles.*

Images copyright C David, Guernsey Biological Records Centre.

A similar situation can be observed in the Isles of Scilly, where non-native plants from the southern hemisphere appear to outnumber native species. One plant that is very invasive in the Scillies is the Wire Plant from New Zealand (Figure 19.3). It forms huge hillocks on the low cliffs in the larger islands. In Guernsey it was first recorded in the 1950s at one location near Moulin Huet. No more records occurred until the 1970s, but since then it has been slowly increasing, both in localities and in areas in these localities unless tightly controlled.

Other garden plants, which have increased and cause visitors some astonishment, are things like Geraniums from Madeira (Figure 19.4) and the Giant Echium (Main image, figure 19.1) which lives in the Canary Islands. These can reproduce and live on their own in the wild, but are no great nuisance to anyone.

Plants which give Guernsey its "sub-tropical" look include things like the Cabbage Palm (Cordyline) and New Zealand Flax (Phormium), both from the Antipodes, and both of which can seed and grow outside gardens. In the past, gardeners would wrap these plants up in polythene or use other means of protection to ensure that they got through the winter, but this does not now appear to be necessary.

Guernsey botanists who have observed plants and plant communities for more than fifty years in the islands, would all say that there have been clear and obvious changes over that period. It is difficult to be completely confident in explaining the reasons for these changes, or even to state if these are unique in the British Isles (for example compared to Cornwall), but such changes are entirely consistent with a warming climate.

Figure 19.4 *Madeiran Geranium (Geranium maderense).* Image copyright C David, Guernsey Biological Records Centre.

References

1. Until her recent death, Bridget Ozanne was Secretary of the Botany Section of La Societe Guernesiaise and managed the Guernsey Biological Record Centre (gsybiorec@cwgsy.net).

20. RECORDS OF SOUTHERN EUROPEAN BIRD SPECIES IN GUERNSEY

Mark Lawlor [1]

As the climate in Guernsey has been getting warmer, it follows that bird species that prefer warmer climates may become more common here. This chapter focuses on species of birds whose breeding range is generally located to the south of Guernsey, and whether their numbers are increasing.

Little Egret

This species was once a very rare visitor but is now a familiar sight around the coastline of the island and has recently bred. It has also shown a phenomenal increase in numbers in Britain during the last ten years or so. All the birds use just two roost sites on Guernsey so quite accurate estimates of the population can be made. Figure 20.1 shows the dramatic increase in recent years.

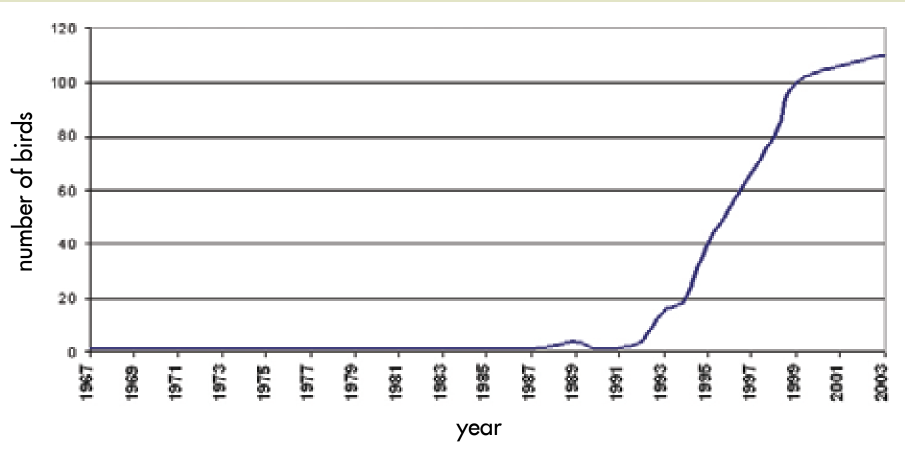


Figure 20.1 *Estimated Little Egret numbers on Guernsey (since first record in 1967).*

Serin & Golden Oriole

These two species are very common in warm parts of Europe including most of France. Both species have shown an increase in records over the years, which can be seen in Figure 20.2.

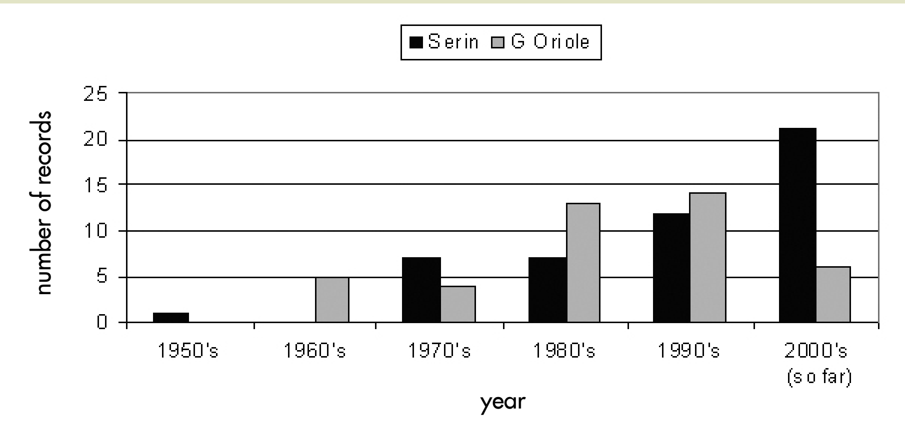


Figure 20.2 *Estimated Serin and Golden Oriole numbers on Guernsey (since 1950).*

Tawny Pipit, Melodious Warbler & Cirl Bunting

These three species are also predominately southern European species. Numbers increased until the 1970's and 80's, but have declined recently (Figure 20.3). There are two possible explanations for this i) both Tawny Pipit and Cirl Bunting are thought to be declining species due to a reduction in suitable habitat. ii) Melodious Warbler and Tawny Pipit are mostly post-breeding autumn visitors to Guernsey.

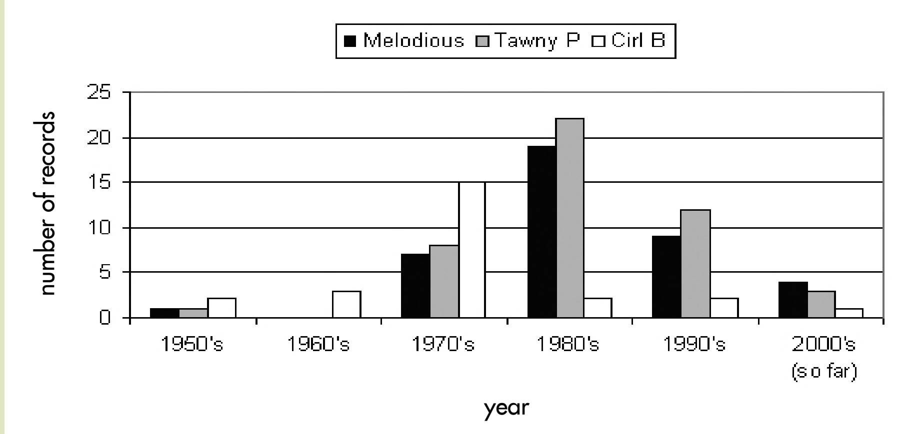


Figure 20.3 *Estimated Tawny Pipit, Melodious Warbler & Cirl Bunting numbers on Guernsey (since 1950) are in decline since the 1980's.*

Cetti's Warbler & Dartford Warbler

Unusually for warblers, these two species do not migrate south for the winter. As they are insect-eating birds, they are reliant on warm conditions and are mainly found in the Mediterranean region. The Dartford Warbler started breeding in Guernsey in 1961 and Cetti's Warbler in 1975. The fact that both these species have successfully colonised the island in the last 50 years indicates that the winters have been warm enough for a plentiful supply of insects, and that there have been few years of extensive freezing conditions that would wipe out their very small populations.

Figure 20.4 *Little Egret photographed by Mark Lawlor.*

Rarer species from Southern Europe

As well as the above-mentioned species there have been 23 other rare species recorded on the island, which can be classed as 'Southern European':

Little Bittern	Night Heron	Squacco Heron
Cattle Egret	Purple Heron	Black Kite
Griffon Vulture	Little Bustard	Black-winged Stilt
Great Spotted Cuckoo	Alpine Swift	Little Swift
Bee-eater	Roller	Short-toed Lark
Red-rumped Swallow	Black-eared Wheatear	Fan-tailed Warbler
Subalpine Warbler	Sardinian Warbler	Bonelli's Warbler

Looking at the records of these species, it appears that rarities from the south are increasingly occurring on Guernsey – even allowing for increasing observer coverage in recent decades.

References

1. Mark Lawlor is the Bird Recorder for La Société Guernesiaise. A Chemistry graduate from Bristol University, he teaches Science at St. Peter Port Secondary School.

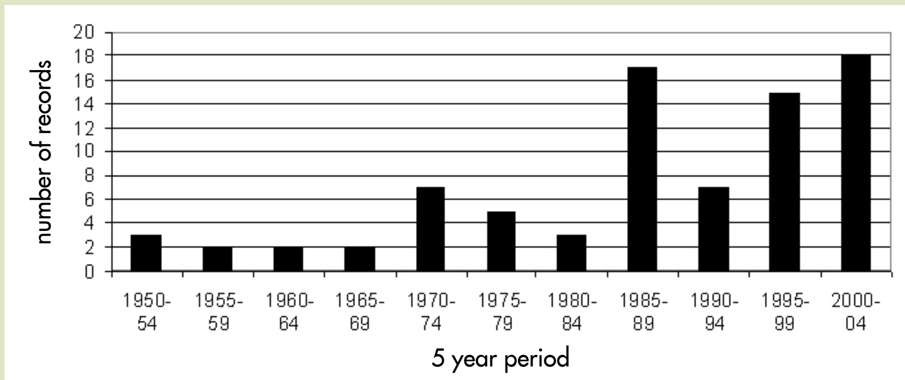


Figure 20.5 *Rare bird records from southern Europe.*

Summary

The majority of southern European bird species that have been recorded in Guernsey have shown an increase in records during the last 50 years or so, which may be due to climate change.

21. SPRING ARRIVAL DATES OF MIGRANT BIRDS

Tim Sparks [1]

Figure 21.1 *Migrant swallow caught for ringing by Jamie Hooper (see Figure 21.2).* Copyright Jamie Hooper.

The dates on which migrant birds return from their wintering locations have been getting earlier across Europe. However these changes are not as great as for plants, or even insects, giving rise to concerns that migrant birds are not adapting sufficiently rapidly to a warming climate. It is now thought that changes in day length trigger migration from Africa, but that temperature modifies migration speed, leading to changes in arrival dates.

We examined the first arrival dates of 20 migrant birds to Guernsey supplied by Barry Wells and Mark Lawlor from La Société Guernesiaise records. The information covers a relatively short period 1985-2004. Whilst the average migrant is now 3 days earlier than 20 years ago, only three species (sand martin, house martin and sedge warbler) are substantially earlier (by 15-30 days). The sand martin has shown great consistency in earlier arrival in Europe. A growing number of observations of migrants in February suggest these birds are wintering closer to Guernsey than the tropics, for example the Mediterranean in the case of house martin, and may in the future over winter on Guernsey itself.

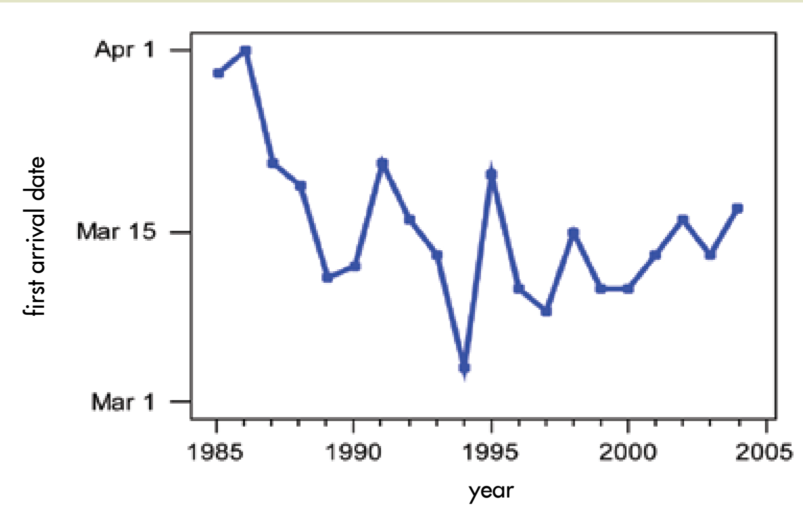


Figure 21.2 *First mean arrival dates for migrant birds to Guernsey from 1985 to 2004.*

The ornithological section of La Société has been active in recording birds in Guernsey throughout its 125 year history. There have been some remarkable changes in migrant birds during this period; including declines in species such as nightjar, corncrake and nightingale; increased frequency of records of species such as sand martin, spotted flycatcher and several warblers; and winter records of species such as blackcap, chiffchaff and turtle dove. In this section we compare first arrival dates of nine commonly recorded species in two periods for which records are reasonably abundant; 1903-1945 and 1985-2005.

The table below shows mean dates for these two periods. Species are arranged in date order of the earlier period.

Mean first dates

Species	1903-1945	1985-2005	Days earlier
Wheatear	March 24	March 6	18
Ring ouzel	April 8	April 2	6
Swallow	April 8	March 23	16
Willow warbler	April 13	March 26	18
Cuckoo	April 15	April 15	0
House martin	April 20	March 25	27
Sand martin	April 22	March 17	36
Swift	April 30	April 22	8
Turtle dove	May 7	April 28	9

These changes are statistically significant except for ring ouzel and cuckoo. Part of the change may be an artefact of sampling, i.e. because more people are now looking for first migrants than previously and hence observing them earlier. There may be some truth to this, but it is unlikely to have much influence on numerous, obvious species such as swallow and, furthermore, these changes have been recorded across Europe from bird observatories operating 'constant effort' sampling.

Can these changes be attributed to a warming climate? We have taken the analysis one step further by comparing arrival dates in Guernsey with temperatures further south, from Spain. For all species, except ring ouzel and cuckoo, we can find a significant relationship with temperature such that earlier arrival in Guernsey by between 3.3 and 9.4 days (depending on species) is associated with a 1°C increase in temperature in Spain (see Figure 21.3). Cuckoo, and possibly ring ouzel, follows a different migration across France, but we did not find agreement with French temperatures for these species. Both species are in decline which may mask climate influences on their arrival dates. Mean March temperatures in Spain were 8.5°C in 1903-1945 and 10.3°C in 1985-2005.

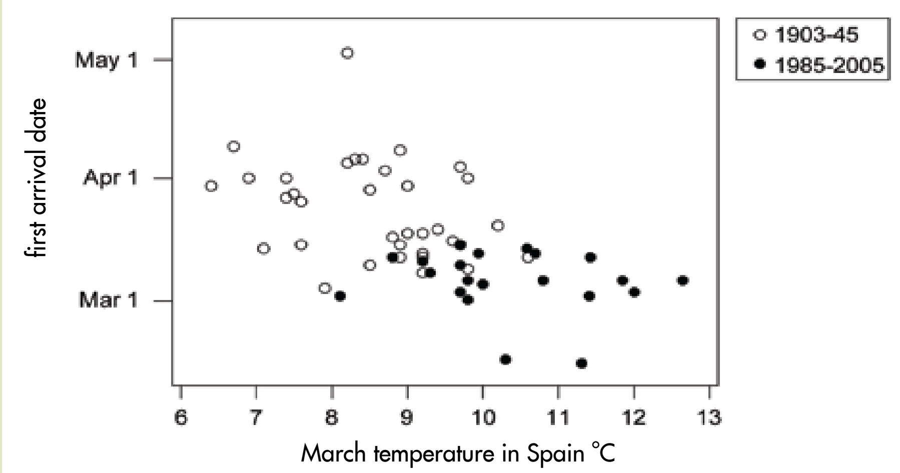


Figure 21.3 *the relationship between wheatear first arrival date and Spanish temperatures in March.*

These results provide strong evidence for a change in spring arrival dates of migrant birds linked to migration route temperatures. In future years it will also be possible to make use of more Guernsey data, for example on the numbers of birds on spring and autumn migration, e.g. through ringing schemes and roost counts, but currently the data hasn't been recorded for long enough to draw conclusions on the influence of climate on these.

References

1. Dr Tim Sparks is an environmental scientist with the Centre for Ecology and Hydrology.

22. FLOWERING DATES OF GUERNSEY WILD PLANTS

Tim Sparks and Andrew Casebow

Figure 22.1 *Early spring flowering daffodils in a Guernsey farmhouse garden.*

The dates on which plants come into flower are determined by a number of factors. With one or two exceptions, plant species flower in specific seasons, for example daffodils in spring and ivy in autumn. This suggests that temperature and day-length are key to inducing flowering. In some desert systems, rainfall is the main driver, but this is unlikely to be an issue on Guernsey. Day-length does not vary from year to year so variation in plant flowering time (within seasonal limits) can be largely and directly attributed to temperature. In fact, plants in Europe are very responsive to temperature, which induces earlier leafing, flowering and fruiting, and can allow later leaf fall. In a warming climate we would expect to see gradually earlier flowering. This is, in fact, what has been observed across Europe and elsewhere in the Northern Hemisphere where records exist. But what has been happening on Guernsey?

Nigel Jee has been recording the first flowering dates of 46 plant species in his Castel garden since 1985. In addition, Peter Danks has recorded the flowering date of his apple trees in St Martins over the same period. We have examined these 47 events to see if there is any evidence of a response to temperature, and indeed if they have been getting earlier in recent years.

Analysis shows that, on average, a 1°C increase in temperature in the three months leading up to flowering causes these flowers to appear ten days earlier. This figure is much higher than some colder parts of Europe. The average masks a range of values from plants showing little influence of temperature, such as sycamore trees, to those with a much greater response, such as lesser celandine. This suggests that any preconceptions we may have about there being a normal order of plants coming into flower may be overturned in the future (under increasing temperatures). The repercussions for insects and other animals feeding on these plants are not yet known.

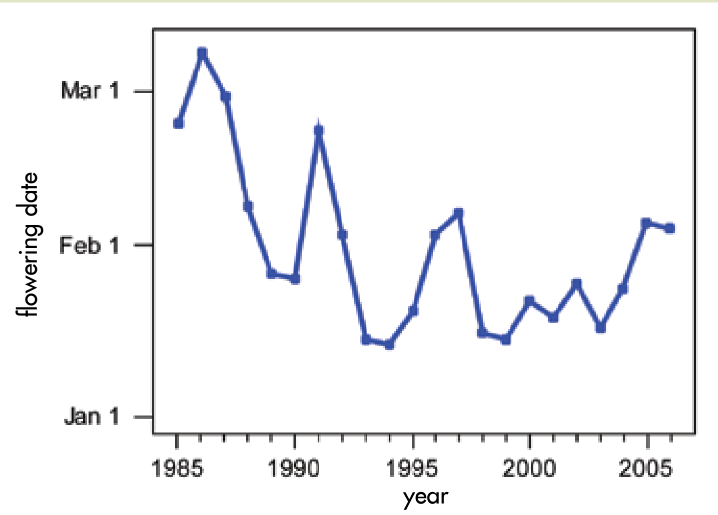


Figure 22.2 *Changes in first flowering of snowdrop: note the lateness in 2005/2006.*

On average these plants have advanced flowering by 13 days since 1985. This figure would have been considerably higher had not flowering been much later in 2006 as a consequence of that year's unimpressively cold spring weather. Nine species, including snowdrop and clematis, have seen substantial advances in flowering, for instance see Figures 22.2, 22.5 and 22.6.

Quite clearly, flowering plants on Guernsey are strongly influenced by temperature and several have already become substantially earlier. In general terms the early spring flowers show this temperature response most and will be the species that will become even earlier as Guernsey's winter temperatures become even milder. As plants exist as part of a food chain, for example, supplying nectar to insects and being pollinated by them, then there is a need to maintain synchrony with those insects. The fact that plant flowering dates are changing at different rates will present a challenge to wildlife in the future.

The timing of biological events, known as phenology, has been widely used to demonstrate changes in wildlife (see page 38). Some historical data exist for Guernsey, but records like Nigel Jee's are invaluable in demonstrating change under the warming that Guernsey has started to experience.

Late flowering is associated with cooler spring temperatures, and warmer winter temperatures cause earlier flowering. This clearly shows how the spring flowering of plants is made much earlier by climate warming.

Figure 22.3 *The common snowdrop (Galanthus nivalis), among the first bulbs to bloom in spring.*

Figure 22.4 *The vigorous climber Clematis montana, a species with advanced flowering dates since 1985.*

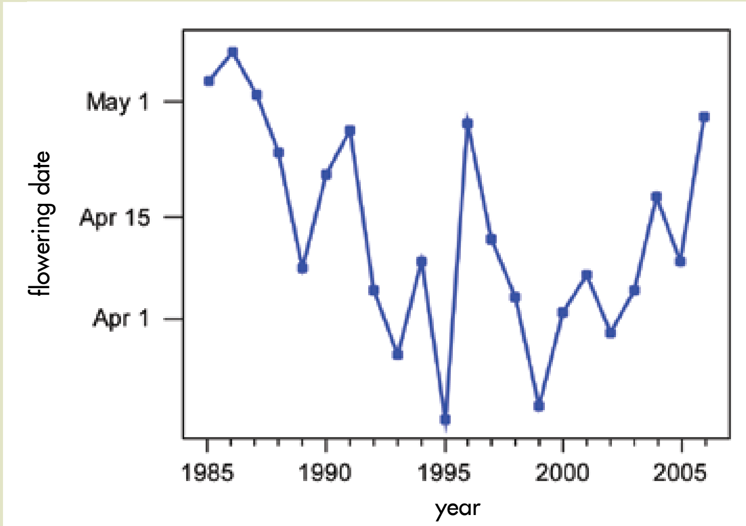


Figure 22.5 *Changes in first flowering of Clematis montana: note the lateness of 2006.*

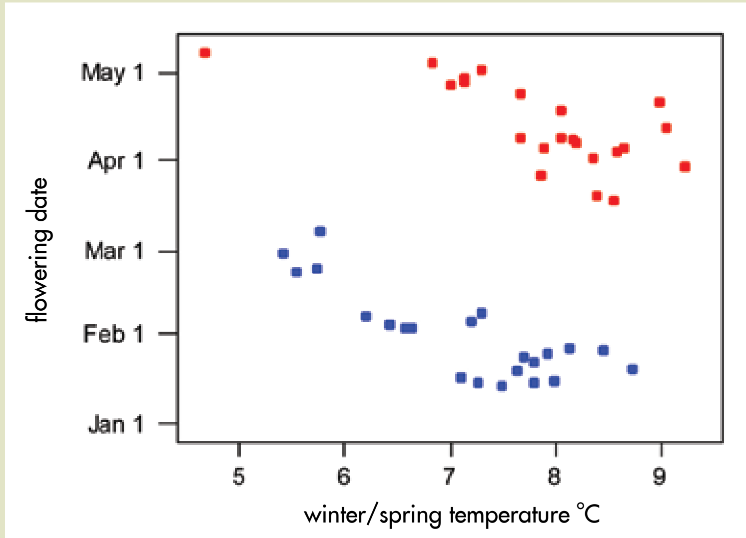


Figure 22.6 *Changes in average temperature of the three months preceding the first flowering dates of Snowdrop (blue) and Clematis montana (red). Note how lateness of flowering is associated with cooler spring temperatures.*

23. CHANGES IN INSECT SPECIES IN GUERNSEY

Charles T. David [1]

Figure 23.1 *The Firebug Pyrrhocoris apterus has become much more abundant in Guernsey in the last ten years.* *Image copyright C David, Guernsey Biological Records Centre.*

As global warming occurs the distributions of species in the Northern Hemisphere would be expected to drift northward, and some previously southern species would be expected to reach Guernsey. There is a lot of evidence that this is occurring. However, one must exercise caution when recording a species as new. Many insects are under-recorded. A species may only appear to be a recent immigrant but could have been present undetected for many years. Even if one is convinced a species is a new arrival it is difficult to determine whether it arrived due to climate change making the island a suitable habitat or because many ecological nichés in the island remain unfilled compared to those on the adjoining coasts of France so that species from the continent can easily establish.

An example of both of these types of colonisation is provided by the fauna of Alder trees. Alder was very scarce in the island until the recent States 'Free Tree Planting Scheme'. Now it is common. In recent years several species of insect new to the island have been recorded from Alder; all but one of these species occur in the UK and Normandy and have presumably migrated from France and established themselves in an unfilled niche. However, one of the new arrivals is the bug Arocatus roeselii (Figure 23.2). This species is apparently spreading northwards in France, but has not yet been recorded in North Brittany or Normandy; presumably this species has managed to establish itself in Guernsey because the climate is now suitable.

Figure 23.2 *The Alder bug Arocatus roeselii. Images copyright C David, Guernsey Biological Records Centre.*

Figure 23.3 *The Tachinid fly Ectophasia crassipennis.*

Other southern species arrive without apparent changes in habitat. The impressive fly Ectophasia crassipennis (Figure 23.3), a parasite of shield bugs, was first recorded in Guernsey in 1998. It is now common and has been found in all the other large Channel Islands. Ant lions Euroleon nostras (Figure 23.4) were first found in Guernsey and Herm in 1997 and were discovered in Suffolk at about the same time, though they had been known in Jersey since the 1940s. They are now found all over the southern part of the island and in two places in the Vale. These two species are large and because they are obvious they do seem to be genuine recent immigrants, which would have been recorded before if they had been present. There are many other cases of southern insects establishing populations in the island in recent years. These include distinctive species such as the bug Ceraleptus gracilicornis and the bee Halictus quadricinctus neither recorded in Normandy, and the flies Peleteria varia, Blepharipa pratensis and B. schineri.

As global warming occurs species with a more southerly distribution would be expected to increase in abundance in the island compared to species with a more northerly distribution whose populations may decline. A southern species that has increased enormously in abundance in the last ten years is the Firebug Pyrrhocoris apterus (Main image Figure 23.1). This was recorded in the 1890s but not seen again till 1995. The current population may have been re-established by immigrants in the 1990s. Evidence of the loss or decline in abundance of Northern species is harder to come by. Many species present in the islands have only been recorded in the literature a few times, and it is difficult to tell if they are now extinct, or are simply under-recorded. It is even harder to determine if their populations have diminished, and if so, why.

Figure 23.4 *(a) Ant-lions Euroleon nostras, (b) ant-lion pits. Images copyright C David, Guernsey Biological Records Centre.*

References

1. Dr Charles David is an enthusiastic entomologist who lives and works in Guernsey. He is a past President of La Société Guernesiaise and Joint Manager of the Guernsey Biological Records Centre.

24. EFFECT OF CLIMATE CHANGE ON MOTH SPECIES AND ACTIVITY IN GUERNSEY

Tim Sparks, Ian Woiwod [1] and Andrew Casebow

Figure 24.1 *Moth trap at Raymond Falla House in Guernsey.*

There are few groups of insects that are recorded on a systematic basis, the exception being moths.

Because most moths fly at night and are attracted to light they can be caught in a 'light trap', and for the past 33 years a light trap has been operated each night in St Martins. The moths that are caught are identified and a list of each night's catch is sent to Rothampstead Research Station, where the information is collated with data from other light traps operating throughout the British Isles. These results have been used to assess moth activity in terms of overall abundance, changes in timing (phenology), and changes in the species complement over time.

The relationship between temperature and moth activity

There are more regular continental visitors to Guernsey, and many more occasional Mediterranean visitors than in earlier years. Although a strong relationship with summer temperatures can be seen, there has been no overall increase in the numbers of moths caught on Guernsey. From this we may deduce that:

- warming temperatures have compensated for what might otherwise have been a decline in moths.
- more moths might be seen in the future.
- alternatively the total moth population might remain in balance as some species increase while others decline.

The relationship between temperature and moth numbers suggests that a 1°C increase in summer temperatures would increase numbers caught in this trap by about 300 moths, although this might just reflect greater moth activity at higher temperatures rather than an increase in moth populations (Figure 24.2).

Changes in the timing of moth flight dates

We have examined changes in the timing of moths by looking at the mean capture dates of nine common species in each year (Figure 24.3). Five of these species have been getting earlier over the last 33 years, and this change is greater for spring flying moths than summer flying moths. This is consistent with changes in a large number of insect species across the Northern Hemisphere. Change in the average of these 9 moth species is shown in the following graph. Overall, the mean flight period of these species has advanced by seven days, but varies between species from almost no change to thirteen days. The average flight period of the nine species is related to mean temperatures from January to September with a five-day advance in flight period for each 1°C warming.

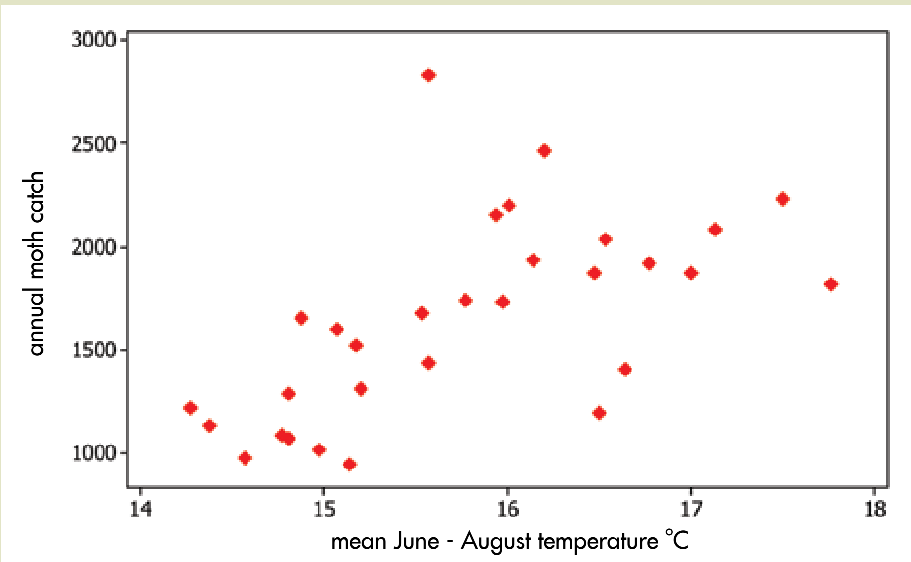


Figure 24.2 *Relationship between the mean June - August Temperature and the Annual Catch of Moths in the St Martins, Guernsey Moth Trap.*

We can conclude that both abundance and activity, and timing of moths on Guernsey, is influenced by temperature. There has already been significant change and both are anticipated to change further in the future.

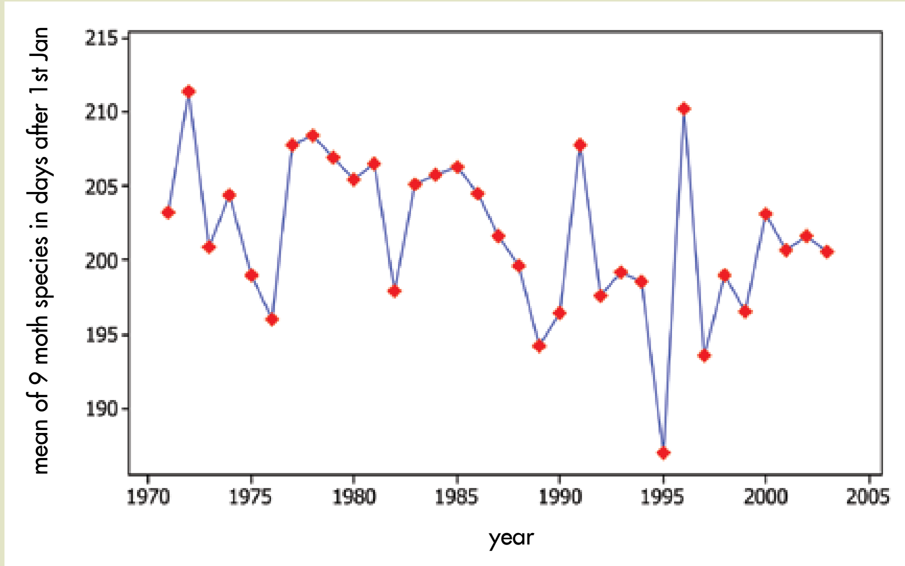


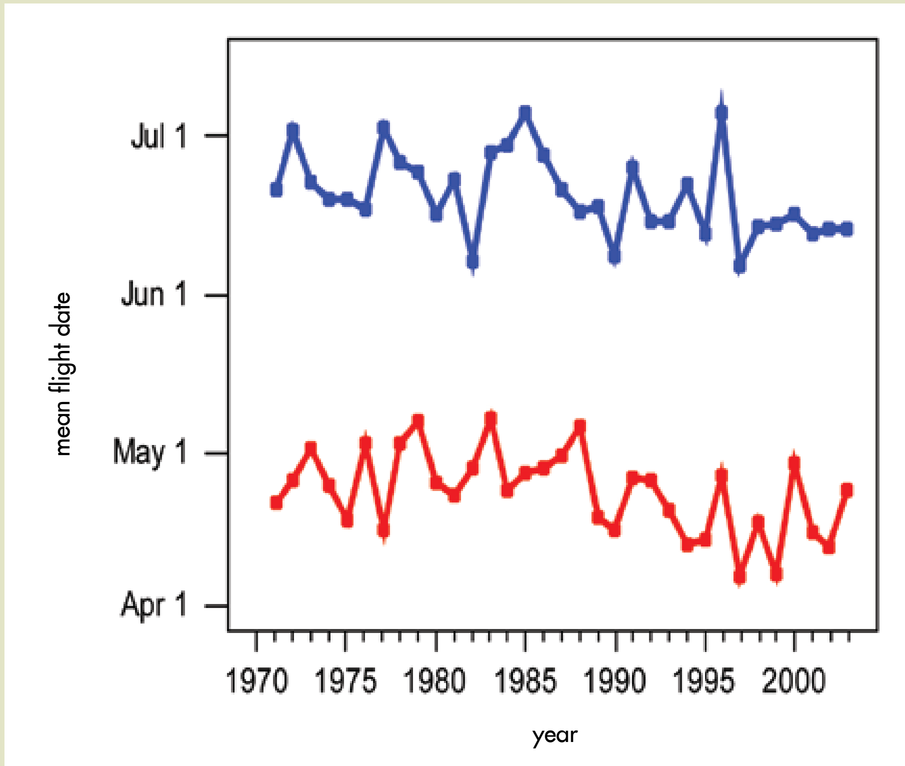
Figure 24.3 *'Mean flight time is getting earlier' (in days after 1st January) of 9 Species of Moths caught in Guernsey.*

Changes in two common species found in Guernsey

Two of our most common species are the White Ermine and the Hebrew Character Moth and are used here for illustration (Figure 24.4). The Hebrew Character Moth flies in March and April and its mean flight date has become 13 days earlier over 33 years. The White Ermine Moth flies from late May to July and its mean flight date has become 12 days earlier over the past 33 years.

References
1. Ian Woiwod is the co-ordinator of the Rothamsted Insect Survey UK network of light traps.

Figure 24.4 Common moth species comparison



Mean Flight Date in Each Year of the White Ermine Moth (blue) and the Hebrew Character Moth (red).

White Ermine Moth.

Hebrew Character Moth.