

# Index

Figures in *Italic*; Tables in **Bold**; information in Boxes indicated by B

- abalone food web 236–7
  - abalone no-take areas 237, 237
  - effects of resurgent sea otters 236–7
  - harvests prone to collapse 236
- Acacia nilotica* subspecies *indica* (spiny acacia) 298, 299
- Acacia* spp. 241
- Acaulospora* 213
- Acer opalus* 211
- Achillea millefolium* 62
- acid rain 2
  - effects of 17
- acorn barnacle 231B
- acorns, ‘mast years’ followed by increase in Lyme bacterium infected ticks 235
- adaptive management 186
- Aedes aegypti*
  - transmission of yellow fever 235
  - vector for dengue fever 307, 308
- Aedes albopictus*
  - failure to replace *O. triseriatus* 236
  - transmitter of dengue fever in Hawaii 235
  - vector for dengue fever 307, 308
- African witchweed (*Striga asiatica*), eradication campaign, eastern USA 142–3
- Agent Orange 150
- agricultural intensification 17–18
  - places pressure on agrosystems 253
  - risks to biodiversity 51–2, 283–4
- agricultural land
  - marginal, available for ‘re-wilding’ 13
  - tropical, abandoned in Panama 62–3, 64–5, 209
- agricultural landscape, management a multidisciplinary endeavor 283–5
- agricultural weeds
  - early-successional, *r*-selected 219
  - greater richness in organically farmed wheat fields 274
- agriculture
  - arable farming 274, 274
  - change in practices can turn native species into pests 141
  - and ecosystem health 253
  - effects of increasing intensity 32
  - and habitat degradation 17–18, 18, 19
  - intensive 2, 245–7, 257, 276, 284
  - minimizing fertilizer input and nutrient loss 245–7, 257
- agroecosystems, sustainable 245–9
  - constructing wetlands to manage water quality 247–8
  - managing lake eutrophication 248–9, 250
  - stopping caterpillars eating broccoli 245
- agroenvironmental subsidies 53
- Agrostis capillaris*
  - cultivar ‘Goginan’ (acidic lead/zinc wastes) 49
  - cultivar ‘Parys’ (acidic copper wastes) 49
- Aira caryophylla*, restricted to dry, nutrient-poor soil 50–1, 52
- Alabama leafworm (*Alabama argillacea*)
  - development of resistance to chemical pesticides 162
  - primary cotton pest 151
- Alaska, Exxon Valdez incident 17
- alder (*Alnus*) 97
- algae 231B, 240
  - control of nuisance blooms in lakes 256

- algal biomass, highest in streams with  
brown trout 240–1, 241
- aliens, unwanted 41–6, 55, 141  
alien plants, British Isles 41, 41, 42  
alien plants, Czech Republic 68–9, 69  
disrupted ecosystems make invasion  
easy 44–6  
ecological niche modeling 42–3  
establishment largely dependent on niche  
requirements 42  
*see also* invaders; invasions
- alleles, dominant or recessive 114B
- allelochemicals 3
- Alliaria petiolata* 221
- Allium* spp., pest and food 141
- allogenic succession 204, 208, 224
- Alnus japonica* 207
- Alpecurus aequalis* 207
- alpine marmots (*Marmota marmota*),  
benefits of constant escapement  
harvesting 183
- Alyssum bertolinii*, heavy metal tolerant 49
- American eels (*Anguilla rostrata*) 255
- amphibians, signs of population decline  
6, 7
- Amphiprion percula*, a mutualist 40B
- Aneilema keisak* 207
- angling 37
- animals, restoration timetable for 208–9  
coastal sand dunes, South Africa 208,  
208  
tidal salt marshes 208–9, 209
- Anopheles gambiae*, transmission of malaria  
in Brazil 235
- aphid alarm pheromone 150–1
- aphid pest (*Rhopalosiphum padi*) 307  
decline in abundance under global  
climate change 303–4, 304
- apples, blemished 141
- Arabis hirsute* 277
- Arctic Oscillation  
likely to change, consequences for  
viability of polar bears 303  
linked to North Atlantic Oscillation 303
- Arctic sea ice, thinning and reduction  
in 293B
- arctic tern (*Sterna paradisaea*), migration  
from North to South poles 82, 83B,  
105
- Arcto-Norwegian cod fishery 187–8  
low effort and large mesh size gave best  
results 188
- mesh sizes eventually increased 188  
stocks seriously depleted through  
overfishing 189
- Ardisia crenata*, experimental inoculation  
with mycorrhizal fungi 44
- Argentine ants  
development of niche model, future  
predictions of distribution 27–8B,  
300, 300  
found on every continent except  
Antarctica 300  
unpleasant consequences for biodiversity  
and domestic life 300
- armadillo (*Priodontes maximus*) 271
- Arnhem Land, aboriginal fire regime  
contrasted with typical modern  
pattern 218–19, 219  
Dukaladjarranj vs. Kakadu National Park  
species diversity 218  
fire-sensitive vegetation remained well  
represented 218  
planned burning to provide green forage  
for game animals 217, 219
- Artemisia gmelinii* 296B
- Artemisia scoparia* 296B
- aspen (*Populus tremula*) 97
- Aster oblongifolius* 216
- atmospheric composition and climate  
increase in atmospheric CO<sub>2</sub> 18, 19, 20,  
32  
observed changes 293B  
observed ecological consequences 293B  
observed physical environmental  
consequences 293B  
*see also* greenhouse gases
- Atriplex prostrata*, halophytic 50
- augmentation biological control  
inoculation 154–5, 158–9  
inundation 154–5, 159–60
- Australia  
Arnhem Land, aboriginal fire regime  
contrasted with typical modern  
pattern 218–19, 219  
Bongil Peninsula, invader-dominated  
sand-mined sites 210  
effect of climate change on some butterfly  
distributions 298  
IPM used against an invasive weed  
166–7  
koalas at risk 120–2  
largest reserves on unwanted land  
13, 13

- marsupials, extinct or endangered 73, 73  
 New South Wales, effects of logging in *Eucalyptus* forest 97–100  
 South, southern emu-wren conservation 267–8  
 southwestern, rufous bristlebird threatened by habitat loss 46–7  
 Western, minimum number of sites to include all fish biodiversity 269, 280  
 Austria, grassland study in meadows 52–3  
 autogenic succession 204B, 224–5  
   primary and secondary 204B, 225  
*Bacillus thuringiensis* (Bt)  
   genetically engineered to produce novel combinations of endotoxins 164  
   in inundation biological control 159  
   two strains effective against malaria, *israelensis* and *sphaericus* 164  
   widespread concern over insertion into GM crops 159  
*Balanus balanoides* 40B  
 baldy cypress swamp (*Taxodium distichum*) 92  
   seeds short lived 92  
 baleen whales, migration to Antarctic 83B  
 ballast water, source of many alien species 92–3  
   compulsory to dump in open ocean (Great Lakes) 93  
   other possible cleaning methods 93  
 banana poka (*Passiflora tarminiana*), serious threat to Hawaiian high elevation forests 156  
 Barents Sea study, showing biomagnification of chlordane 148  
 barn swallows (*Hirundo rustica*), and a positive NAO index 301, 302  
 barnacles, coexistence of 40B  
 barndoor skate (*Dipturus laevis*) 75  
*Bashania fargesii*, panda food 24B, 85, 86  
 bats 97–100, 253  
   activity and species richness assessed, southern England 253  
   community recovers well within 15 years of logging 99–100  
   comparison of activity, logged and unlogged forest patches 98–100, 99  
   as ecosystem health indicators in agricultural soils 253  
   essential maternity roosts 100  
   importance of trackways as dispersal pathways for feeding 98  
   may be favored by some forestry practices 97  
   species richness highest on forest tracks 98  
 bearded vultures (*Gypaetus barbatus*)  
   important variable, biomass of ibex 275  
   reintroduction program for 275–6  
*Beauveria bassiana* 159  
 bees, native, pollination services of 103–4  
   maximum foraging distance 103–4  
 beet army worm (*Spodoptera exigua*) 152  
 behavior management 89  
*Bellis perennis* 50, 52  
 benzoin gardening in Sumatra 216–17, 225  
   indigenous people know range of uses for forest plants 217, 218  
   tapping trees of genus *Styrax* 216–17  
   three categories of garden and tree species richness 217, 218  
*Berteroa incana* 219  
 big-horn sheep (*Ovis canadensis*)  
   long-term population records in desert areas 116  
   smaller the population greater risk of extinction 116, 116  
 bigeye tuna 238  
 bioclimatic niche modeling, *Protea* species in Cape Floristic Region 297–8, 297  
 biodiversity 4, 287  
   in Berlin 277  
   can be a matter of economics 52–3, 53  
   compromised by human actions 61  
   consequences for in regions fulfilling economic potential 6–7  
   ecosystem function and ecosystem services 7–10  
   regional, depleted by intensive agriculture 284  
   selecting new reserves for 279  
   unwanted 13–14  
 biodiversity change, principal drivers 11–12, 12  
 biodiversity conservation  
   designing reserve networks for 277–80, 284B, 287  
   possible in big cities 277  
   relevance of Island Biogeography Theory 264B

- biodiversity crisis 4–20, 32
  - scale of problem 6–7
- biodiversity hotspots 265B, 277, 278
- biodiversity loss 2, 312
  - awareness of 8, 9
  - causes 32
  - drivers of, the extinction vortex 11–12
  - through agricultural intensification 51–2, 283–4
  - tropical forest in Panama 62–3
- biodiversity managers, climate change a problem for 309–10
- biological control agents 25B, 162–5
  - occasional use of vertebrates 157–8
  - unwanted outcomes 160–1
- biological pest control 143, 154–61, 167, 168
  - augmentation 154–5, 158–60
  - conservation biological control 154, 156–8
  - importation of a natural enemy 154, 155–6
  - introduction/augmentation of enemies of target pest 145B, 146B
  - when it goes wrong 160–1
- biological pesticides 154–5, 159–60
- biological pollution, invasions as 96
- biomagnification 147
  - of DDT and related products 147–8, 148
- biomanipulation, managing eutrophication 248–9, 250
- biosecurity managers, animal invaders 241, 256
- biosecurity precautions 14, 28B
  - routine in many parts of the world 92
- biosecurity strategies, national 96
- birch (*Betula* spp.) 97
- bird biodiversity
  - recovery after logging 99–100
  - relative importance of extinction drivers 11, 11
- bird populations
  - dispersal, migration and wind farms 82
  - uptake of GM technology impacts on weed abundance 133, 133
- birds
  - access to, consequences for broccoli 245, 246
  - British, species in decline 6, 7
  - extinctions 11, 11
  - invasion success 66–7
  - migrating and dispersing, threatened by wind farms 100–1
  - migratory, challenged by global climate change 301
  - non-migrating, powers of movement
    - important for future distribution 302
  - vulnerable to predation of eggs and young and nest parasitism 268–9
- bison (*Bos bison*), grazing in shifting prairie mosaic 207
- black fly (*Simulium damnosum*)
  - larva control program 162–3
  - strategy, rotating range of pesticides 163, 163
- black guillemots (*Cephus grylle*), evidence of biomagnification 148
- black rockfish (*Sebastes melanops*), larvae from older females 189, 189
- black-legged kittiwake (*Rissa tridactyla*) 102
- black-throated diver (*Gavia arctica*), nonmaneuverable and vulnerable 102
- bog restoration 89–91
- boll weevil (*Anthonomus grandis*), primary cotton pest 151
- Bombycilaena erecta*, tolerant of grazing 51, 52
- Borrelia burgdorferi* 236
  - bacterium causing Lyme disease 26B, 234
  - white-footed mouse, efficient transmitter to ticks 235
- botanicals 147, 167
- Bothriochloa ischaemun* 296B
- Brachypodium pinnatum*, tolerates only minimal grazing pressure 51, 52
- bracken fern (*Pteridium aquilinum*), spreads by underground rhizomes 83B
- British Isles, alien plants 41, 41, 42
  - many arrive from similar climatic locations 41, 42
  - more found in disturbed habitats close to transport centers 41
- broccoli (*Brassica oleracea*), predation by caterpillars 245
- brown trout (*Salmo trutta*)
  - alter energy and nutrient flux 240–1
  - change behavior of grazing herbivorous algae 240
  - fare better in floods than native fish 45

- an invasive species 37  
 predation by 40B  
 brown-headed cowbird (*Molothrus ater*) 268  
 bushmeat harvest, tropical forests  
   significant threat to biodiversity 196  
   vital food resource for local people 197  
 butterflies  
   Australian, effect of climate change on  
     distributions 298  
   first aid for 222–3  
 by-catch  
   and extinction risk 185  
   monitoring of 185–6  
  
 C:N ratio 234B, 244  
 cabbage loopers (*Trichoplusia ni*) 152  
 Cache River floodplain, Illinois, possible  
   restoration of baldy cypress  
   swamp 92  
 cacti, Mexican, reserves in wrong  
   place 309–10  
*Caesalpinia violacea* 214  
 California  
   abalone population, human harvest and  
     sea otter predation 236–7, 237  
   biological reserves, Central Valley 310,  
     310–11  
   Channel Islands, outfoxing the  
     foxes 130, 130  
   forest fires 203, 226  
   invasions and failed introductions of fish  
     in catchment areas 70–1  
   northern, role of native bees in  
     watermelon farms 103–4, 103, 104  
   successful eradication of *Terebrasabella*  
     *heterouncinata* 142  
   Californian red scale insect (*Aonidiella*  
     *aurantii*) 158  
   *Callitris intratropica* woodlands 218  
   *Callophrys affinis* 223  
   *Calophyllum longifolium*, survives well in  
     *Saccharum* grassland 63–4  
   Canada lynx (*Lynx canadensis*)  
     clear-cutting beneficial in long term 222  
     occurs in areas with regenerating  
       forest 222  
     specialist predator of snowshoe  
       hares 221  
   *Canis simensis* (Ethiopian wolf) 123–6  
   canonical correspondence analysis 45, 45  
   Cape Floristic Region, South Africa 297B  
     conservation planning for 279–80  
     ‘fynbos’ 297–8, 297  
     irreplaceability analysis 279, 281  
   *Carapa guianensis*, survives well in  
     *Saccharum* grassland 63–4  
   carbamates 149, 149  
   carbon addition, lowers soil nitrate  
     levels 244, 245  
   carbon dioxide (CO<sub>2</sub>) 18–20  
     indirect and direct effects on plant  
       performance and distribution 298  
     sources and sinks 19–20, 20  
   Caribbean black-striped mussel (*Mytilopsis*  
     *sallei*), blunderbuss approach to  
     eradication 142  
   carrying capacity 112B, 123–6, 175B,  
     176B  
   Carteret Islands, disappearing 291  
   *Chalinobus motia* 99  
   chalk grassland species, plotting mean  
     locations and variance 50–1, 51–2  
   *Chamaecytisus supinus*, tolerates only  
     minimal grazing pressure 51, 52  
   Channel Islands (Californian coast)  
     long-term records of birds indicate  
       minimum viable population 116  
     outfoxing the foxes 130, 130  
   chemical pesticides 146–54, 167  
     undesirable outcomes argue for  
       precautionary approach 154  
     use in poorer countries 154  
   China, giant pandas 83B, 85–6, 86  
     design of nature reserves for 24B  
   Chinese bush clover (*Sericea lespedeza*),  
     native and potentially invasive 42,  
     43, 43  
   chitons 231B  
   chlordanes, biomagnification of 148  
   chlorinated hydrocarbons 147–8, 148, 149,  
     151  
   *Chrysanthemum* spp., pyrethrum from 147  
   *Chthamalus stellatus* 40B  
   cityscape ecology 277, 287  
   classical biological control (importation of  
     natural enemy) 155–6  
   climate change 4  
     caused by CO<sub>2</sub> 17  
     caused by greenhouse gases 293B  
     future, ecological consequences  
       of 293B, 296B, 297B  
     likely effect on European ecosystem  
       services 307–8

- climate change (*cont'd*)  
 modification of interactions among  
 species 306  
 power to change disturbance  
 frequency 306  
 predicted to affect successional end  
 points 296B, 306  
 predictions for twenty first  
 century 293B, 294–5B  
 sociopolitical scenarios 30, 31  
*see also* global climate change
- climate change modeling 291  
 changes to water stress in Europe 308,  
 309  
 including SHIFT, of sweetgum 302–3,  
 302  
 large river catchments, effects in 308  
 positive effect on European  
 vegetation 308  
 predicted twenty first century  
 changes 293, 294–5B  
 simulated world distribution of  
 biomes 296B
- climate change predictions 297–303  
 based on community–ecosystem  
 interactions 306–8, 312–13  
 based on ecology of individual  
 organisms 297–303, 312  
 based on landscape ecology 313  
 based on theory of population  
 dynamics 303–5, 312  
 life history traits and the fate of  
 species 300–3  
 niche theory and conservation 297–8,  
 297B  
 niche theory and invasion risk 298, 299,  
 300, 300
- climate envelope models 40B  
 used to indicate future species  
 occurrences 293B, 297B, 312
- climate matching 40B, 44
- climate models 40B, 44, 312  
 climate change models 291, 293,  
 294–5B, 296B, 302–3, 302, 304, 308
- climatic conditions, year-to-year vagaries  
 in 179–80, 184
- coastal sand dunes, South Africa  
 millipedes colonize spontaneously  
 regenerating dunes 208, 208  
 recovery from opencast mining 208  
 successional pattern in dung beetle  
 community 210
- Cochlospermum vitifolium* 214
- cod (*Gadus morhua*)  
 Arcto-Norwegian cod fishery 187–8  
 North Atlantic, decline in maturity  
 size 26B, 192, 193  
 outcomes of climate change  
 models 304, 305  
 shows evidence of biomagnification 148  
*see also* Newfoundland cod fishery; polar  
 cod
- Colias eurytheme* 223
- Colorado pikeminnow (*Ptychocheilus lucius*)  
 present distribution 53, 54  
 rarity due to river bed accumulation of  
 fine sediment 53, 54
- coltsfoot (*Tussilago farfara*), an invader 60
- Columbia, newly discovered rice virus 141
- commercial whaling, strictly  
 regulated 198
- common skate (*Dipturus batis*) 75  
 locally extinct 185
- communities  
 composition affected by  
 disturbances 303, 312–13  
 patch dynamics concept 263B  
 some richer in species than others 265B
- community ecology 22, 26–7B, 33  
 and concept of ecological  
 succession 203  
 food web theory 22, 26–7B  
 succession theory 22, 26B
- community groups, confronting a  
 sustainability issue 27B, 29–30
- competition, role in reducing fundamental  
 niche size 40B
- competition–colonization trade-off 204B,  
 225  
 in Panama and Costa Rica 209
- competitiveness 77
- complementarity 279, 280, 288  
 complementarity analysis in Western  
 Australia 279, 280
- conifers, invasive, in the USA 23B, 66, 67
- conservation arguments, in cost–benefit  
 terms 28
- conservation biological control 154,  
 156–8
- conservation genetics 127–30  
 genetic rescue of the Florida  
 panther 128  
 outfoxing the foxes 130, 131  
 the pink pigeon 128–9, 129

- reintroduction of a 'red list' plant  
129–30, 130
- conservation management  
and food webs 239, 240  
information used to define adequate  
management 50, 51, 52  
knowledge of intricacies of food  
webs 239  
lessons from emu-wren problem 268  
one large or several small reserves  
264B  
painful decisions about priorities 130–1
- conservation planning  
for Cape Floristic Province, South  
Africa 279–80  
regional or national scale 279
- constant escapement, in space 183–4  
spatial controls on fishing and  
hunting 183
- constant escapement, in time 182–3  
appropriate for annual species 183  
strategy used for the *Loligo* squid 183,  
183
- coral reefs  
cold water, destruction by bottom  
trawling 17, 28  
protection against tsunamis 230–1  
use of dynamite 17
- corncrake (*Crex crex*), declining 113
- cost–benefit economic analyses, for  
estimates of EIL and ET 143–4B
- Costa Rica, migratory behavior of  
three-wattled bellbird 84–5  
complex behavior poses big challenges  
for managers 84–5
- Costelytra zealandica*, became a pest 141
- costs, fixed and variable 194
- Cotesia plutellae*, parasitoid 165, 165
- cotton  
emergence of secondary pests 151  
example of pesticides gone wrong 151,  
152  
mass use of organic insecticides 151
- cotton boll worm (*Heliothis zea*) 152
- cottony cushion scale insect (*Icerya  
puchasi*)  
and first use of DDT in California 165  
importation of two candidate  
enemies 155  
long-term outcome, both enemies are  
necessary 155
- Crataegus monogyna* 211
- crop plant pests  
the most costly 14, 15  
*see also* pests
- Cryptochaetum* sp. 155
- CSR concept 61B, 71, 77  
competitive strategy (C) 61B  
ruderal strategy (R) 61B  
stress-tolerant strategy (S) 61B
- Cuba, spiny lobster fishery  
determination of long-term maximum  
profit 194  
effort (boat fishing days) 195  
previously managed according to biomass  
yield 194
- cultural eutrophication 247
- cultures, identity can be dependent on  
native flora and fauna 224
- cyclamen mites (*Steneotarsonemus pallidus*),  
target pest resurgence 151
- Czech Republic, transport, release and  
establishment of alien plants 68–9,  
69
- data-less fisheries management 186
- DDT 163  
and related products, problems of toxicity  
and environmental long life 147, 149  
resistance to 162
- decomposer system 232B, 256  
secondary production and respiratory  
heat loss 232B
- deer mouse (*Peromyscus maniculatus*),  
primary vector of Sin Nombre  
hantavirus 160, 161
- deforestation, fractures within-forest  
nutrient cycling 234B
- degradation  
of habitat 4, 17–18  
of provisioning services 9  
of regulating services 9–10
- demographic uncertainty 135  
in small population 113B
- dengue fever 235, 307, 308
- developed nations, responsible for climate  
change 291
- diamondbacked moths, parasitoid attack,  
application of botanical  
pesticide 165, 165
- Dianthus monspessulanus* 51, 52
- diclofenac, used for sick cattle 133–5  
and associated vulture deaths 134–5,  
134

- dieldrin 153–4  
*Dipteryx panamensis* 209  
   survives well in *Saccharum*  
     grassland 63, 64  
 dispersal 83B, 301  
   active or passive 83B  
   by clonal growth 83B  
 dispersal behavior 92–6, 104  
   thorough understanding of necessity to  
     managers 96  
 dispersal corridors 207–8, 264B, 270  
   novel dispersal pathways 92  
 dispersal and migration 83–4B, 105, 263B  
   dispersal 83B  
   dormancy 84B  
   migration 83B  
*Distichlis spicata* 208  
 disturbances 203  
   affecting community composition 306  
   and concept of the successional  
     mosaic 205–6B  
   in grasslands 204B  
   open up forest gaps 204B  
   on rocky shores 204B  
   variation in relative importance of  
     species on abandoned plots 206B  
 DNA analysis, can identify closeness of  
   relationships 130  
 dormancy 60B, 64, 77, 84B, 105  
   see also seed-banks  
 dynamic pool models in fisheries  
   management 187–90  
  
 early-successional species 204B, 219, 225  
 Eastern red cedar (*Juniperus*  
   *virginiana*) 215  
*Echinacea paradoxa* 216  
 ecological communities 203  
 ecological consequences  
   of freshwater invaders 240–1  
   observed, of global climate change 293B  
 ecological engineers, changing habitats 3  
 ecological factors, conditions and  
   resources 37–8B  
 ecological niche modeling 39–40B, 39B,  
   42–3  
   climate envelope models 40B  
   climate matching 40B, 44  
   modeling fundamental or realized  
     niches? 44  
   studies of four invasive plants in North  
     America 42–3, 43  
   of sweetgum fundamental niche 302–3,  
     302  
 ecological problems, may have social  
   aspect 56  
 ecological restoration 242–4, 245  
 ecological specialists, vulnerable 72  
 ecological succession 86  
 ecological succession theory 203, 204–6B  
   allogenic succession 204B  
   autogenic succession 204B  
   primary or secondary successions 204B,  
     205B, 206B  
   species traits determine course of  
     succession 204–5B  
   successional mosaic and central role of  
     disturbance, concept 205–6B  
 ecological theory, hierarchical  
   organization 22, 23–8B  
 ecologists, as advocates or advisers xv  
 ecology, meets economics and social  
   sciences xiv–xv  
 ecology and economics, and the  
   sociopolitical dimension 131–3,  
   195–8, 200  
 Economic Injury Level (EIL) 143–4B  
   pest control and economic gain 143–4B,  
     144B  
 economic optimum yield (EOY), and MSY,  
   difference between 194, 194  
 Economic Threshold (ET) 144B  
 economics, traditional, environmental costs  
   not taken into account 28  
 ecosystem ecology 26–7B, 33  
 ecosystem effects  
   of freshwater invaders 240–1  
   of invasive plants 241–2  
 ecosystem health 231, 257  
   in an agricultural landscape 253  
   of forests 252–3  
   of a marine environment 255–6  
   often or partly a social construct  
     154–5  
   of rivers 254–5  
 ecosystem management, pressure, state and  
   management response 252, 253  
 ecosystem processes, possibly responding  
   to biodiversity change 7–8  
 ecosystem properties 8  
 ecosystem provisioning services 9, 230–1,  
   249, 257  
 ecosystem regulating services 9–10, 231,  
   249, 257

- ecosystem services 10, 28, 31, 136–7, 207–8, 230–1, 257  
 contributions of species to 251–2  
 cultural and supporting services 9  
 from intact wetland 251  
 losses to 32  
 lost, determination of real costs possible 29  
 lost through pesticide use 284  
 many degraded by humans 9–10, 252, 257  
 provided by native plants and animals 104  
 provided by vultures 109, 135  
 value of 231, 249, 251–2  
 of the world, estimated total value 29
- ecosystem theory 22
- ecosystems 7, 10, 230  
 abiotic compartments 233B  
 disrupted, make invasion easy 44–6  
 energy and nutrient dynamics in 256  
 natural, destroyed by humans 2  
 unhealthy 252, 257
- eels (*Anguilla* spp.), long-distance one-way migrant 83B
- El Niño events 180, 185
- Elytrigia repens* 219
- emerging infectious diseases 141
- emu-wren (*Stipiturus malachurus intermedius*) 267–8  
 metapopulation in patches of dense swamp 267, 268  
 need for interpatch corridors 207–8  
 optimal management decisions 268
- Encarsia formosa*, used for inoculation 158
- endangered species 239, 286, 287  
 dealing with 109, 110, 110–13B  
 plants, found in city lawns and gardens 277  
 population of 262  
 relevance of successional theory to 221–4  
 restored to locations where extinction occurred 89
- endangered species conservation 46–9, 55, 108–38  
 historical reconstructions help identify best reserve sites 49  
 Monarch butterfly 46–7  
 setting aside areas where exploitation is restricted/prohibited 46  
 translocation of the takahe 23B, 48–9
- endemism hotspots 277
- enemy-interaction theory 215–16, 225
- energy flow  
 general patterns of 233B  
 ocean food web, central north Pacific 238
- English pasture, recovery to species-rich meadow 208
- entomopathogenic nematode worms, as biological control agents 159–60
- environmental factors, influencing birth, death, migration rates and  $\lambda$  110–11B
- environmental impact, of human population density and technology 3–4
- environmental issues  
 nearly all have a sociopolitical angle 29–30, 31, 33
- environmental problems, risky to assume availability of technical fixes 21
- environmental uncertainty 135  
 in small population 113B
- epidemiology theory, size of epidemics and intervals between 123–4
- Equilibrium Population 144B, 144B
- Eryngium campestre*, defence against grazing 51, 52
- Ethiopean wolves, dogged by disease 123–6  
 carrying capacity of each occupied patch 123–6  
 critically endangered 124  
 domestic dogs reservoir of rabies 124  
 female dispersion 124  
 live in close-knit, male biased packs 124  
 population viability sensitive to female recruitment to packs 123–4  
 potential of vaccination intervention to limit epidemics 125
- Euglandina rosea*, biological control agent disaster in Polynesian islands 160  
 unsuitable, generalist diet 160
- Euphorbia maculata* 219
- European hare (*Lepus europaeus*) 276
- European rabbit (*Oryctolagus cuniculus*) 140
- European stem borer (*Dioryctria sylvestrella*), moth caterpillar 272

- eutrophication  
   cultural 247  
   and excess nutrients 233B  
   *see also* lake eutrophication
- exotic species  
   abundance and richness declines during  
     succession 221, 221  
   lost in forests due to canopy  
     closure 221  
   newly arrived, eradication of 142
- exploiter mediated coexistence 242–3, 244
- extinction 4  
   of birds 11, 11  
   chances of 110  
   humans adding to causes 109, 110  
   local 264B, 270  
   uncertainty and risk of 113B  
   vulnerability to 71–2
- extinction drivers 11, 32
- extinction hotspots 277
- extinction rates  
   difficult to establish 6  
   natural 6
- extinction risk 185  
   assessment from correlational data 113, 115B, 116  
   categories of (IUCN Red List) 5B  
   classification 5B  
   economic extinction occurs before  
     ecological extinction 185  
   of endemic species estimated 308–9  
   fairy shrimps, California 310, 311  
   high, Cape Floristic Region 297  
   highest for large-bodied, *K*-selected  
     species 73–4, 73, 116  
   increase in 298  
   skates and rays 74, 75  
   species traits as predictors of 71–7
- extinction vortex/vortices 11, 136  
   progressively lower population size to  
     extinction 115B, 115B
- extinctions  
   modern 16  
   prehistoric 14, 16
- Exxon Valdez* (oil tanker), 1989  
   incident 17
- facilitation, by early species 205B
- facilitation theory 210–15, 225  
   nurse plants 210–13
- fairy shrimp (*Branchinecta* spp.) 310, 311
- fairy shrimp (*Streptocephalus vitreus*),  
   dormant phase 60B
- fairy shrimps, inhabitants of temporary  
   ponds 310, 311  
   current distribution of protected areas,  
     California 310, 311  
   different niche requirements for different  
     species 311  
   variation in  $F_{\max}$ , current climate  
     conditions 310, 311
- Falkland Islands, constant escapement  
   strategy for *Loligo* squid 183, 193
- Falsistrellus tasmaniensis* 99
- Fargesia spathacea*, panda food 24B, 85, 86
- farm animals, nitrogen-rich waste  
   from 247
- farmed habitat, restoration for hares 276, 277
- farmers, use of honey bees 103
- fat hen (*Chenopodium album*), suitable to  
   show GM sugar beet effects on  
   weed–bird interaction 132–3
- Fender's blue butterfly 117  
   probability of population  
   persistence 117, 118
- ferrets (*Mustela furo*), imported into New  
   Zealand to control rabbits 140–1
- fertilizers 253  
   heavy use 2, 17–18, 19  
   indiscriminate use should cease 21  
   runoff from fuelling ocean dead  
     zones 247  
   and sustainability 21  
   tools to minimize loss from the  
     land 246
- Festuca ovina* 50, 52
- Festuca rubra* 62  
   cultivar 'Merlin' 49
- fires 64, 203, 225  
   burning brush piles in Missouri 215–16  
   creating successional mosaic benefiting  
     hunters 217–19, 219  
   effects on tropical dry forests 213  
   now less frequent but more intense 206  
   *see also* forest fires
- fish  
   effect of size on quality of  
     offspring 189–90  
   food web consequences of  
     harvesting 238–9  
   harvesting in the future 304  
   influenced by high river discharges 53

- management by fixed quota 178–81
- survival affected by increased sea temperature 304, 305
- see also shark species; skates and rays
- fisheries collapses
  - from overfishing 184
  - unfavorable climatic conditions 179–80, 180, 184–5
- fisheries management, dynamic pool
  - models 187–90
  - Arcto-Norwegian cod fishery
    - example 187–8
  - management measures, input controls or output controls 190
- fisheries managers 304
  - use of ecosystem-based fisheries models 238, 238
- 'fishing down marine food webs' 239, 257
- fishing industry, a keystone predator 238
- fixed effort, management by 177–8B, 178B, 181–2, 199
  - Pacific whiting 181
  - Saiga antelope 181–2
- fixed quota, management by 176–7B, 177B, 178–81, 199
  - of fish 178–80
  - of moose 180–1
  - setting of quota for the year 178–9, 179
- flood protection 284
- Florida panther (*Puma concolor coryi*),
  - genetic rescue of 24–5B, 128
  - cougar ancestry, dramatic reversals of undesirable traits 128
  - suite of undesirable traits 128
  - translocation of individuals from another subspecies 128
- flower-visitation webs 214
- fluoracetate (basis for pesticide 1080) 163
- flying squirrel (*Pteromys volans*) 97
  - core breeding habitat 97
  - dramatic decline in Finland 97
  - favors spruce-dominated forest 97
  - optimal breeding habitat
    - recommendations 97
  - typical breeding and dispersal landscape 98
- food or feeding techniques, novel, adoption by birds 210
- food web theory 22
  - and human disease risk 26–7B, 234–6
- food webs 230, 256
  - aquatic, affected by leaching fertilizers 245–6
  - and climate change 313
  - and conservation management 239, 240
  - direct and indirect effects in 231B, 307
  - and harvest management 234–9
  - ocean, central North Pacific 238–9, 238
  - top-down and bottom-up control 232B, 256
- food webs and pathways of energy and nutrients 231–4B
  - direct and indirect effects in food webs 231B, 307
  - ecological energetics 232B
  - ecological stoichiometry 233–4B, 241, 256
  - nutrient dynamics 232–4B
  - strong interactors and keystone species 231–2B
- food-web interactions 307
- forbs 242
  - in grassland restoration 62, 63
  - morphological defences to grazing 51, 52
- forest fires
  - California 203, 226
  - Indonesia 19, 20
- forest fragmentation, variation in wood thrush fundamental rate of increase  $\lambda$  268–9, 269
- forest health, potential value of predatory soil mites as indicators of 253, 254
- forest improvement, willingness to pay for 276
- forest patches
  - different harvest values, Peruvian forest 271, 272
  - linking forest fragments 213
  - logged and unlogged, bat activity in 98–100, 99
  - vulnerability of birds living on edges of 268–9
- forested wetlands, much lost to agriculture 91
- forestry 190–1
  - a boost for developing countries 305, 306, 306
  - plantation forestry in the landscape 272–3
  - planting of more appropriate trees 305
  - sustainable harvesting of New Zealand beech forest 190–1

- forestry management 105
- forests
- community forest concessions 173, 174
  - dieback and global warming 305, 306
  - ecosystem health of 252–3
  - gaps caused by disturbances 204B
  - landscape management in 271, 272, 287
  - natural, protection for future generations 173–4
  - regenerating, home to lynx and snowshoe rabbit 221–2
  - using succession to control invasions 220–1, 226
  - see also Mediterranean forest; tropical dry forests; tropical forests
- fossil fuels
- causing atmospheric pollution 17
  - increase in atmospheric CO<sub>2</sub> 18, 19, 32
  - indiscriminate use of threatens sustainability 21
  - oil pollution 17
- French pine plantations, attacks by
- pests 272–3, 273
- fundamental niche 53, 55
- of hares 276
  - many dimensions 38–9B, 38B
  - sand shrimp (*Crangon septemspinosa*), two-dimension niche 38B, 39B
  - summary of organism tolerance and requirements 38B
  - of sweetgum, modeled 302–3, 302
- fur seals (*Callorhinus ursinus*), anticlockwise predator–prey spiral 195, 196
- fybos vegetation, South Africa
- assessment of extinction risk 308–9
  - extinction risk as result of habitat loss 297
  - Protea* species, possible gains and losses 297–8, 297
- Galaxias anomalus*, fundamental niche 45–6
- Galaxias depressiceps*, fundamental niche invaded 40B
- Galaxias* spp. 240
- gallflies (*Urophora* spp.) 160, 161
- garlic mustard (*Alliaria petiolata*) 43, 43
- adversely impacts rare native insects 42
- genetic diversity
- loss of in small populations 114B
  - lower in small populations 127
  - and population dynamics 270
- genetic drift, in small populations 114B, 136
- genetic mixing, reduces inbreeding effects 127, 128–30
- genetic modification 131–3
- control action of *Bacillus thuringiensis* (Bt) 159
  - use of glyphosphate on crops 149
- genetic variation 114B, 136
- determined by natural selection and genetic drift 114B
  - loss of in small populations 114B
- genetics of small populations 114–15B, 136
- inbreeding depression 114–15B, 136
  - loss of genetic variation 114B
  - relative importance of genetic and demographic risks 115B
- Genipa americana* 209
- Germany
- development of species sensitivity index for some seabirds 101–2
  - North Sea, areas of concern about wind farms 102, 102
  - wind farm sensitivity index (WSI) 102
- Ghana, bushmeat consumption vs. fish consumption 197, 197
- harvests inextricably linked, risk of overexploitation 197
- giant pandas (*Ailuropoda melanoleuca*), conservation of 85–6
- core panda habitats 86, 86
  - elevational migrants 85
  - extreme dietary specialists 85–6
  - migratory behavior and design of nature reserves for 24B
  - nature reserves are insufficient 86
  - seasonal variation in feeding habits 83B
- Gibraltar, installation of two land-based wind farms 100–1, 100
- important migration bottleneck between Africa and Europe 100
  - migrating soaring birds not badly affected 101
  - mortality rates 101
- Gigaspora* 213
- glaciers and icecaps, melting 18–19
- glasshouses, inoculation biological control in 158–9
- glaucus gull (*Larus hyperboreus*), shows evidence of biomagnification 148

- Gliricidia sepium* 214
- global climate change 8, 11, 18–20, 22, 290–314
- effects on tree growth and forestry yields 305, 306, 306
  - observed changes to atmospheric composition and climate 293B
  - observed ecological consequences 293B
  - observed physical consequences 293B
  - predicting ecological effects of 292–7B, 312
  - r*-species and habitat generalists less vulnerable 301
  - see also climate change
- global extinction 113B
- global hotspots 287
- Cape Floristic Province, South Africa 279
  - identification to guide international conservation efforts 277, 279
- global mean sea level, rise in 293B
- globalization, how to manage invasions under 96
- Glomus* spp. 213
- glyphosate, genetic modification in certain crops 149
- golden whistlers (*Pachycephala pectoralis*), declined after logging 72
- goose barnacle (*Pollicipes* sp.) 231B
- gorse (*Ulex europaeus*) 223–4
- grass genotypes, metal tolerant 49
- grassland
- Californian, change in grass types 242
  - disturbances in 204B
  - using succession to control invasions 219–20
- grassland experiments, Europe 8, 9
- grassland restoration 62, 63
- forbs, good establishment 62, 63
  - grasses 62
  - increasing restoration efficiency 62
  - relating species performance to life-history traits 62
  - to perennial or annual grassland 242
  - see also prairie grassland restoration
- grazer system 232B, 256
- grazing, by zooplankton, fish-induced reduction in 240–1
- grazing intensity, can affect likelihood of invader success 44
- grazing pressure
- 'decreasers' and 'increasers' 77
  - and perennial species 77
- grazing trials, prediction of grazing vulnerability 77
- great auk (*Alca impennis*), globally extinct 185
- Great Lakes of North America, invasions 92–3
- invaders arrived in ballast water 92–3
  - sea lampreys, treated with lampricide TFM 150
  - zebra mussels, devastating effect of 14, 15, 93–4, 241
- Great Lakes–Baltic Sea trade link, biotic homogenization at each end 14
- Great Lakes–Caspian Sea trade route, arrival of the zebra mussel 93
- great tits (*Parus major*), as biological control agents in orchards 157–8
- greater prairie-chickens (*Tympanuchus cupido pinnatus*)
- current populations isolated 114B
  - relationship between population size and genetic diversity 114B
- greenhouse gases 293B, 312
- further rises in and continuing temperature rise 18–19
  - future emissions, varying estimates 30, 31, 33
  - principal causes of increase 19
- griffon vultures (*Gyps fulvus*), deaths in Gibraltar 101
- grizzly bears (*Ursus arctos*), probability of population persistence 270
- growing season, lengthened 293B
- Guazuma ulmifolia* 214
- habitat degradation 2, 32, 71
- by agricultural development 17–18, 18, 19
  - by fossil fuels 17
- habitat fragmentation 12, 71, 73
- vulnerability of shade-tolerant species 77
  - vulnerability of the southern damselfly 87
- habitat loss 4, 12–13, 32, 71
- biggest problem facing threatened bird species 11, 11
  - management response to 13

- habitat restoration 49–54, 55–6
  - agricultural intensification 51–2, 55
  - cost of restoring a species 52–3
  - land reclamation 49–51
  - mined sites 49–51, 55
  - river restoration 53–4, 55–6
- habitat specialists, at higher risk of extinction 73
- habitats
  - continuous, diffusive spread of invaders 96
  - discontinuous, invasion hubs 95–6
  - K*-selecting 61B
  - r*-selecting 61B
- hairy vetch (*Viola villosa*), as a nurse plant to sweetgrass 224
- halibut (*Hippoglossus stenolepis*), alternative to Pacific fur seal fishery 195
- halophytic plants 50
- hare barley (*Hordeum murinum*) 242
- hares (*Lepus europaeus*), restoration of farmed habitat for 276, 277
  - agriculture now too intensive 276
  - habitat availability 276, 277
  - resource availability 276, 277
- harvest management 172–201, 257
  - adaptive management approach 186
  - avoiding the tragedy of the commons 173–4, 198
  - counteracting evolution towards small size 25–6B
  - difficulties in using MSY as basis for 176–7B, 177B, 178–86
  - early maturation a threat to 192
  - ecologist's role is stock assessment 186, 199
  - and food webs 236–9
  - killing just enough 174, 178
  - MSY concept central to 174, 178–86
  - role for nature reserves 183
  - setting aside nonharvested areas for larger fish 192
  - socioeconomic view of 195–8, 200
- harvest management in practice 178–86
  - assessment of MSY, ecologist's role 186
  - evaluation of the MSY approach – role of climate 184–5
  - management by constant escapement 199
  - management by fixed effort 181–2
  - management by fixed quota 178–81
  - species especially vulnerable when rare 185–6
- harvest models recognizing population structure 186–91, 199
- dynamic pool models in fisheries management 187–90
- a forest bird of cultural importance 191
- forestry 190–1
- Saiga antelope, male worth more than female 181–2, 186–7
- harvested populations, evolution of 191–3, 199
  - setting aside nonharvested areas 192–3
  - size-selective harvesting, effects of 191–2
  - trophy big-horn rams, decrease in body size and horns 192, 193
- harvesters
  - exert strong selection pressures on exploited populations 175
  - indigenous, regulations reduce chance of overexploitation 189
- harvesting
  - involves predator–prey interaction 195
  - managing succession for 216–19
  - reduces population below carrying capacity 176B
- harvesting efficiency, and small populations 185
- harvesting effort, effective regulation difficult 16
- harvesting, managing succession for 216–19, 225–6
  - aboriginal burning enhances harvests 217–19, 219
  - benzoin gardening in Sumatra 216–25
- Hawaii
  - customary fishers take only medium-sized fish 189
  - extinction of many endemic birds 40B
- health hazards, excess nitrates in drinking water 245
- hedgehog (*Erinaceus europaeus*) 223
- hemiparasites, used to enhance meadow species richness 243, 244
- herbicides 149, 150, 253
- herbivores
  - influence on succession 215
  - vertebrates, as influential as insects 215
- Heteractis magnifica*, a mutualist 40B
- Heteranthera dubia* 92

- Hieracium pilosella*, aggressive invader in  
New Zealand 50, 52
- historical data sets, long-term, provide  
valuable insights 116
- Homo sapiens* 2–4  
(not) just another species 3, 32
- honey bees (*Apis mellifera*) 103
- horsechestnut leaf-mining moth (*Cameraria  
ohridella*) 158–9
- horticulture in the landscape 273  
brussels sprout study 273  
natural enemies depress pest  
populations 273
- host-specificity testing, expansion of  
recommended 161
- house sparrow (*Passer domesticus*),  
successful invader, more novel  
behavior 67
- houseflies (*Musca domestica*), resistance to  
DDT 162
- human actions, reduced abundance and  
range of many species 110
- human behavior 195–7  
behaving as classic predators 195, 196  
poaching 196, 196  
problem of bushmeat harvest 196–7,  
197
- human disease organisms, imported 14
- human disease risk 230, 234–6, 257, 313  
dengue fever 235, 307, 308  
Lyme disease 26–7B, 230, 234–5, 257  
minimizing of 26–7B  
understanding transmission from wild  
animal populations 235–6
- human health  
and emerging infectious diseases 141  
fertilizers pose risk to 245  
may be compromised by indirect food-  
web effects 160, 161  
pesticides pose risk to 154  
reflects aspects of ecosystem health  
252
- human impact 5, 14  
excreta rarely placed on land of  
origin 247  
felt by different species in different  
ways 76
- human migration, mirrored by megafaunal  
extinction 14, 16, 16
- human population  
expansion causing environmental  
problems 3–4  
greater growth expected in species-rich  
tropical areas 18
- human pressure  
and extinction risk 73  
and fish extinction 72
- Huron, Lake, dispersal of waterfleas via  
regular boat traffic from 95, 95
- Hydrilla verticillata*, native and potential  
invaded distributional areas 42, 43,  
43
- Hyperaspis pantherina*, ladybird beetle  
156  
biological control agent 25B
- Hypochrysops halyetus*, butterfly at  
risk 298
- ibex (*Capra ibex*) 275
- Icaricia icarioides* (Fender's blue  
butterfly) 117, 118  
'immigration potential by wind' 90–1
- Imperata cylindrica*, invasive perennial  
grass 210
- inbreeding depression 11, 114–15B, 127,  
136
- inbreeding, frequent, purges more lethal  
recessive alleles 115B
- Indonesia  
economic cost of deliberate vegetation  
burning 29  
forest fires and atmospheric CO<sub>2</sub> 19, 20
- inoculation biological control  
in glasshouses 158–9  
under field conditions 158
- inorganics 167  
early natural chemical weapons 147
- insect growth regulators 149, 150
- insect pollinators 103
- insecticides  
organic, application to cotton crops 151  
third-generation 150–1  
toxicity to nontarget organisms and  
persistence of 149
- insects for inoculation, from local plant  
material 158–9
- integrated pest management (IPM) 143,  
164–7, 168  
accepts presence of pest not always a  
problem 164  
against an invasive weed in  
Australia 166–7  
against potato tuber moths in New  
Zealand 165–6

- integrated pest management (IPM) (*cont'd*)  
 integrates control measures in a compatible manner 165  
 involves use of computer-based expert systems 165  
 relies on natural mortality factors 165
- intermediate disturbance hypothesis 206B
- International Commission for the Conservation of Atlantic Tunas (ICCAT) 179
- International Whaling Commission (IWC) 198
- interspecific competition 231B
- inundation biological control 159–60  
 bacterium *Bacillus thuringiensis* (Bt) 159  
 fungal agents 159  
 viruses 159
- invader traits, what we know and don't know 71
- invader-dominated community, controlling succession in 223–4
- invaders 3, 11–12, 60  
 favored by present combinations of conditions 45  
 freshwater, consequences of 240–1  
 loss of exotics in forests due to canopy closure 221  
 more in disturbed habitats, fewer in remote areas 41, 41  
 rapid response to, blunderbuss rather than surgical strike 142  
 shade-tolerant, require more active management 221  
 unwanted biodiversity 2, 13–14  
 what we know and don't know about invader traits 71  
*see also* aliens, unwanted
- invaders, pests and diseases, new set of 292
- invaders, predicting arrival and spread of 92–6, 105  
 Great Lakes 92–4  
 invasion hubs or diffusive spread 95–6  
 lakes as infectious agents 94–5  
 managing invasions under globalization 96
- invasion hubs 94–5  
 or diffusive spread 95–6  
 identified for special management treatment 95
- invasion risk-related tariffs 96
- invasion success, predictors of 65–71  
 importance of flexibility 66–8  
 invasive conifers, success for some predictable 66, 67  
 separating invasions into sequential stages 68–71
- invasions  
 Bongil Peninsula, Australia, of aggressive perennial grass 210  
 ecosystem effects of invasive plants 241–2  
 ecosystems consequences of 240–2  
 how to manage under globalization 96  
 spiny acacia in Australia 298, 299  
 successful, and niche theory 37  
 using succession for control 219–21, 226
- IPM *see* integrated pest management
- irreplaceability 279–80, 281, 288  
 irreplaceability analysis, for Cape Floristic Province 279, 281
- Island Biogeography Theory 263–4B, 264B, 286, 313  
 applicable to oceanic islands and habitat islands 263B  
 island size and isolation important 263B  
 relevance to biodiversity conservation 264B  
 and wildlife reserves 269–70
- Italy, marine zoning plan 280, 281, 282–3  
 final plan, for sustainable desires of all interest groups 282, 283  
 maps, factors important to interest groups 281–3, 282  
 permitted or prohibited activities 280, 281
- IUCN Red List of Threatened Species* 5B, 126–7
- Ixodes scapularis* (black-legged tick) 235, 236
- Ixodes* (ticks)  
 carrier of Lyme disease bacterium 26–7B, 234–5  
 life cycle 234–5  
 most abundant host, white-footed mouse 235, 236
- Jacaranda copaia* 63
- Japanese grass (*Microstegium vimineum*), weed of Asian origin 67

- Japanese quail (*Coturnix coturnix japonica*), evolved resistance to DDT 163
- jarrah (*Eucalyptus marginata*) forest  
passerine species and selective logging 72
- Juncus effusus* 207
- K-selected traits 142  
in endangered pine species 61B, 66
- K-selection, skates and sharks 75
- K-strategists, most vulnerable to overexploitation 75
- Kalahari bushmen  
hunting techniques (film) 262  
problem of wildlife reserves 262
- Kenya, Tana River crested mangabey study 118
- kereru (*Hemiphaga novaeseelandiae*) 191  
Maori plans, reduce predation and protect habitat 191  
population viability analysis 191, 192  
shrinking population 191
- kestrels (*Falco tinnunculus*), juvenile deaths in Gibraltar 101
- key concepts xv
- keystone species 231–2B, 256  
sea otter (*Enhydra lutris*) 236–7
- Kincaid's lupin (*Lupinus sulphureus kincaidii*) 117
- koalas (*Phascolarctos cinereus*), an icon at risk 120–2  
modeling of two populations in Queensland 120–2, 120, 121  
potentially threatened nationally 120  
sensitivity analysis 121, 121
- kokako (*Callaeas cinerea*)  
advice to managers 239, 240  
diet shared by rats and possums 239, 240  
nesting success poor due to predation 239
- Korea, central, abandoned rice fields to species-rich alder woodland 207
- lake eutrophication management 248–9, 250  
biomanipulation, top-down control 248–9  
bottom-up control of nutrient availability 248  
reversed by chemical or biological means 248
- lakes  
cultural eutrophication 247  
examples of discontinuous habitat 95–6  
as infectious agents 94–5  
invasion hubs or dead ends 94–5  
managing eutrophication 248–9, 250
- land reclamation, mined sites 49–51  
candidate plants for restoration, fundamental niches 49  
ecotypes having evolved resistance in mined areas 49  
phytoremediation 49–50
- landscape ecology 22, 27–8B, 33, 263B, 313  
important general principles 263–7B  
landscape harvest management 270–1, 272, 287  
marine zoning plan for sustainability 27B  
predicting future invasions due to climate change 27–8B
- landscape perspective 308–11  
fairy shrimps 311  
Mexican cacti 309–10
- landscape theory 263–7B  
determination of species richness 264–5B  
metacommunities and Island Biogeography Theory 263–4B  
metapopulations 263B  
partitioning of species richness, local and landscape scales 265–6B, 267B  
patches, patch dynamics and landscapes 263B
- landscapes 285–6  
agricultural, management of 283–5  
arable farming in 274  
patchy, oceanic and terrestrial 270  
regional, envisioning future reorganization 292, 313  
species richness similar in organic and conventional fields 274, 274
- Lantana camara*, successful invader 65, 65
- late-successional species 204B, 225
- latex 173
- leguminous plants 3, 223  
as nurse plants 211–12, 213
- Lemna minor* 92
- Lespedeza davurica* 296B

- lesser white-fronted goose (*Anser erythropus*)  
   alteration of migration route  
     achieved 89  
     knowledge of migratory behavior useful  
       for management 89  
*Leucaena leucocephala* 214  
*Leucanthemum vulgare* 62  
 life-history theory 60–1B  
   the CSR concept 61B  
   life cycles 60B  
   the *r/K* concept 61B  
   species traits 60–1B  
 life-history traits 62  
   and the fate of species 300–3  
   used to make management decisions 60  
 limpets 231B  
*Linepitheme humile* (Argentine ant) 300, 300  
 Loess Plateau, China, secondary succession on 206B  
 logging  
   effects of in a *Eucalyptus* forest 97–100  
   recovery of bat communities after 99  
   selective, and passerine species in jarrah forest 72  
 logistic equation 112B  
*Loligo* squid, constant escapement strategy for 183, 183  
*Lolium perenne*, high tolerance of trampling 50, 51, 52  
 long-nosed skate (*Dipturus oxyrinchus*) 74  
*Lonicera maackii* 221  
*Lonicera tartarica* 231  
*Lotus wrightii* 223  
 lupin (*Lupinus polyphyllus*)  
   an invader 60  
   see also Kincaid's lupin (*Lupinus sulphureus kincaidii*)  
*Lupinus arboreus* 241  
 lygus bug (*Lygus hesperus*) 152  
*Lymantria dispar*, nuclear polyhedrosis virus 159  
 Lyme disease 234–5, 257  
   minimizing risk to humans 26–7B  
   spread by ticks 230, 234–5  
  
*Maculina arion*, large blue butterfly, extinction of 160  
 malaria 164  
   transmission of in Brazil 235  
   and use of DDT 147  
  
 mallard duck (*Anas platyrhynchos*), successful invader 67  
*Mamestra brassicae*, caterpillars pests of brussels sprouts 273  
 management plan for Fiordland region, New Zealand 283  
   bottom-up effort by local community 283  
   concept of gifts and gains 283  
   sustainable middle ground identified 283  
 marine environment, ecosystem health 255–6  
 marine fisheries 257  
   management for MSY difficult to achieve 186  
   truly difficult to manage 174  
 marine protected areas 287  
   benefits for harvest management 184, 190, 270  
   fish density increase may lead to migration 270  
   increase in target species density and size 184  
   modeling movement of 'virtual fish larvae' 270, 271  
   sustainability of abalone harvest 236–7, 237  
 marine reserve design 88  
   bimodal distribution of dispersal distances 88, 88  
   duration of propagules in floating phase 88  
   self-replenishment possible 88  
 marine zoning plans 27B, 280, 281, 282–3  
 marri trees (*Corymba calophylla*) 72  
 marsh wren (*Cistothorus palustris*) 208  
 maximum sustainable yield (MSY)  
   approaches to management 174–86, 199  
   difficulties in use as basis for harvest management 176–7B, 178–86  
   evaluation of and the role of climate 184–5  
   finding the top of the curve 177B, 180, 184  
   putting theory into practice 176B  
   simplification of the approach 174  
   see also constant escapement; fixed effort; fixed quota  
 meadow goldenrod (*Solidago altissima*) 215

- meadow restoration 50–1, 51–2  
 manipulation of the food web 242–3, 244  
 plant–pollinator interactions  
 compared 213, 214, 215
- meadow species 50–1, 51–2  
 cannot use higher nitrogen inputs efficiently 44  
 European springtime flowers, peasant farming areas 60, 153–4
- meadows, species rich, uncommon in  
 European agricultural landscapes 242
- Mediterranean forest  
 restoration of 26B  
 Spain, planting of seedlings under nurse plants, high success rate 210–12
- megafaunal diversity, disappearance of 14, 16, 16
- Melampus bidentatus* 208
- Mendota, Lake, Wisconsin, attempted biomanipulation of 248–9, 250  
 biomass of zooplanktivorous fish declined 249, 250  
 density of two species of piscivorous fish increased 249, 250
- metacommunities 263–4B, 286  
 metacommunity concept 263B
- metapopulation conservation 267–70  
 the emu-wren 267–8  
 endangered species exist as subpopulations 267  
 problem with large carnivores 269–70  
 the woodthrush 268–9
- metapopulation dynamics  
 importance of dispersal and migration 263B  
 may counter local extinction and enhance genetic diversity 270
- metapopulations 263B, 286
- methane 293B
- Mexico  
 overwintering habitat for monarch butterfly 46, 47  
 protected rainforest, carbon storage by one key species 252, 252  
 target pest resurgence 151
- migrants  
 elevational (giant panda) 85  
 one-way (Pacific salmon) 83B
- migration 83B  
 and global climate change 301  
 long distance 83B  
 mass directional movement from one location to another 83B  
 movement on different timescales 83B
- migration and dispersal, lessons for  
 conservation 84–8  
 designing marine reserves 88  
 dispersal of a vulnerable aquatic insect 86–7  
 panda conservation 85–6  
 the three-wattled bellbird 84–5  
*see also* dispersal and migration
- migratory species, attempts to restore populations 89
- Millennium Ecosystem Assessment 22
- millipedes, important role in ecosystem recovery, sand dunes 208
- Mimosa pigra*, invasive weed in  
 Australia 156  
 IPM used against 166–7
- minimum viable population 110
- Mohawk Nation, value sweetgrass for use in basketry 224  
 nearest gathering site too far 224  
 planting sweetgrass with hairy vetch 224
- moi (*Polydactylus sexfilis*), sustainably harvested in Hawaii 189
- molecular (DNA) technology, use of 127, 130, 136
- monarch butterfly (*Daneus plexippus*) 83B  
 critical dimensions of overwintering niche in Mexico 46, 47  
 no-constraint scenario preferred and accepted 46, 47
- Monardia fistulosa* 244
- monocultures  
 and nitrate leaching 246  
 and pest attacks 272–3
- moose (*Alces alces*), realistic quota set 180–1
- mosquitos 257  
 carry many transmittable diseases 235–6
- moth populations, controlled by sex-attractant pheromones 150
- multipurpose reserve design 262–3, 280–5  
 marine zoning 280, 281, 282–3
- Mus musculus*, development of evolved resistance to bromadiolone 163

- Muskoka, Lake  
 development as an invasion hub 95  
 first inland lake invaded by  
 waterflea 95, 95  
 mussel (*Mytilus edulis*) 231B  
 mutualisms/mutualists 213  
 pollination 213, 214, 215  
 positive effects of 40B  
 mycorrhizal fungi, enhance seedling  
 growth 213, 214  
 mycorrhizas 41, 213  
*Myrica faya* 241  
 myxoma virus  
 biocontrol of UK rabbits led to extinction  
 of *Maculina arion* 160  
 evolution of resistance to in  
 Australia 163–4  
 myxomatosis 140
- natural enemies 145B, 152–3  
 adequate distribution of essential 158  
 importation of 154, 155–6  
 parasitism by 272, 273, 273  
 natural habitats, economic value of  
 retention or conversion 249, 251,  
 251  
 coral reefs, sustainable vs. destructive  
 fishing, Philippines 251, 251  
 draining of freshwater marshes for  
 agriculture 251  
 forest conversion to plantations,  
 Cameroon 249, 251  
 logging in Malaysia 249, 251  
 mangrove swamps vs. shrimp farming,  
 Thailand 249, 251, 251  
 natural mortality  
 density-dependence in 191  
 and harvest mortality 190–1  
 natural selection, and genetic  
 variation 114B, 136  
 nature, economic valuation of 28–9  
 nature reserves 292  
 and future fynbos habitat 297  
 for giant pandas 24B, 86  
 a role in harvest management 183  
 in the wrong place? 298  
*see also* dispersal behavior  
 nest parasitism 268  
 net primary production (NPP) 232B  
 New Zealand  
 and the brown trout (*Salmo trutta*) 37,  
 40B, 45, 240–1  
 conservation of the kokako 239, 240  
 Fiordland, ecosystem management  
 plan 27B, 283  
 forest bird of cultural importance 191,  
 192  
*Hieracium pilosella* an aggressive  
 invader 50, 52  
 IPM against potato tuber moths 165–6  
 Kakaunui River, use of Maori Cultural  
 Stream Health Measure  
 (CSHM) 255, 255  
 marine zoning plan for 27B, 283  
 offshore islands, brute-force methods to  
 destroy small weed population 142  
 possibility of dengue fever if vector  
 mosquitos become established 307,  
 308  
 problems of imported ferrets (*Mustela  
 furo*) 140–1  
 proposal for sustainably harvesting  
 mixed beech forest 190–1  
 rabbits, myxomatosis and rabbit  
 calcivirus disease 140  
 rediscovery of giant weta (*Deinacrida  
 mahoenuiensis*) 223–4  
 river managers use macroinvertebrate  
 community index 254  
 success and failures of bird  
 introductions 66–7  
 translocation of the takahe 23B, 48–9  
 New Zealand wood pigeons 191, 192  
 Newfoundland cod fishery, an ecosystem  
 lost 29  
 niche analyses, vulture sightings in Valais  
 region, Switzerland 275  
 niche breadth 52, 265B  
 and behavioral flexibility 73  
 broad 68  
 niche matching, for species success 60  
 niche opportunity 44  
 niche theory 33, 36–58  
 conditions and resources 37–8B  
 and conservation 297–8, 297B  
 the fundamental niche 38–40B  
 and invasion risk 298, 299, 300, 300  
 niche an n-dimensional  
 hypervolume 39B  
 the realized niche 40B  
 restoration ecology 49–54, 55–6  
 and translocation of New Zealand's  
 takahe 23B, 48–9  
 unwanted aliens 41–6, 55

- Nile perch (*Lates nilotica*), Lake Victoria 2, 3, 13
- nitrogen (N)
- minimizing unintended loss from the land 246
  - reasons for ready nitrate losses from land 246
  - in runoff, fueling ocean dead zones 247
- nitrogen oxides NO<sub>x</sub> 17
- nonharvested areas, set-aside, for and against 192–3
- North Atlantic, decline in cod maturity size 26B, 192, 193
- North Atlantic Oscillation (NAO), NAO index would be strengthened by global warming 301, 301
- North Pacific fur seal fishery, fleet size response to seal herd size 195, 196
- northern cardinal (*Cardinalis cardinalis*) 245
- northern corn root worm (*Diabrotica barberi*), evolved resistance to cultural control method 164
- Northern fence lizard (*Sceloporus undulatus*) 216
- nurse plants 210–13
- in restoration of Spanish forest 210–12, 213
- nutrient cycling 233B
- nutrient dynamics 232–4B
- nutrient elements, availability to plants 233B
- nutrients
- can cause oligotrophic lakes to become eutrophic 247
  - enhancement of availability 40B, 44
  - see also nitrogen (N)
- oak tree (*Quercus robur*) 82
- oak trees (*Quercus* spp.) 211
- ocean dead zones 247
- oceans
- management to alleviate runoff problems 247
  - profound changes in 293B, 294B and sea level rise 291
- Ochlerotata triseriatus* (North American mosquito) 236
- Oenothera parviflora* 277
- oil pollution 17
- Onionis spinosa*, defence against grazing 51, 52
- optimal economic yield, not always possible to achieve 198
- ordination 44–5, 45
- organic farming 253, 274
- organisms, individual
- ecology of 22, 23–4B
  - species traits, importance of 23B
- organophosphates 148–9, 149, 151
- Orthezia insignis*, killing St Helena gumwoods 25B
- overexploitation 3, 12, 14, 16–17, 32, 109, 110, 195
- of bushmeat, a risk 197
  - by world's industrial fishing industries 16
  - chance of reduced by indigenous harvesters 189
  - collapse of Newfoundland cod fishery 29
  - in forests 174
  - impacts, coupled to destructive harvesting techniques 17
  - K-strategists most vulnerable 75, 75 and local or global extinctions 185
  - overharvesting, of wild populations 71
  - overstorey reduction and slash mulching (ORSM) 222–3
- Ozark glades, intrusion of fire-intolerant species 215–16
- burning of brush piles bad for Northern fence lizard 215–16
- pacific mites (*Tetranychus pacificus*), target pest resurgence 151
- Pacific Ocean, islands disappearing with sea level rise 291
- pacific salmon (*Oncorhynchus nerka*), long-distance one-way migrant 83B
- Pacific whiting (*Meluccius productus*)
- recruitment and spawning stock estimates 178–9, 179
  - total allowable catch shared 181
- Pakistan, diclofenac, use banned for sick cattle 135
- pampas grass (*Cortaderia selloana*) 142
- Panache, Lake (northern Ontario), future invasion hub 95

- Panama, tropical forest restoration 62–5  
 invasion by *Saccharum spontaneum* 63  
 lack of naturally arriving tree seeds 63  
 large-seeded late successional trees  
 planted by hand 65, 209  
 loss of biodiverse tropical forest 62–3  
 medium or large seed species do  
 best 63–4, 64, 209
- pandas *see* giant pandas (*Ailuropoda melanoleuca*), conservation of
- parasite wasp *Aphytis melinus*, an inoculant  
 in lemon orchards 158
- parasites  
*Giardia* 284  
 as good ecosystem health indicators  
 255
- parasitism  
 by natural enemies of pests 272, 273,  
 273  
 rates increase with area of pasture  
 273
- parasitoid wasp (*Macrocentrus sylvestellae*) 272, 273
- parasitoid wasp (*Venturia robusta*) 272,  
 273
- parasitoids 157, 165, 165, 272, 273
- parrots, assessment of transport, release  
 and establishment 68, 69  
 migratory species not suited to  
 invasion 68  
 species with broader niches more likely  
 to establish 68  
 successful invasions correlated with  
 development of international  
 market 68, 69, 96  
 threatened species do not figure in  
 transport and release 68
- patches  
 with different harvest values, Peruvian  
 forest 271, 272  
 patch dynamics and landscapes 263B
- peat bog restoration 89–91
- peregrine falcon (*Falco peregrinus*), victim  
 of DDE in the food web 134, 147
- periwinkle (*Littorina* sp.) 231B
- Peru, forest successional mosaic 271, 272  
 old secondary forest, largest number of  
 useful plants and animals 271  
 value of agricultural products on cleared  
 land 271  
 wood and medicines most valuable forest  
 commodities 271
- Peruvian anchovy (*Engraulis ringens*)  
 fishery  
 collapse of, overfishing compounded by  
 El Niño events 179–80, 180, 184–5  
 management by fixed quota 179–80
- pest control 151, 245  
 landscape perspective on 272–4, 287  
 physical, California 142  
 on St Helena 25B  
 sustainable in the face of resistance  
 evolution 162  
*see also* biological pest control
- pest eradication or control  
 may not be feasible 142  
 of newly arrived exotic species 142  
 population dynamics theory  
 applied 141, 143–6B  
 to reduce population to Economic Injury  
 Level 143
- pest management 139–71  
 aim of 193–4  
 biological control 154–6  
 chemical pesticides 146–54, 167  
 eradication or control 141–3, 167  
 evolution of resistance and its  
 management 162–4, 168  
 integrated pest management (IPM)  
 164–7, 168  
 pests or pets 140–1
- pesticides 253  
 adverse effect on provision of high  
 quality water 284  
 and biodiversity reduction 283  
 disrupting cellular functioning 147–50  
 loss of ecosystem services through 284  
 results of heavy use 2  
 upsetting growth and development  
 150  
 widespread effects on nontarget  
 organisms 153–4
- pests  
 changing behavior of 150–1  
 defined 141  
 eradication or control 141–3, 167  
 evolve resistance to pesticides 162, 162  
 native or exotic imports 141  
 or pets 140–1  
*r*-selected 142  
 that seem to arise from nowhere 141  
 phenoxy (hormone) weed killers 150  
 pheromones, used to control pests 150–1  
 physical pest control, California 142

- phytoremediation 49–50  
   phytoaccumulation 49–50  
   phytostabilization 50  
   phytotransformation 50  
*Phytoseiulus persimilis*, used for  
   inoculation 158  
 picture-winged fly (*Paracantha culta*),  
   adverse impact of *Rhinocyllus*  
   *canescens* on 160  
*Pieris virginiensis*, adversely impacted by  
   garlic mustard 42  
 pine (*Pinus sylvestris*) 272  
   flying squirrel dispersal habitat 97  
 pine trees *see* conifers  
 pink pigeon (*Columba mayeri*) 128–9,  
   129  
   descent of captive population 128  
   inbreeding, effect on probability of  
   survival to thirty years 128, 129  
   recovery program dependent on  
   captive-breeding 128  
   reintroduction on Mauritius 128  
*Pinus maximartinezii*  
   prone to extinction 23B  
   rare and endangered 66  
 pioneer desert 209  
 pioneer species, *r*-selected, do not do well  
   in *Saccharum* grassland 63  
*Piscidia piscipula* 214  
 plant biomass, top-down control or bottom-  
   up control 232B, 256  
 plant community restoration 89, 206–8  
   restoration of former agricultural  
   land 207  
   shifting prairie mosaic 207, 207  
 plant invaders, physiological and behavioral  
   flexibility 67–8  
 plant seeds, many passively dispersed in air  
   currents 83B  
 plantation forestry 272–3  
   expansion of 272  
   French Pine plantations, attacks by  
   pests 272–3, 273  
 plants 3  
   alpine, moving higher 293B  
   halophytic 50  
   life histories challenge simulation  
   modeling 122  
   mutualists 40B  
   as natural arms factories 146, 147  
   Protacea species, minimum number to be  
   safeguarded 280  
   ‘red list’, reintroduction of 129–30, 130  
   restoration timetables for 206–8  
 plants, invasive  
   ecosystem effects 241–2  
   North America 42–3, 43  
 Platte thistle (*Cirsium canescens*), density  
   loss affected picture-winged fly 160  
 poaching 196  
   effects on legal yield of Saiga  
   antelope 196, 196  
 polar bears (*Ursus maritimus*)  
   link between birth rate and oscillating  
   climate pattern 301, 303  
   under pressure from hunting and high  
   pollutant levels 303  
 polar cod (*Boreogadus saida*), shows  
   evidence of biomagnification 148  
 political realities confronted 197–8  
 pollination 213, 214, 215  
   by native (wild bees) 103–4, 103, 251–2,  
   252  
   flower-visitation webs 214  
 pollutants, atmospheric 17  
 polluter pays principle 96  
 pollution 2  
   by fertilizers and pesticides 4  
   by human and animal waste products 3,  
   247  
   from intensive agriculture 245–7  
 Polynesian islands  
   biological control gone wrong 160  
   social costs of loss of *Partula varia* and  
   *Partula rosea* 160  
 Ponderosa pine forest (western USA), shows  
   relationship between pressure, state  
   and response 252–3  
 Ponderosa pine (*Pinus ponderosa*) 252–3  
   population, carrying capacity of 112B  
   population determination 111B  
   population dynamics models 109,  
   111–12B  
   logistic equation 111B, 112B  
   population dynamics theory-1 110–13B,  
   135–6  
   models of population dynamics 109,  
   111–12B  
   population dynamics of small  
   populations 113B, 135–6  
   population regulation and  
   determination 111B, 112B  
   uncertainty and risk of extinction  
   113B

- population dynamics theory-2, and pest management 143–6B  
   biological control of secondary pest outbreaks 146B  
   economic injury level (EIL) 143–4B  
   economic threshold (ET) 144B  
   evolution of resistance 146B, 146B  
   secondary pest outbreaks 145B, 145B, 151, 152  
   target pest resurgence 144–5B, 167  
 population dynamics theory-3 175–8B  
   fixed effort harvesting 177–8B, 178B  
   fixed quota harvesting 176–7B, 177B  
   logistic growth, underlying patterns in births and deaths 175B, 176B  
   maximum sustainable yield (MSY) 176B  
   when a harvest is sustainable 175–6B  
 population growth, logistic 175B, 176B  
 population regulation, density-dependent or density-independent 111B, 112B, 175B  
 population theory 22, 24–6B, 33  
   countering threat of extinction 24–5B  
   harvest management, counteracting evolution towards small size 25–6B  
   pest control on St Helena 25B  
 population viability analysis  
   how good is your analysis 126–7  
   for the New Zealand woodpigeon 191, 192  
   persistence in time of a population 116, 117  
   population growth rates seen as variable 117  
   simple algebraic models 117–18  
   simulation modeling for 119–27  
 populations, ecological applications at level of 24–6B  
*Populus deltoides* × *nigra*, able to degrade TNT 50  
 possum (*Trichosurus vulpecula*) 223, 239  
 potato tuber moth (*Phthorimaea operculella*) 165–6  
 potato tuber moths, IPM against in New Zealand 165–6  
   caterpillars protected against parasitoids and insecticides 165–6  
   IPM strategy, monitoring, cultural methods and insecticides 166, 166  
 prairie grassland restoration 219, 226  
   Minnesota tallgrass prairie 219–20, 220  
 precipitation, increased in mid and high northern latitudes 293B  
 predation  
   of bird eggs and young 268  
   can slow or stop a successional sequence 205  
 predator–prey spiral, anticlockwise 195, 196  
 primary successions 225  
   on volcanic lava flows 204B, 205B  
 Principal Components Analysis, exploring relationship between plant traits and invasiveness 66, 67  
 Protacea 280  
*Protea lacticolor*  
   bioclimatic model for 297B  
   prognosis 297, 298  
*Protea* spp. 297–8, 308–9  
 protected areas  
   growth of 13, 13  
   suitable choice can minimize predicted losses 309, 310–11, 313  
   see also marine protected areas; nature reserves; wildlife reserves  
*Prunus caroliniana*, mycorrhizae allow seedlings to compete successfully with *Ardisia* seedlings 44  
*Pseudomonas putida*, bacterium, used on toxic remnants of mustard gas 50–1  
*Puma concolor coryi* (Florida panther) 24–5B, 128  
*Puma concolor stanleyana* (Texas cougar) 128  
  
*r*-selected traits 142  
   in invading pine species 61, 66  
*r*-selection  
   good invaders 300  
   small opportunists 76  
*r*/*K* concept/theory 61B, 71, 73–6  
   *K*-species 61B, 75, 205B  
   *r*-species 61B, 63, 142, 204B, 219, 300  
 rabbit calcivirus disease, in New Zealand 140, 168  
 rabbits, killed using 1080 163  
 ragwort (*Senecio jacobaea*) 142  
 rainbow trout (*Oncorhynchus mykiss*) 241  
 RAMAS-STAGE (simulation modeling package) 122–3, 122, 126  
 rats (*Rattus rattus*) 14, 223, 239  
   successful invaders 65  
 realized niche 40B, 44, 55

- recreational boaters, visiting invaded and uninvaded lakes 94, 94
- recruitment curves 176B, 177B, 305  
and maximum sustainable yield (MSY) 304, 305
- recruitment rate, of young salmon and baby whales 185
- red admiral butterfly (*Vanessa atalanta*), breeds at both ends of migration 83B
- red fire ant (*Solenopsis invicta*) 15  
damage to wildlife, livestock and public health 14  
occurs in monogynous and polygynous forms 96
- red-cockaded woodpecker (*Picoides borealis*), sensitivity to forest fragmentation 73
- red-crested cardinal (*Paroaria coronata*) 245
- red-winged blackbird (*Agelaius phoeniceus*) 208
- refuge/riparian strips, for natural predators 152–3, 153, 156–7, 284
- reserve design, multipurpose 280–5, 287–8
- reserve networks, designed for biodiversity conservation 277–80, 287–8  
complementarity 279, 280  
irreplaceability 279–80, 281
- resistance, evolution of 146B, 146B, 162–4, 168  
evolved resistance to cultural control 164
- resources, limited  
interspecific competition for 38B  
intraspecific competition for 38B
- restoration, of biodiverse grasslands and woodlands 13
- restoration ecology 49–54, 55–6
- restoration, ecosystems approach to 242–4, 245  
carbon added to soil lowers nitrate levels 244, 245  
exploiter mediated coexistence 242–3, 244
- restoration landscapes 274–7, 287  
reintroduction of vultures 275–6  
restoring farmed habitat 276  
willingness to pay for forest restoration 276
- restoration, managing succession for 206–16, 225  
invoking enemy-interaction theory 215–16  
invoking facilitation theory 210–15  
invoking successional-niche theory 209–10  
invoking theory of competition–colonization trade-offs 209  
restoration timetable for animals 208–9  
restoration timetables for plants 206–8
- restoration and species mobility 89–92  
behavior management 89  
bog restoration 89–91  
wetland forest restoration 91–2  
*Rhamnus alternus* 211  
*Rhinanthus minor*, hemiparasite 243  
*Rhinus megaphyllus*, made use of trackways 98, 99
- riparian and wetland communities 257  
lost to agricultural production 248
- river blindness (onchocerciasis), controlled 162
- river flow, reduction in 17–18
- river health 254–5  
macroinvertebrate community index (MCI) 254, 255  
Maori Cultural Stream Health Measure (CSHM) 255, 256  
positive relationship between pressure and health index 254  
some health indexes include more indicators 254
- river restoration 53–4, 55–6  
approaches used to define minimum discharges 53–4  
restoration of natural flow regimes 45
- river water quality, reduction in 17, 28
- rivers  
ecosystem health of 254–5  
land use and nitrogen transport in 31
- rockroses (*Cistus* spp.), provide no nursing benefit 212
- rocky shores, gaps opened by severe wave action 204B
- Rodolia cardinalis*, predatory ladybird beetle 155
- rooks  
*Corvus frugilegus*, successful invader 67  
*Corvus monedula*, unsuccessful invader 67

- royal catchfly (*Silene regia*) 122–3  
 growth, fecundity and survival  
 contribute to population  
 performance 123  
 long-lived prairie perennial with  
 shrunken range 122  
 management including fire  
 recommended 123, 123  
 successful germination episodic 122
- Rudbeckia missouriensis* 216
- rufous bristlebird (*Dasyornis broadbenti*),  
 threatened by habit loss 46–7
- rufous treecreepers (*Climacteris rufa*)  
 72–3
- Russian olive (*Elaeagnus augustifolia*),  
 native and potential invaded  
 distributional areas 42, 43, 43
- ryegrass (*Lolium multiflorum*) 224
- Saccharum* grassland 63–4  
 species traits significant for tree seed  
 success 63–4, 64, 209
- Saccharum spontaneum*, invasive 63
- Saiga antelope (*Saiga tatarica*)  
 effects of poaching on legal yield 196,  
 196  
 males worth more than females 181  
 simulation model for future  
 management 181–2, 182
- St Helena gumwoods (*Commidendrum  
 robustum*), saved by a ladybird  
 beetle 155–6
- St Helena, pest control on 25B
- Salix koriyanagi* 207
- San Joaquin Valley, California, pesticide  
 problems amongst cotton pests 151,  
 152
- sand mining  
 restoration timetable for animals 208,  
 208  
 and successional-niche theory 210
- sand shrimp (*Crangon septemspinosa*), two-  
 dimension niche 38B, 39B
- sandwich tern (*Sterna sandvicensis*),  
 maneuverable but declining  
 102
- scarecrows and hawks, old method of pest  
 control 151
- Schizachyrium scoparium* 216
- screwworm fly (*Cochliomyia hominivorax*),  
 eradicated by biological  
 trickery 143
- Scutellospora* 213
- sea lampreys (*Petromyzon marinus*), treated  
 with lampricide TFM 150
- sea level, rising 18–19
- sea otter (*Enhydra lutris*)  
 affecting red abalone harvests 236  
 locally extinct 185
- seabirds  
 biomagnification most marked 148  
 development of species sensitivity index  
 for (Germany) 101–2
- seals 140
- secondary pest outbreaks 145B, 145B, 151,  
 152, 167
- secondary productivity 232B
- secondary successions 225  
 occur after partial or complete removal of  
 vegetation 204B, 206B
- seed dispersal 83B
- seed-banks 60B, 78  
 ex-swamps cf. intact swamps 91–2
- seed-feeding weevil (*Rhinocyllus connicus*),  
 introduced to N America to control  
*Carduus* thistles 160
- semiochemicals 150–1
- Septoria passiflorae*, fungus specific to  
 banana poka 156, 157
- Seraria viridis* 296B
- Setaria glauca* 219–20
- shark species 74  
 fast–slow continuum 74, 7474  
 mean population growth rates ( $\lambda$ ) 74,  
 74  
 various species' ability to respond to  
 increased mortality 74
- Sherardia arvensis*, tolerant of cutting  
 disturbance 51
- Silene douglasii* (var. *oraria*),  
 reintroduction 129–30, 130  
 comparison of variation of  
 inbreeding 129–30  
 progeny of outbred, cross-pollinated  
 flowers showed better  
 survival 129–30, 130
- silvertop stringybark (*Eucalyptus  
 laevopinea*) 98
- simulation models/modeling  
 future management of Saiga  
 antelope 181–2, 182  
 for population viability analysis  
 119–27  
 RAMAS-STAGE 122–3, 122, 126

- using susceptible-infectious-recovered (S-I-R) process 124
- VORTEX 120, 121, 126
- Sinapsis arvensis* 244
- Singapore island
  - extinctions 7
  - problems of population growth 7, 8
- size–vulnerability relationship 16
- skates and rays (Rajidae), and
  - extinctions 74, 75
- skipjack tuna 238
- skylark (*Alauda arvensis*)
  - density dependent on weed seed density 132–3, 132
  - impact of GM seed depends on effect on high-density weed patches 132–3
- small populations
  - genetics of 114–15B, 136
  - relative importance of genetic and demographic risks 115B
- small populations, population dynamics 113B
  - chance events play a large role 113B
  - demographic uncertainty 113B, 135
  - environmental uncertainty 113B, 135
  - spatial uncertainty 113B, 135
- snowshoe hare (*Lepus americanus*) 221
  - high densities associated with regenerating forest 222
- snowy egret (*Egretta thula*) 208
- social capital, increased by social learning 29–30
- sociopolitical dimension, added to ecology and economics 195–8, 200
- sociopolitical scenarios 30, 31
  - adapting mosaic 30, 31
  - global orchestration 30, 31
  - order from strength 30, 31
  - technogarden 30, 31
- soil mites, predatory 253, 254
- soil water balance, affected by
  - invaders 242
  - exotic grassland maintained highest water content 242, 243
  - star thistle reduced soil moisture 242, 243
- Solanum nigra* 244
- song sparrow (*Melospiza melodia*) 208
- Sorghastrum nutans* 244
- South African polychaete worm (*Terebrasabella heterouncinata*), use of physical pest control 142
- South African sand mine restoration 208, 208
  - successional pattern in dung beetle community 210, 211
- South American scale insect (*Orthezia insignis*) 155–6
- southern damselfly (*Coenagrion mercuriale*) 87
  - determination of net lifetime movement of individuals 87, 87
  - poor flight powers of adults 87
  - restricted to highly fragmented habitat of ancient water meadows 87
  - suggested management effort 87
- Spartina* spp. 208
- spatial uncertainty 135
  - in small population 113B
- specialists and generalists 78
- species
  - community numbers balance between colonization and extinction 263B
  - especially vulnerable when rare 185–6
  - forest species, expected changes to habitable areas 305
  - future distributions of 292, 312
  - large/very large seed, survive well in *Saccharum* grassland 63–4
  - larger, vulnerable through low reproductive rate 73–4
  - maintaining a viable population 40B as metapopulations 263B
  - named and unnamed 6
  - natural and current extinction rates 6
  - niche characteristics reasonably constant over evolutionary time periods 39B
  - predictable sequences of appearance and disappearance 204B
  - reduction in habitable area 292–3, 298
  - shade-tolerant, vulnerability of 77
- species conservation 301, 303
- species conservation, managing succession for 221–4, 226
  - controlling succession in an invader-dominated community 223–4
  - enforcing a successional mosaic 222–3
  - nursing a cultural plant back to health 224
  - when early succession matters most 221–2
  - when late succession matters most 223
- species gain 231B

- species invasions, separating into sequential stages 68–71
- alien plants in the Czech Republic 68–70, 69
- California, invasions and failed introductions of fish in catchment areas 70–1
- parrots, assessment of transport, release and establishment 68, 69
- see also* birds, invasion success; conifers, invasive, in the USA
- species loss 231B
- species mobility
- and conservation 105
  - and management of production landscapes 97–104, 105–6
  - and restoration 89–92, 105
  - why it matters 82
- species pools, relationships between 264–5B, 265B
- species range shift 298, 312
- of invasive species 312
  - towards poles and higher altitudes 293B, 294B
- species restoration 52–3
- species richness 4, 98, 287, 306–7
- in benzoin garden areas 217, 218
  - Berlin, correlated with habit diversity 277, 278
  - and biodiversity 287
  - correlates negatively with farmers' profit margins 52–3, 53
  - determination of 264–5B, 265B
  - gamma, alpha and beta richness 265–6B, 267B
  - hotspots 277
  - of *Protea* species 308
- species traits 60–1B
- can predict invasive trees and threatened natives 23B
  - and life cycles 77
  - linking particular traits to particular environments 60–1B
  - as predictors for effective restoration 61–5
  - as predictors of extinction risk 71–7, 78
  - as predictors of invasion success 65–71, 78
  - and restoration 78
  - significant for tree seed success in *Saccharum* grassland 63–4, 64
  - timing, location and distance involved in dispersal and migration 82
- Sphagnum* bogs, eastern Canada 89–91
- assessment of wind dispersal ability of some peatbog plants 89–91, 90
  - exploited for peat then abandoned 89
  - mosses, high immigration potential but poorly represented 91
  - no persistent seed-bank, slow recolonization 89
  - propagules capable of dispersing by water or animals 91
  - recolonization by vascular plants well predicted 91
- Sphyrna tiburo* (fast shark) 74
- spiny acacia, invasive in Australia 298, 299
- with climate change invadable area will be larger 298, 299
- spiny lobsters (*Panulirus argus*), Cuban fishery 194–5, 195
- spiny waterflea (*Bythotrephes longimanus*), dispersal from Lake Ontario 94–5
- spottail shiner (*Notropis husonius*) 255
- spotted alfalfa aphid (*Therioaphis trifolii*), keeping density down 144B
- spotted sandpiper (*Actitis macularia*) 208
- spruce (*Picea abies*) 97
- spur lupin (*Lupinus arbustus*) 117
- squirrels 97
- starfish (*Leptasterias* sp.) 231B
- starfish (*Pisaster ochraceus*) 231B
- keystone species 231–2B
- starling (*Sturnus vulgaris*), successful invader 65
- Steller's sea cow (*Hydrodamalis gigas*), globally extinct 185
- stem-mining moths (*Neurostrata gunniella* and *Carmenta mimosa*) 167
- Stipa bungeana* 296B
- stoat (*Mustela erminea*) 223, 239
- stock assessment, of harvested populations 186, 199
- strip intercropping 284
- strong interactors 231–2B
- Styrax paralleloneurum*, benzoin garden tree 217
- succession 306–7
- runs from pioneer to climax community compositions 204B

- succession and management 202–28  
   managing succession for  
     harvesting 216–19  
   managing succession for  
     restoration 206–16  
   managing succession for species  
     conservation 221–4  
   theory of ecological succession 204–6B  
   using succession to control  
     invasions 219–21
- succession, species traits determining  
   course of 204–5B  
   early-successional species (*r*-species),  
     persistence of 204B  
   late-successional species  
     (*K*-species) 204B
- succession theory 205–6B  
   benzoin gardening in Sumatra 217  
   nursing a community back to  
     health 26B
- successional mosaics 226, 263B  
   first aid for butterflies 222–3  
   Peruvian forest 271, 272  
   and the role of disturbance 205–6B,  
     217–19, 219
- successional-niche theory 204B, 209–10,  
   225
- sugar beet (*Beta vulgaris*), GM modified  
   adoption more likely on intensively  
     managed farms 133  
   impact on birds depending on cropland  
     weed seeds 131–3
- sulfur dioxide SO<sub>2</sub> 17
- summer drought 293B
- surplus yield models 176–8B, 178–86
- sustainability  
   ecological dimensions 22–8, 33  
   economic dimensions 28–9, 33  
   exploiters and preservationists 20  
   in fisheries 239  
   marine zoning plan for 27B  
   the middle ground 20–1  
   and our way of life 2  
   sociopolitical dimension 29–31, 33
- The sustainable biosphere initiative: an  
   ecological research agenda* 21
- sustainable fisheries, ecological and  
   economic models never  
   perfect 197–8
- sustainable forestry  
   Australia, retention of maternity roost  
     trees for bats 100  
   New Zealand beech forest  
     proposal 190–1, 190
- sustainable future, moving towards 20–31,  
   33  
   ecological applications 22–8
- sustainable harvest 173–4, 175–6B, 198
- sustainable management 29
- sweet vernal grass (*Anthoxanthum*) 49
- sweetgrass (*Anthoxanthum nitens*), used in  
   basketry 224
- sweetgum (*Liquidamber styraciflua*),  
   possible response to global  
   warming 302–3  
   current and predicted distributions 302
- Sydney blue gum (*Eucalyptus saligna*) 97
- takahe (*Porphyrio hochstetteri*), translocation  
   of 23B, 48–9  
   fossil evidence of former locations 48,  
     48  
   fundamental and realized niches  
     for 48–9  
   intense conservation efforts 48  
   translocated island populations can  
     become self-sustaining 48
- tallgrass prairie restoration 219–20, 220  
   reducing soil nitrate by carbon  
     addition 244, 245
- Tana River crested mangabey (*Cercocebus  
   galeritus galeritus*)  
   population size needed for a hundred  
     years persistence 118
- tangled web spider (*Nesticodes rufipes*),  
   predation on broccoli 245
- tapir (*Tapirus terrestris*) 271
- target pest resurgence 167  
   explanations for 144–5B  
   pest population recovers quicker than its  
     enemies 151–2  
   and secondary pests 151–3, 167
- Tehuacán-Cuicatlan Biosphere Reserve,  
   Mexico 309–10  
   cacti species under various  
     scenarios 311  
   information on possible extinctions, case  
     for new reserve 310
- temperatures, predicted to continue  
   rising 18
- Tetranychus urticae*, pest 158
- thermal inertia 291
- thick-leaved oak (*Cyclobalanopsis  
   edithiae*) 215, 215

- Thlaspi caerulescens*, zinc-accumulating herb 49
- three-wattled bellbird (*Procnias tricarunculata*), migratory behavior in Costa Rica 84–5
- Thymus serpyllum* 50, 52
- Thyridoptery* × *ephemeraeformis*, bagworm caterpillars 157
- ticks *see* *Ixodes*
- tidal salt marshes, restoration of tidal action 208–9, 225  
recovery of different aspects of ecosystem functioning 209, 209
- tobacco plant (*Nicotiana rustica*), produces nicotine 147
- Tolo Harbor, Hongkong 255–6  
management response, Tolo Harbor Action Plan 256  
significant physical and chemical pressures 255–6  
suite of ecosystem health indicators proposed 256
- topshell (*Tegula* sp.) 231B
- tragedy of the commons, avoidance of 173–4, 198
- trees  
coped with waxing and waning ice ages 302  
North American, will global warming move too fast 302–3, 302
- Trema micrantha* 63
- Trialeurodes vaporariorum*, pest 158
- Trichogramma* wasps, parasitize brussels sprouts 273
- Trinia glauca*, restricted to dry, nutrient-poor soil 50, 52
- Trisetum flavescens* 62
- trophic cascades 232B, 240–1, 241  
control on biomass is top-down 232B  
and top-down and bottom-up control of food webs 232B, 256  
useful natural pest control for certain crops 245
- trophic level, mean, declining in fisheries catches 239, 239
- tropical birds, range 223  
mature forest specialists at risk of extinction 223  
mean latitudinal range sizes 223
- tropical dry forests, much converted to agriculture and pasture 213, 214  
effects of accidental fires on remaining forest 213  
patches augment and link forest fragments 213
- tropical forest restoration, Panama 62–5  
suggestions for restoration management 64–5
- tropical forests  
biodiversity threatened 196–7  
high species richness 265B  
Panama, diversity loss 62–3  
Peru, successional mosaic 271, 272  
*see also* tropical birds; tropical dry forests
- tsunami 230
- tumble mustard (*Sisymbrium altissimum*) 242
- uncertainty, and risk of extinction 113B
- urban settings, pest control problems in 157, 157
- Urocyon littoralis* (Californian Channel Island fox)  
recent extinction, translocation possible 130  
relationships among subspecies 130, 131
- USA  
area where wood thrush populations likely to become extinct 269, 269  
Connecticut, recovery of salt marsh vegetation 208  
eastern, eradication campaign against African witchweed 142–3  
eastern, pests of ornamental trees and shrubs 157, 157  
estimated annual costs associated with invaders 14, 15  
food web for a rocky shore 231B  
forest blazes in California 203, 226  
genetic rescue of Florida panther 24–5B  
Japanese grass (*Microstegium vimineum*), invasive potential of 67–8  
Minnesota, restoration of tallgrass prairie 219–20, 220, 244, 245  
Oregon, holistic forest restoration, willingness to pay 276  
Ozark glades, intrusion of fire-intolerant species 215–16  
piñon-juniper woodland, butterflies in decline 222–3  
problem with some introduced pine species 23B, 66, 67

- southeastern, floodplains due for reforestation 91  
 study of beetle richness 266B 267B  
 use of organic insecticides and emergence of secondary pests 151, 152  
 Walnut Creek, Iowa 284–5, 285  
*see also* California
- Vanuatu, success of data-less management for trochus shellfishery 186
- Varroa* mite, arrival in South Africa threatens 'natural' bee colonies 13
- vernal pools, home to fairy shrimps 310, 311
- vertebrates  
 evolved resistance to some pesticides 163  
 as influential as insects on succession 215  
 marine and freshwater, signs of population decline 6, 7  
 occasional use as biological control agents 157–8
- Vespadelus darlingtoni* 99
- Vespadelus pumilus* 99
- Vibrio cholerae*, found in ballast water 93
- Victoria, Lake  
 introduction of Nile perch (*Lates nilotica*) 2, 3, 13  
 loss of biodiversity 13
- Virola surinamensis*, survives well in *Saccharum* grassland 63–4
- VORTEX (simulation modeling package) 120, 121, 126
- vultures, reintroduction in Valais region, Switzerland 275–6
- Walnut Creek, Iowa  
 biodiversity scenario 284, 285, 286, 286  
 present landscape 284, 285, 286  
 production scenario 284, 285, 286  
 water quality scenario 284, 285, 285, 286
- wasp parasitoids, enemies of  
 bagworms 157
- water meadows, ancient, damselfly habitat 87
- water runoff, improved 242
- watermelon (*Citrullus lanatus*), and native bees 103
- watermelon fields, northern  
 California 103–4  
 economic argument for preserving bee natural habitat 104  
 pollination by native bees 103–4, 103, 251–2, 252
- waterways, nitrate pollution, main culprit farm specialization 247
- weed biomass, declined with addition of carbon to soil 244, 245
- western yellow robins (*Eopsaltria griseogularis*) 72–3
- weta (*Deinacrida mahoenuiensis*) 223–4
- wetland construction to manage water quality 247–8, 248
- wetland forest restoration 91–2  
 floodplains due for reforestation, USA 91  
 major problems 91–2
- wetlands 91–2, 247–8, 257
- wheat, aphid pests, overwintering of predators 156–7
- wheatgrass (*Pseudoroegneria* sp.) 242
- white skate (*Rostroraja alba*) 74
- white stork (*Ciconia ciconia*) 101
- white-backed vulture (*Gyps bengalensis*)  
 in crisis 109  
 diclofenac found in dying birds 134  
 dramatic decline in numbers 133  
 economic benefit of ecosystem services 109, 135, 136–7  
 no longer enough to dispose of all refuse 109  
 use of diclofenac banned in Pakistan 135
- white-backed vulture, long-billed (*Gyps indicus*) 109
- white-backed vulture, slender-billed (*Gyps tenuirostris*) 109
- white-footed mouse (*Peromyscus leucopus*) 236  
 transmission of Lyme disease to ticks 235
- white-naped honeyeaters (*Melithreptus lunatus*), declined after logging 72
- wilderness protection 13
- wildlife reserves  
 and Island Biogeography Theory 269–70  
 and the Kalahari bushmen 262
- willingness to pay 29, 276

- wind farms 82, 100–2, 106
  - expansion without detailed ecological information 100
  - siting of turbines 105
  - threats to migrating and dispersing birds 100
- winter moths (*Operophtera brumata*) 158
- wood thrush (*Hylocichla mustelina*),
  - variation in fundamental rate of increase  $\lambda$  268–9, 269
- woody plants, nitrogen fixing 241–2
  - restoration using burning 242
- wren (*Troglodytes troglodytes*), and a positive NAO index 301, 301
- yellow star thistle (*Centaurea solstitialis*) 14, 15, 141, 242, 243
- yellow-fin tuna (*Thunnus albacares*) 238
  - sustainable yield from 179, 180
- yield curves 177B, 178B
  - shortcomings of 184–6
- Zea mays* 152–3
- zebra mussel (*Dreissena polymorpha*)
  - damaging invader in Great Lakes 14, 15, 93–4
  - exerts profound ecosystem effect 241
  - predicted spread to inland lakes 93, 93
- zero-fishing zones *see* marine protected areas
- zooplankton, northerly shift in northeast Atlantic 293B, 294B