Global Initiative on Invasive Species

The Global Environment Facility (GEF) of the World Bank has allocated funds to the Global Invasive Species Programme (GISP)—coordinated by SCOPE (Scientific Committee on Problems of the Environment), and in which IUCN is a major partner. The programme will run for over 2 years and will involve a series of meetings and publications on various aspects of invasives and their impacts. The team’s goal is to enable local, national, and multi-national communities to draw on the best available tools to improve pest prevention and control systems immediately, and to identify priorities for the development of new tools needed to achieve longer term success. "Despite over a century of organised work on pest prevention and control", the GISP brochure explains, "the world community today lacks many of the essential technical tools to overcome this problem. Moreover, many of the tools that do exist are not fully accessible to all nations". GISP is organised into a series of sections including: ecology, pathways, early warning, prevention, rapid assessment, economic assessment, risk analysis, legal/institutional arrangements, and management/control. Most of these involve ISSG members.

IUCN had already resolved to make invasives one of its primary foci for global action. This plan was announced by Director General David McDowell in the latest issue of World Conservation. He writes: "The World Conservation Union already has a wide variety of activities relating to invasives, ranging from the technical work of SSC, to the policy work of the Biodiversity Programme and the Environmental Law Centre, to field activities in East Africa and elsewhere. Now we are launching a new Union-wide initiative to bring these together".

Thus, between 31 March and 4 April, both IUCN and SCOPE held back-to-back meetings in San Mateo, California, to discuss this work. IUCN’s meeting brought together a range of experts and perspectives on invasives management. Agreement was reached on priorities for the new invasives initiative, and a start was made on planning for future actions. The SCOPE workshop specifically addressed invasive species and global change. Participants considered potential responses of invaders to changes in climate and many other parameters. A publication is proposed as a result of this meeting.
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**Wedelia trilobata** on Pohnpei

Pohnpei is a small volcanic island in the eastern Caroline Islands, located in the western Pacific's Federated States of Micronesia. It is the highest island and second largest in the Caroline Island chain. Subsistence agriculture is the predominant occupation of the island inhabitants. Rainfall is high, with as much as 4820 millimetres falling within 300 days per year.

Many different alien plant species have been introduced to the island by people who come to Pohnpei as visitors, as well as by island peoples who travel back and forth. Invasive plants are now considered to be one of Pohnpei’s biggest problems. Getting rid of invasive plants is quite a predicament to us Pohnpeians. _Wedelia trilobata_ (Pohnpei: tuhke ongohng) is one of the plants that is deemed to be amongst the worst of all the invasive plants that have been introduced to the island.

According to our practical knowledge, we Community Conservation Officers (CCOs) certainly believe that the wide spread of this tuhke ongohng will soon destroy our own important grasses and herbs that are useful for local Pohnpeian medicine. Even Waun Kepin Semwei, part of this island which is a reserve, has different types of plants which were introduced and have spread quickly from one area to another, killing important and useful native plants.

As _Wedelia trilobata_ grows and lengthens, it falls over and sprouts new roots and sends out new shoots and branches that also grow up and fall over. Thus the plant’s main body develops into a tangled cover, up to four inches thick, covering all the grass and killing it.

The main body of this plant is just like thin strings that cover the ground. The leaves are a little forked and perhaps 2.5 inches long. The flower has yellow oval ray florets surrounded by bracts and the inflorescence center is made up of disk florets.

During one workshop of CCOs, which was held from October 21-31, 1997, there was training on monitoring and management. In this workshop, during the small group sessions, one group made it an objective for CCOs to solve problems. No best solution was found to deal with the basic problems with this plant. Some CCOs spoke of burning it—but it will be difficult to try this. The reason is that when this plant is cleared by cutting with a knife, some of the stems stay on or below the ground and continue to grow. When clearing the land, people roll up the plant and cut it into rolls of screen because of the ways that the plant runs together and piles up. When it is finished being rolled up from the dirt, the roll is set afire, and the outside burns, but on the inside of the roll some of the stems that are unburned may grow into a new plant. There is also a concern that in rolling the plant, perhaps some stems get stuck—between roots, under logs—and begin to spread out.

No one has tried to find out how to do away with this plant. It reproduces very quickly and is most difficult to kill. Clearing it away will only bare the earth and cause debris to become abundant.

We, the CCOs of Waan Kepin Semwei, expect help from places that can find out how to slow or stop the growth and spread of this plant. We believe that lack of action to control this plant will result in great difficulties for the natives of Pohnpei.

On Pohnpei there is also a vigorous grass which people fear spreading onto their land. The name of this grass in Pohnpeian is reh padil (paddle grass?). _Wedelia trilobata_ also usually covers and kills it.

According to my own observations, if there is nothing done to remove _W. trilobata_, there will be difficulties for native grasses, weeds and plants which are used for local Pohnpeian medicine because they will be consumed by the spread of this plant.

Perhaps in some parts of the world, in different countries, it might be an important plant or herb. Research has been obtained on _Wedelia trilobata_ (tuhke ongohng) and discoveries show that it is used as a medicine, but in the meantime the medicine is not for us the Pohnpeians. Traditionally it is used in other countries while for us Pohnpeians it is destroying our land, and banishing our own herbs, grasses and plants which are important for our own local medicine and other purposes.

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White-spotted tussock moth—an aggressive eradication strategy

The White-spotted tussock moth *Orgyia thyellina* was discovered infesting a seven square kilometre area of Auckland’s eastern suburbs in April 1996. The insect, a member of the family Lymantriidae (which includes gypsy moth and Douglas fir tussock moth), is a native of Japan, Korea, Taiwan and China. It is not regarded as a serious pest in its native range, but given its family relationships and the unpredictability of exotic insects in new environments, it was considered a potentially serious threat to New Zealand’s forests and trees.

Once the infested area had been defined, and all available information assembled both from overseas experience and observations in Auckland, a response strategy was developed. This strategy involved an interim decision to attempt to eradicate the pest, and it set in motion operational planning to be implemented in the spring of 1996. At the same time research was commissioned to clarify the risk, evaluate control options, and develop monitoring systems.

Feeding trials showed the caterpillars had a strong preference for plants in the rose family including pip and stone fruit, but also for maple, birch and willow. Amenity, shelter, and residential garden trees were seen as primarily at risk. Horticulture, and forests where favoured plants such as blackberry grew, could also be affected.

The organic pesticide *Bacillus thuringiensis* var. *kurstaki* (Btk) was found to be effective against the caterpillar, particularly in the first three of the six instars of its development. With confirmation that the infestation was confined to a seven square kilometre area, and concentrated in a single square kilometre, it was agreed that eradication would be attempted and the Operation Evergreen Team under the Ministry of Forestry’s John Handiside was born.

The insect over-wintered as egg masses during 1996 on plants, fences, houses, and outdoor furniture within the infected area. These eggs were expected to hatch in the spring and the first generation of caterpillars to then pupate producing flight-capable females and male moths. The moth would give rise to two further generations over the summer, the final female adults being unable to fly and laying over-wintering eggs wherever they pupated.

The operational strategy aimed to treat, by up to six aerial applications of Btk, a total area of 40 square kilometres centred on the infested area. Applications were spaced about seven days apart and beginning soon after egg hatch. The objective was to ensure that all caterpillars were exposed to at least three applications of Btk before they entered the fourth larval instar. However the unexpectedly protracted egg hatch and the survival of some first-generation larvae led to nine sprays by DC6 aircraft over the 40 square kilometres and a further 14 helicopter applications to the much smaller infested area (approximately 300 hectares), finishing in April 1997. In addition, weekly ground spraying of more than 200 infested properties was carried out.

The spraying strategy had an immediate impact on population levels of the insect, and ground searching for residual infestations became less and less effective. This problem had been identified early in the programme and the search for a more effective monitoring tool already had high priority. Efforts focused on the development of a synthetic pheromone, the chemical attractant the female moth emits to attract a male.

All commercially-available lymantrid pheromones had been tested to no avail, and then despite a major effort by New Zealand researchers and colleagues at Simon Frazer University in Canada, which found a solution, this was not in time for the 1996-97 spray...
programme. Monitoring over this time was carried out using live caged female moths from the Forest Research Institute in Rotorua, ca. 250 kilometres away, where thousands of insects were reared for host testing, spray evaluation, pheromone research and field monitoring. The rearing, transport, handling and deployment of all live insects had to meet strict quarantine requirements and always involved some risk.

In December and January 1996-97, 68 first-generation male moths were caught in 46 traps of an array of 250. The catches were tightly focused in the "hot zone" of the infested area. During April a further six male moths were caught, arguably late second or early third generation individuals. Monitoring continued into late June with no further catches.

The programme was far more complex than is evident from this brief article. Management of spray application alone involved advanced flight control, mapping and aircraft monitoring techniques, so that schools and businesses could be advised by the control centre just minutes in advance of the aircraft passing over. All aircraft were calibrated to deliver five litres of Btk per hectare and deposition monitoring was carried out for all flights. Researchers sampled Btk build-up on vegetation and in soil, modelled deposition patterns and droplet size, provided hourly weather predictions for flying, modelled population change, and monitored egg embryonic development to predict egg hatch.

The programme also involved two other key components: a public communication and information initiative involving all aspects of the media, public meetings and one-on-one response; and extensive health monitoring and review including the establishment of an archived database which all individuals subject to spraying were encouraged to join.

The 1997-98 programme has involved the deployment of 7000 synthetic pheromone traps over 2000 properties and risk sites. Traps are inspected every two weeks from the beginning of December to mid June. As at late March no male moths have been caught. It is hoped to continue monitoring for at least the first generation of the 1998-99 season if no moths are caught. Despite strict vegetation controls imposed soon after the infestation was discovered, the possibility the insect has been transported to a new site cannot be excluded. It is hoped that with increased public awareness any such event will be detected earlier than the original infestation.

Finally if there is any single attribute that has characterised Operation Evergreen it is teamwork, teamwork, teamwork. Cooperation between researchers, operations people, communications staff, contractors, and most of all the people of the eastern suburbs. This is one programme where the cry "people are our greatest resource" is truly appropriate and so much more than a platitude in a glossy annual report.

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Pelagic plastics and marine invaders

For some time emphasis has rightly been placed on the role of ballast water as a vector by which exotic, aggressive, and ecologically-damaging marine taxa can be translocated to estuarine, harbour and shallow near-shore environments far from their native territories. There are numerous, well-documented examples from Australasia, Europe and elsewhere, with attention usually focusing on perceived or identified detrimental impacts of the new arrivals. However, it has also been recognised that many marine fouling organisms have long since achieved a global distribution through natural methods. Some of this may have occurred without human intervention and by way of attachment to logs, seaweed and pumice passively drifting at the whim of the wind, wave, tide and current, or by hitching a ride on turtles and other active marine animals. Furthermore, it has been demonstrated that terrestrial vertebrates and invertebrates may be transported in a similar fashion—the iguanas of Fiji may have reached the South West Pacific in this way. It has even been speculated that the human species may have reached northern Australia by accidental rafting on floating islands of soil, matted roots and vegetation torn from Papua New Guinea river banks in times of flood.

Over the past three decades or more, concern has developed over the general health state of the oceans and the extent to which surface waters and shorelines everywhere have been progressively fouled by marine debris (collectively defined as "...manufactured or processed solid waste material entering the marine environment from any source..."). The ocean surface’s often filthy state was clearly revealed by observations made in 1970 by Heyerdahl during the raft Ra II’s westward drift across the North Atlantic. Almost thirty years later there is no evidence that the situation has improved, given recent statements by the rowers Hamill and Stubbs after their successful passage from Tenerife to Barbados through the very same waters. Unsightly accumulations of marine debris are now known from the most remote and generally inaccessible shores, e.g. unhabited Oeno and Ducie Atolls and Henderson Island in the Pitcairn Group, as well as seldom visited subantarctic islands.

Marine debris is dominated by persistent synthetic materials, most of which are plastics. Despite the often repeated claim that >75% of marine pollution has a land-based source, there can be little doubt that locally, a significant proportion of marine debris may have its origins in nearby offshore maritime activities. Most plastics float and are highly durable in seawater, and herein lie potential surrogates for the substrata provided in nature by floating logs, seaweeds and pumice, as well as some surface-dwelling, free-swimming marine animals.

Studies of beach-cast pelagic plastics on shores of the Western Atlantic (Florida, Bermuda and the Caribbean) as well as around northern New Zealand, eastern Australia, the South West Pacific and subantarctic islands, have shown that they also can support a varied community of encrusters and fouling epibionts as well as attract a diverse motile biota. The community is similar to that associated with Sargassum and other drifting seaweeds, although with reduced species richness and diversity.

More than 100 epibiont species have now been identified on beached plastic. They are mostly hard-shelled and crustose organisms including barnacles, tube worms, bryozoans, and bivalve molluscs as well as foraminiferans and coralline algae together with hydrozoans, ascidians and rare corals. This record, however, is somewhat biased as soft fleshy organisms do not long resist desiccation and disintegration once exposed to harsh beach environments.

Studies of freshly-arrived plastic on Florida beaches and fouling history of PET bottles moored in shallow near-shore marine waters of the Leigh Marine Reserve north of Auckland, New Zealand, have emphasised that the initial colonisers, following biofilm development, are filamentous algae, hydroids and other fleshy epibionts. In addition a diverse motile biota, typified by crabs, amphipods, polychaete worms and gastropods as well as rare isopods, shrimps, limpets, chitons and echinoderms is recorded from freely-floating plastics. Several fish species and marine mammals are also drawn to pelagic plastics.

Bryozoans are the most common taxon on marine debris around northern New Zealand, with at least 60 identifiable species. Of these, 28 had no previous local record, although most were known from eastern Australia and the Kermadec Ridge. In several instances bryozoan colonies were
plastic may represent considerably less potential than ballast water for introduction of aggressive, habitat destroying/modifying alien taxa, but this does not mean it should be ignored. In addition, there are the scarcely acknowledged risks to terrestrial ecosystems of the coastal zone. There are matters here to be addressed by those having stewardship and management responsibilities for sensitive coastal estate—particularly for areas having heritage status, high conservation values or harbouring endangered species, whether marine or terrestrial.

sexually mature and could have reproduced whilst living a pseudoplanktic lifestyle on their adopted floating island. While most of the marine debris epibionts so far identified are local benthic taxa there are several examples illustrating translocation potential. Florida debris carried a previously unrecorded bryozoan (*Thalamporella* sp.) bearing close similarity to a species described from Brazil. Similarly the well known tropical Indo-Pacific oyster, *Lopha cristagalli* has been recorded twice in New Zealand waters—on marine debris in both instances. The cosmopolitan, warm-water low latitude bryozoan, *Membranipora tuberculata* now dominates beach-cast marine debris around northern New Zealand and is common on South Pacific island and eastern Australia shores. This species was only earlier recorded in isolated instances during the late 1960s and 1970s—and on all occasions substrata were plastic. As improbable as it may seem, plastic debris could transport terrestrial organisms picked up during earlier episodes of stranding. A toy plastic boat, drifting ashore on an infrequently visited island approximately four kilometres off the northern New Zealand mainland, carried viable seeds of several plants, including one species not known from the island. It also has been suggested that rats and predators such as cats and stoats as well as other vertebrate and invertebrate pests could be rafted across open water in similar fashion.

The environmental threats posed by marine debris are often viewed at an emotive level, involving cosmetic and aesthetic factors as well as those arising from wildlife entanglement and ingestion. This brief review suggests that there are other aspects warranting attention. Pelagic

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*Lopha cristagalli* attached to nylon rope
Prior to the advent of the first Polynesian settlers into Samoa some 3000 years ago, all plants found in the archipelago were native species (i.e. they had all arrived by natural means) and nearly all the land was covered with forest—the major exceptions being recent lava flows, the scrub-covered peaks of Tutuila and Ta‘u, the littoral strand, and successional areas of disturbance caused by high winds or hurricanes. Thus, the vast majority of native plants were (and still are) adapted to living in undisturbed, relatively shaded environments. Although none of the native plants could have been called a weed (which can be defined as any plant growing out of place, i.e., growing where it interferes with the activities of humans), some species present did have characteristics typical of weeds—i.e. fast growth in sunny places, rapid means of dispersal, and prolific reproduction.

However, everything changed with the arrival of the first Polynesian settlers in Samoa. Forests were cut down or burned in order to provide space and light for the cultivation of the non-native plants, referred to as Polynesian introductions, that were brought in Polynesian voyaging canoes. Some of these plants, such as yams, tapa, and red hibiscus, were intentionally brought in to be used for food, material purposes, decoration, or medicines. These can be termed intentional Polynesian introductions. Others, however, were accidental arrivals, typically transported as seeds in soil around root crops, or burs stuck to clothing or animal fur; these can be termed accidental Polynesian introductions.

Most of the alien (introduced) plants were no problem for the environment since they lacked the characteristics that would allow them to spread and become naturalised on their own. Many of them, such as taro, bananas, and breadfruit, cannot even reproduce by themselves and have to be propagated by vegetative means (e.g. stem cuttings, rhizomes, etc.). Prior to the arrival of the first Europeans (which is the beginning of the “European era” that is best defined as starting in 1830—the year European missionaries first arrived), the only weedy species that impacted the environment were about 28 accidental Polynesian introductions, about 7 intentional Polynesian introductions that became naturalised (e.g. Dioscorea bulbifera, the bitter yam), and perhaps as many as 16 native plants that were preadapted to the sunny conditions created by Polynesian agriculture.

However, with the arrival of Europeans came a flood of new alien plants. Those intentionally brought during the last two centuries are termed intentional modern (or European) introductions if they were purposefully brought, or accidental modern (or European) introductions if their transport to Samoa was unintentional. Over the last 168 years scores of new plants have been added to the weed flora, and the total number of weeds now present in Samoa is now about 240 (a few more than reported a decade ago by Whistler 1988).

Polynesia has a history of severe weed problems. In places, such as the smaller islands of Hawai‘i, virtually no native lowland vegetation remains. In Samoa, however, the native lowland vegetation was fairly intact until a few decades ago, particularly on the big island of Savai‘i. But with the development of a commercial timber industry in 1968 and major population pressure on the natural resources, the situation in Samoa has rapidly deteriorated. Part of this is due to recently introduced (i.e. in this century) weeds.

Some of the alien weed species are restricted to sunny, disturbed places and make an impact mostly on croplands and pastures. The most common and economically important of these species in Samoa include Mikania micrantha, Paspalum conjugatum, Ruellia prostrata, Bidens alba, Hyps its rhomboidea, Mimosa pudica, Mimosa invisa, Stachytarpheta urticifolia, Commelina diffusa, and Kyllinga polyphylla. Other species, however, are able to invade native forest—usually somewhat disturbed forest—and either retard natural plant succession or cause other problems for the ever-shrinking areas of natural vegetation. The most important of the weeds that are invasive in native forest are the secondary forest trees Funtumia elastica (African rubber tree), Castilla elastica (another rubber tree), and Albizia chinesis, the shrubs Clidemia hirta (Koster’s curse) and Cestrum nocturnum (night-blooming cestrum); the vines Mikania micrantha (mile-a-minute vine) and Passiflora laurifolia (an edible passionfruit); and the grasses Ischaemum timorense, Paspalum conjugatum (t-grass), and Brachiaria mutica (California grass). Any listing of problem forest weeds would also have to include Merremia peltata, a high-climbing native
vine that can smother secondary vegetation.

In the past, only the weeds that caused problems for farmers and ranchers received attention. However, it is clear that weeds causing ecological problems are also important and in need of attention. While it is not usually the case, agriculture development sometimes is a major cause of ecological problems, such as the introduction of the potential crop plant *Funtumia elastica* (which proved of no value as a rubber tree, but is a major forest weed).

This lack of attention to forest weeds and potential forest weeds is still the case today. One example is the introduction by an aid agency of a rattan species into Samoa as a possible source of rattan cane. The plant is armed with vicious spines that would create major problems for anyone working in or walking through the forest if the plant becomes naturalised, but pleas for its elimination from research cultivation have gone unheeded. Clearly there is a need to determine what the major forest weeds are and how they can be controlled. There is also a major need to prevent future plant introductions from becoming a problem.

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Paspalum conjugatum ("T-grass")

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**New Biological Invasions Journal**

Papers are now being accepted for the new journal *BIOLOGICAL INVASIONS*, to be published by Kluwer Academic Publishers (Netherlands).

*BIOLOGICAL INVASIONS* seeks to publish research papers from many disciplines, and we hope to achieve broad representation of work from freshwater, marine, and terrestrial systems. Research papers are welcome on the patterns and processes of biological invasions (including both human-mediated introductions and natural range expansions), the ecological consequences of invasions in terms of both interspecific interactions as well as alterations to community and ecosystem structure (such as energy flow modifications, biodiversity, and invasion-mediated extinction), the factors that influence inoculation, establishment, and persistence of invasions and the mechanisms that control the abundance and distribution of invasions, amongst other topics.

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New introductions and a special law for

Galapagos

The flora and fauna of the Galapagos Islands are remarkably fortunate in the relatively late arrival of humans to this isolated archipelago, lying some 600 miles west of South America and composed of 15 major islands and many islets and rocks. But now they are feeling the effects.

The islands are presumed to have been pristine when they were discovered in 1535 by the Spanish. The discovery was accidental and the islands remained largely unvisited until the late 1600s, when British buccaneers found Galapagos to be a useful refuge after their attacks upon Spanish ports and galleons. At most, however, they can have been responsible for the introduction of rats or mice.

Major visitation, colonization, and, consequently, introductions came in the 1800s. Whaling ships visited the archipelago in large numbers from the early 1800s until about 1860. Although their greatest impact was on the tortoise populations—which they took for food in such huge quantities that many races were brought to the brink of extinction and two races were killed off completely—whalers are undoubtedly responsible for the introduction of black rats (Rattus rattus) and domestic cats to some islands.

In 1832, Ecuador claimed the Galapagos and established a colony on Floreana. The settlers brought food crops and domestic animals, such as cattle, horses, burros, pigs, and chickens. The Floreana colony failed and some settlers moved to other islands. Some domestic animals were taken along, but the cultivated crops and many animals, now feral, remained. Further colonization attempts were made here and on other islands, with further intentional introductions of food crops and domestic animals.

Today, by decree promulgated in 1959, 97% of the Galapagos Archipelago is National Park. The remaining 3% (parts of Floreana, San Cristobal, Isabela, and Santa Cruz Islands and all of Baltra Island) are inhabited.

Baltra, a low, arid island, is a military reserve, but the other inhabited islands each contain a port village and an extensive agricultural zone in the highlands.

With the increase in tourism in the past two decades and, in 1991, the beginning of a very lucrative fishery for sea cucumbers (illegal as of this writing), the population of Galapagos began to explode, as people flocked to the islands. The current population is estimated at 15,000, with an annual increase of over 8% during the 1990s.

Increased population, especially with increased wealth, meant an increase in the amount of cargo arriving, with the concomitant increased risk of introductions.

Regulations today prohibit the importation of animals and plants. Farmers, particularly those who raise cattle, have been happy enough to comply, since their animals, (at least until recently, when an isolated outbreak of foot-and-mouth disease was detected), are known to be free of such diseases as brucellosis and tuberculosis.

Nevertheless, the regulations are neither obeyed by everyone, nor strictly enforced. In March 1998, the Ecuadorian Congress passed a Special Law for Galapagos which aims to promote conservation and includes, among many other topics, provisions regarding control of introduced species and quarantine. A new system of inspection and quarantine is ready, but implementation is only preliminary; full implementation will need substantial investment for infrastructure, training, and education. Thus further intentional, although illegal, introductions have been made with the result that canine parvovirus has recently appeared, as have Newcastle and Marek's disease in chickens. The notorious plant kudzu (Pueraria—species as yet unconfirmed) was discovered in the highlands of Santa Cruz a few years ago. Fortunately, it was found by an officer of the Provincial Agriculture Department and the head of Botany at the Charles Darwin Research Station, so it was eliminated before it could spread (periodic monitoring and control is still necessary).

Cargo vessels come from the mainland with a wide array of materials, including lumber, sacks of potatoes and onions, stalks of bananas, and cardboard containers that may harbor any number of insects. Fresh vegetables also arrive in air cargo.

Some thirty years ago, cargo boats arrived once every 3-6 months; today they arrive weekly. Similarly, air traffic was one flight per week about twenty years ago, coming to the air strip on Baltra. Now there is an additional airport on San Cristobal and a small airfield for interisland flights on Isabela. Flights occur daily to both Baltra and San Cristobal. On some days, during high tourist seasons, three flights arrive at Baltra.
The introductions today tend to be of inconspicuous—and therefore all the more insidious—organisms. Around 1988 a vespid wasp (*Polistes versicolor*), from the mainland, was discovered on Floreana, probably introduced with a stalk of bananas. Today it occurs throughout the entire archipelago, its dispersal undoubtedly aided by fishing boats and/or tour vessels, many of which carry stalks of bananas—very attractive to these wasps—on the back deck. In 1994, another vespid wasp (*Brachygastra lecheguana*) was found in the port village of Santa Cruz.

A biting black fly (*Simulium bipunctatum*), introduced to San Cristobal around 1989, may find dispersal more difficult, since its larval stage requires running fresh water and San Cristobal is the only island with a constantly running stream. The cushion-cotton scale (*Icerya purchasi*) was introduced to San Cristobal, probably with ornamental plants in the early 1980s; it has now spread to several other islands.

The effects of introduced organisms on native Galapagos species are just what one would expect in an insular ecosystem: for example, endemic snakes are rare where introduced cats occur; black rats are the suspected cause of the extinction of several native rice rat species; tortoise habitat has been devastated by goats; agriculture has altered biological communities in the highlands; and the number of introduced plant species will soon equal—and perhaps surpass—the number of native species.

The major threat facing Galapagos ecosystems today comes from introduced organisms. Tomorrow’s problems may be here already—we simply don’t know how many newly introduced organisms there are, nor what problems they may cause in the future. What we do know is that the problems will be difficult and costly to control.

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See *Aliens* issue 1, March 1995, for an earlier report from Galapagos.
However, goat sign was found on the lowest southern slopes of Alcedo in 1979, indicating that either they were indeed able to cross this natural barrier or were introduced to the north side of the isthmus by humans. Within the last 15 years, this population has exploded and dispersed throughout Alcedo. Goats have also been reported on both Darwin and Wolf Volcanoes; these may have dispersed from Alcedo or been released directly by humans.

The island of Isabela in the Galapagos Archipelago is plagued by feral animals, and some of its natural communities are already seriously modified due to enormous browse pressure by feral goats (Capra hircus). Urgent action to restore the natural communities of Isabela is of vital importance to the conservation of biodiversity of native species and communities in this unique World Heritage Site. Galapagos is the largest remaining archipelago in the world with the vast majority of its species extant (approximately 95%). This is because the arrival of humans and the spread of introduced organisms are relatively recent phenomena. However, the recent spread and explosion of the goat population on Isabela, the largest of the islands, has already had major impacts on the ecosystem and may push many endemic species to the brink of extinction.

The island of Isabela (458,812 ha.) contains more than half of the total land area of the archipelago and more endemic species than any other island in the Galapagos. Although most of these endemic species occur elsewhere in the archipelago, Isabela has a greater concentration of endemic species than the other islands (40% of the endemic vertebrate species and 66% of the endemic plant species). Many of these populations are now seriously threatened. An innovative research and management program is imperative to ensure the survival of the island’s native flora and fauna.

While northern Isabela (Alcedo, Darwin, Wolf, and Ecuador Volcanoes; approximately 250,000 ha.) is entirely within the Galapagos National Park, southern Isabela (Cerro Azul and Sierra Negra Volcanoes; approximately 210,000 ha.) has a small urban zone (111 ha.) and a somewhat larger rural zone (3457 ha.), both on the southern half of Sierra Negra. Primarily due to its human population, southern Isabela has had, for many decades, large populations of feral animals (goats, cattle, horses, donkeys, pigs, dogs, cats, and rats), while northern Isabela has had few (donkeys on Alcedo, and cats and rats on all of northern Isabela). Northern Isabela is separated from southern Isabela by the Perry Isthmus, a natural barrier of rough a’a lava, approximately 12 km across (from Elizabeth Bay to Cartago Bay), and 12 km from north to south. The Perry Isthmus has few pockets of vegetation and was considered an effective barrier to keep the goats and other feral animals on southern Isabela from crossing to northern Isabela.

However, goat sign was found on the lowest southern slopes of Alcedo in 1979, indicating that either they were indeed able to cross this natural barrier or were introduced to the north side of the isthmus by humans. Within the last 15 years, this population has exploded and dispersed throughout Alcedo. Goats have also been reported on both Darwin and Wolf Volcanoes; these may have dispersed from Alcedo or been released directly by humans.

In 1995, the Charles Darwin Foundation (CDF) and the Galapagos National Park Service (GNPS) began the Isabela Project. The project goal, to restore the island to as near a pristine condition as possible, implies restoring fully the biodiversity of Isabela and its natural ecological and evolutionary processes, in the absence of introduced species, whilst accommodating and incorporating the community of southern Isabela. Since 1995, goat control in critical tortoise habitat and semi-annual monitoring of the flora and fauna on Alcedo Volcano has occurred regularly. In 1997 two areas on the southern rim of Alcedo (approximately 300 m² and 500 m²) of the threatened endemic tree fern (Cyathea weatherbyana) were fenced; in addition, approximately 200 Zanthoxylum and Tournefortia trees were wrapped with chicken wire to protect them from goats. These trees are critical to the formation of drip pools where tortoises drink and rest during the dry season.

In September 1997, the Isabela Project conducted a workshop in Galapagos to develop a plan to stop the ecosystem degradation on Isabela through eradication of feral ungulates. Fourteen experts on introduced species from New Zealand and the United States convened with several experienced and knowledgeable representatives of the CDF and GNPS for nine days of intensive group meetings, with visits to several sites on northern Isabela. The unanimous conclusion of the participants, experts in eradication of goats and other vertebrate pests, and
restoration of islands, was that eradication is definitely the preferred approach, both ecologically and financially.

A detailed plan, consisting of three phases, was developed. The objectives of the plan are to:
1. Enhance the management and operational capacity of the GNPS and the CDF for this and future conservation projects.
2. Eradicate ungulates from northern Isabela.
3. Prevent the reinvasion of northern Isabela by ungulates following their eradication.
4. Develop a restoration plan for southern Isabela.

Phase I of the plan prepares for the eventual elimination of all ungulates from northern Isabela, fills data gaps critical to a successful eradication campaign, accomplishes interim protection, and enhances the capacity of the GNPS to manage and operate pest control and eradication programs. Phase II details an appropriate strategy, which is to progressively eradicate the ungulates, as rapidly and efficiently as possible, from all of Isabela Island north of Perry Isthmus and to maintain that isthmus as a buffer against further immigration from the south. Phase II relies on highly skilled contractors and state-of-the-art technologies developed during the last few decades for large-scale ungulate management and control projects throughout the world. Phase III, begun during and continuing after the eradication objective is achieved, calls for continued monitoring for introduced ungulates and preventative actions to protect northern Isabela from further introductions.

The estimated total cost of the plan is $US 8.5 million over the next four years. Completion of this plan will be a major step forward in the restoration of the island of Isabela and the protection of natural ecological processes within the Galapagos National Park.

The workshop was organized by Linda Cayot, the Isabela Project Coordinator (GNPS/CDF) and facilitated by Peter Jenkins of Biopolicy Consulting. Other participants in the workshop were:


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Cautionary Tales...

Bats journey to England

At the end of February, an inadvertent transfer took place—a transfer of bats—from France to England. On 26 February, five Nathusius’ pipistrelle (Pipistrellus nathusius) were discovered in a timber truck carrying oak planks from Normandy. This seems to be only the fourth occurrence of the species in the UK, but because of the rabies risk, it was decided either to send them back to France for release, or to euthanase them, despite their full protection all over Europe. So with the authorization of the French government, the help of the French mammal society and the collaboration of our British colleagues, it was possible to drive the bats to Dover, put them in the shuttle under the Channel, pick them up in Calais, France, and drive them back safely to their Normandy home, where they were released in early March.

Amami Mongoose

Mountainous Amami-Oshima island, with an area of 719 km², and dominated by broadleaved evergreen forests, is situated in the northern Ryukyu Island archipelago and has a highly endemic fauna. A mongoose species (Herpestes auropunctatus) was introduced to the island around 1979 to control the poisonous snake (Trimeresurus flavoviridis) and the rat (Rattus rattus). The mongooses were first introduced at northern Naze City and are expanding in all directions at the rate of 1km/year. At present they occur in every district of the island, though the highest population densities are found over a quarter of the island; to the southeast of Naze and covering the central part of the island. One estimate of the population size in 1993 was about 100,000, although this figure seems exaggerated. There is great concern that the mongoose preys upon the endemic and endangered animal species. So far, remains of the Amami rabbit, Ryukyu spiny rat, Watase shrew and Ryukyu robin have been found in the stomach contents and droppings of the mongoose, and an attack on the nest of Ridth’s jay was observed. Also the distribution pattern of the Ryukyu spiny rat, Amami woodcock and, to some extent, the Ryukyu rabbit, suggests that these species are affected by the mongoose. The Environment Agency launched a five-year project (1996-2000) to investigate the current situation and to find appropriate schemes to control the mongoose, and directed Japan Wildlife Research Center to carry out the project. The Environment Agency project aims to find a measure to eradicate the mongoose, but currently the budget is too small. It is possible that populations of endemic species will decline during the project. With our findings we are now trying to convince the governments (central and prefectural) to spend enough money.

Raccoon’s sojourn in France

On 2 April 1998, a container of resin for tyres was opened in the city of Le Havre, Normandy. A raccoon (Procyon lotor), exhausted but alive, walked out of it and started to drink at once in a small water pool on the ground. After a short enquiry, it was learnt that the container had been closed on 25 February, five weeks earlier, in Houston, Texas, USA. The container had been shipped across the Atlantic Ocean, arrived at harbour in Antwerp, Belgium, and was trucked to Le Havre. The raccoon is now being kept in quarantine in Normandy, and seems to be recovering from its journey. What to do with it? Besides these cases, how many are we missing?

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...and Solutions?

When you can't beat 'em, eat 'em

SEOUL, South Korea — Fried frog, sweet and sour frog, frog gruel. Introduced at a government-sponsored food-tasting party today, frogs in almost any cooked form seem to be South Korea's answer to its latest pest problem. Biologists have warned that imported American bull frogs — 10 times larger than indigenous frogs — are decimating local stocks of snakes and other frogs in many lakes, endangering the ecological balance.

In the past month, school children and soldiers were enlisted to help catch bull frogs. But the government has come up with a novel extermination method — eat 'em. The cooked frogs were sampled by hundreds gathered outside the Environment Ministry. Low in fat and calories but high in nutrition, frog meat is a healthy alternative to beef, the ministry said. While eating frog is not new to Korea, only a few have acquired the taste. Bull frogs were imported from the United States in the 1980s for their meat but the attempt at mass marketing fizzled. The frogs soon escaped into the wild.

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A comment from Rob Cowie of the Bishop Museum, Honolulu

Samoa too, has recently taken a similar approach to its Giant African snail problem — by trying to promote their consumption. But this has engendered some controversy, and so far the scheme hasn't taken off.

My own view is that it may be a bad idea. If you successfully promote eating them, someone from a currently non-infested area is going to want to get some African snails and breed them to make some money (or perhaps just raise them for personal consumption), so she or he brings them to the area, some escape, and the infestation has been spread.

African snails (and many others, including E. rosea) do harbor Angiostrongylus cantonensis, the rat lung-worm, which if ingested by humans can cause eosinophilic meningoencephalitis (which is nasty). So the snails must be thoroughly cooked. This is a concern, and may be the root cause of some people being worried that African snails are poisonous.

North American raccoon Procyon lotor
In 1997 the Regional Citizens' Advisory Council of Prince William Sound and the U.S. Fish and Wildlife Service sponsored a pilot study of the risk of nonindigenous species introductions associated with oil tanker ballast water discharge in Port Valdez and Prince William Sound. The study, conducted by the Smithsonian Environmental Research Center, included a review of existing invasion literature relevant to the problem, the sampling and analysis of plankton in both the segregated and oily ballast water of arriving tankers, and limited ballast exchange experiments.

Prince William Sound is a large inland archipelago, roughly 15,000 square kilometers in area, located in south-central Alaska at the northern tip of the Pacific Ocean. The sound is vital, ecologically (for the array of marine resources it supports) as well as economically (for the industries that rely on those resources), and because 20% of the United States' domestically-produced oil passes through its waters. In the northeast corner of Prince William Sound is Port Valdez, a roughly 20km-long fjord with the small community of Valdez situated on its northeast shore and the Valdez Marine Terminal on the southeast shore.

A relatively small fleet of oil tankers has made more than 15,000 voyages to this terminal since it began operations 20 years ago, and tankers are currently arriving at the rate of roughly 600 per year. These tankers discharge as much as 40 million metric tons of ballast water annually into the waters of Prince William Sound. Although proportions and volumes vary widely between ships, roughly half of that total arrives as segregated ballast water, which is carried in ballast tanks and discharged directly into Prince William Sound and Port Valdez. This volume of segregated ballast discharge ranks Port Valdez third in the United States behind Chesapeake Bay and the New Orleans/Mississippi Delta area. The other half is unsegregated, or "oily" ballast carried in cargo tanks and pumped ashore to a ballast water treatment facility before being discharged into the Port.

The vast majority of these tankers arrive from U.S. West Coast domestic ports which are themselves invaded by nonindigenous species. The balance of traffic comes from Far East ports, and on these voyages ballast exchanges are required. Voyage durations from the West Coast vary from as little as three days from Puget Sound to a little over a week from southern California. Since no ballast is exchanged during domestic voyages, we conclude the average age of the vast majority of the arriving coastal ballast to be five or six days.

The major field component of the pilot study consisted of sampling (with an 80-micron mesh net) both the segregated and oily ballast water of 13 tankers that arrived in Valdez during a two-week period in late May and early June of 1997. We found that the oily ballast water contained very little, if any, viable plankton, which would seem to all but eliminate that medium as a potential vector for introductions.

But the segregated ballast samples revealed a rich and abundant medley of coastal plankton, including polychaetes, barnacles, and copepods. At least 69 different taxonomic groups were identified. By multiplying the plankton densities times the amount of ballast water in the tankers, we estimate that 244...
million organisms are being released on average by these ships on each voyage. The plankton samples included four species of Asian copepods which we could positively identify as nonindigenous. While we have no evidence that these species have become established in Alaska, it is now clear that NIS or highly invasive source ports are being transported alive and in good condition to Port Valdez.

We were able to conduct two ballast exchange experiments in this pilot study thanks to the cooperation of SeaRiver Maritime, one using a 150% volume flow-through exchange, and the second using a 300% volume flow-through exchange. Both experiments showed that exchange is effective at reducing various plankton groups by between 70% and 90%. However, there was no indication that the higher percentage of exchange was more effective. For coastal plankton taxa, the exchange was very effective in reducing organisms, although total numbers of organisms remained high as the process is not 100% efficient. Because of the large volume of water in the tanks, even the small amount of residual coastal plankton in the tanks amounts to large numbers of coastal organisms being transferred in exchanged water. Both temperature and salinity of the arriving ballast was found to be quite similar to that of the receiving waters beside the tanker at surface and at 10 meters depth—well within the tolerances of most of the species in the source ports.

The pilot study is now being followed up by an expanded, two-year investigation that includes year-round sampling of segregated ballast, expanded ballast tank exchange experiments, survivability studies of ballast plankton, fouling plate deployment, and collection and analysis of Prince William Sound plankton. The pilot study and the extended study represent a highly collaborative effort between oil shippers, Alyeska, regulators, scientists, and non-profit organizations. Both through the Regional Citizens' Advisory Council, the U.S. National Sea Grant College Program, the Regional Citizens' Advisory Council, the U.S. Fish and Wildlife Service, and Alyeska Pipeline Service Company (which operates the Trans-Alaska pipeline and Valdez Marine Terminal). Funding for this expanded work comes from the U.S. National Sea Grant College Program, the Regional Citizens' Advisory Council, and the U.S. Fish and Wildlife Service. Alyeska Pipeline Service Company (which operates the Trans-Alaska pipeline and Valdez Marine Terminal). Funding for this expanded work comes from the U.S. National Sea Grant College Program, the Regional Citizens' Advisory Council, and the U.S. Fish and Wildlife Service. Alyeska Pipeline Service Company (which operates the Trans-Alaska pipeline and Valdez Marine Terminal). Funding for this expanded work comes from the U.S. National Sea Grant College Program, the Regional Citizens' Advisory Council, and the U.S. Fish and Wildlife Service. Alyeska Pipeline Service Company (which operates the Trans-Alaska pipeline and Valdez Marine Terminal). Funding for this expanded work comes from the U.S. National Sea Grant College Program, the Regional Citizens' Advisory Council, and the U.S. Fish and Wildlife Service. Alyeska Pipeline Service Company (which operates the Trans-Alaska pipeline and Valdez Marine Terminal). Funding for this expanded work comes from the U.S. National Sea Grant College Program, the Regional Citizens' Advisory Council, and the U.S. Fish and Wildlife Service. Alyeska Pipeline Service Company (which operates the Trans-Alaska pipeline and Valdez Marine Terminal). Funding for this expanded work comes from the U.S. National Sea Grant College Program, the Regional Citizens' Advisory Council, and the U.S. Fish and Wildlife Service. Alyeska Pipeline Service Company (which operates the Trans-Alaska pipeline and Valdez Marine Terminal). Funding for this expanded work comes from the U.S. National Sea Grant College Program, the Regional Citizens' Advisory Council, and the U.S. Fish and Wildlife Service. Alyeska Pipeline Service Company (which operates the Trans-Alaska pipeline and Valdez Marine Terminal). Funding for this expanded work comes from the U.S. National Sea Grant College Program, the Regional Citizens' Advisory Council, and the U.S. Fish and Wildlife Service. Alyeska Pipeline Service Company (which operates the Trans-Alaska pipeline and Valdez Marine Terminal).
Due partly to their arid climate, many of the over 150 islands and islets of Northwest México have, until recently, experienced minimal human use and impact. However, introduced mammals are present on various islands in this region and threaten endemic species with extinction. For example, of the nine island vertebrate extinctions in NW México, eight have been caused by introduced mammals. However, despite the recent increase in human use and disturbance, these islands remain relatively intact in comparison to most temperate or tropical island groups throughout the world.

In the last few years these islands have benefitted from a developing collaboration between the Mexican Instituto Nacional de Ecología (INE) which manages the islands, several academic institutions and a number of NGOs. Amongst the NGOs most active in island conservation are: CCREAR (Comité Cientifico para la Conservacion y Estudia Archipelago Revillagigedo), Conservation International México, ISLAS, Pronatura, The Nature Conservancy, WWF and The Island Conservation & Ecology Group (ICEG). ICEG is a binational non-profit organisation of conservation biologists, educators and public officials working to protect biological communities on islands in NW México and Southern California. We undertake projects that have a clear conservation benefit, are locally based and are supported by the Mexican government. The U.S. office is headed by Bernie Tershy and Don Croll in Santa Cruz, California. The Mexican office is headed by Jose Angel Sanchez Pacheco in Guegero Negro, Baja California Sur.

Over the past four years ICEG has worked with INE and Universidad Nacional Autonoma de México (UNAM) to remove introduced black rats and feral cats from three important seabird nesting islands off Baja California: Asunción and San Roque Islands in the Vizcaíno Biosphere Reserve and Coronado Norte Island near the U.S./Mexican border. Since removal of introduced mammals, seabirds have begun to recolonise and expand their breeding colonies on these islands. While conducting these restorations, we have improved our introduced mammal removal techniques and trained Mexican and U.S. students in island conservation techniques. We have also collaborated with INE and NGOs on draft management and education plans for island reserves in NW México and have provided technical aid to colleagues at UNAM, who successfully removed mammals from Rasa and Isabela Island in the Gulf of California. In Southern California we developed a plan to eradicate ship rats from Anacapa Island in the Channel Islands National Park. Currently island research and restoration projects are underway on the San Benitos, Todos Santos and Natividad Islands. The San Benitos Islands, which are 38 miles west of the Vizcaíno Peninsula, are threatened by introduced rabbits, goats and burros. Introduced herbivores have nearly driven an endemic species of succulent (Dudleya linearis) to extinction. On the Todos Santos islands which are approximately 90 kilometres south of the U.S./Mexican border, introduced cats and rabbits threaten the native flora and fauna. Predation by feral cats and perhaps competition with rabbits have likely driven the Todos Santos endemic packrat (Neotoma anthonyi) and an endemic subspecies of rufous-crowned sparrow (Amphispiza ruficeps sanctorum) to extinction. In addition, an endemic subspecies of deer mouse (Peromyscus maniculatus davis) has been heavily preyed on by feral cats. Eradication programs for these islands are nearing completion and are taking place in conjunction with a study on the ecosystem effects of introduced herbivores. On Natividad Island, ICEG is working with the Vizcaíno Biosphere Reserve and local fishermen to gather natural history data on the black-vented shearwater (Puffinus opisthomelas), a little-known Baja California endemic which is thought to have experienced dramatic population declines. These data will be used by managers of the Vizcaíno Biosphere Reserve to help protect the black-vented shearwater and other species on Natividad Island.

At INE's request, we are working with CCREAR to plan an introduced mammal removal project for the Revillagigedos Archipelago Biosphere Reserve. On these remote islands introduced cats, sheep, pigs and rabbits directly or indirectly threaten at least 16 endemic species or subspecies with extinction. One species, the Socorro dove (Zenaida graysoni) is extinct in the wild but survives in a captive population which is being managed for the introduction once cats are removed. Our first planning trip will take place this year.

Finally ICEG is developing an Island Conservation Database for the NW México region, which we plan to make available over the WWW. This database will aid in the systematic prioritisation of islands for research and conservation action, which can be improved as the database develops.

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The Invasive Species Specialist Group has been growing in size, as well as in the scope of projects being undertaken. The over 80 members are involved internationally in diverse projects, all with the aim of preventing new invasions, reducing the impacts of current ones and educating people about the impacts of this generally little-known threat to biodiversity. Early 1998 has been a time of great worldwide concentration on invasives, with group members taking part in several meetings. Among these were two with a global focus held in San Mateo, California (see front cover).

In addition, ISSG sent a representative, Rod Hay, to the May CITES Animals Committee meeting held in Caracas, Venezuela. His aim was to follow up the close liaison between ISSG and CITES which was proposed at the last CITES Conference of the Parties.

Two excellent invasives-awareness publications have just been produced. IUCN’s latest World Conservation is a comprehensive, 64-page, double issue on invasives. It is superb, with its many colour photographs, for public advocacy use. The publication is global in its coverage, and many articles have been written by group members. The second publication is an eye-catching fold-out brochure which explains the Global Invasive Species Programme (GISP) (see front cover). This is being coordinated by SCOPE (Scientific Committee on Problems of the Environment), with IUCN, CAB International, and the United Nations Environment Programme (UNEP) as partners. The brochure charts the background, components and tools of this international team now being organised to prepare a global strategy for addressing the invasive species problem. It is for advocacy and fundraising purposes and is being widely distributed.

Another upcoming meeting with which ISSG is involved, is the Society for Conservation Biology’s Annual Meeting, to be held for the first time in the Southern Hemisphere, in Sydney, Australia. The ISSG is convening a half-day Symposium, with 10 invited speakers, entitled: “Conservation issues of invasive species in Australasia and the Pacific” (see page 22).

The “Draft IUCN Guidelines for the Prevention of Biodiversity Loss due to Biological Invasion” have now passed to Wren Green for final polishing before ratification is sought from IUCN’s Council.

To help with this process, and also address the increasing need for information on invasives, ISSG now has a website, nested within the IUCN pages and accessible at: http://iucn.org/themes/ssc/programs/invasives/issg/

This office has received steadily-increasing numbers of requests for background as well as specialist information, from journalists, governments, NGOs and other agencies. The draft guidelines can be read from the ISSG website. The site also features an introduction to the group, descriptions of projects, plus links to other interesting and relevant sites.

The Aliens-l listserv is thriving, and with 473 subscribers is one of the most active within IUCN.

And finally, Aliens has been attracting some positive feedback and is now in its fourth year. Please continue to send in notes, reports and comments to your newsletter so that we can continually improve its usefulness to readers worldwide. The deadline for Aliens 8 is 30 September.

Sarah Lowe and Mick Clout
In spite of a climate relatively inhospitable to most of the Earth’s species, introduced aliens are an unexpectedly real threat in the Antarctic. The introduction of pathogens could have devastating effects on previously unexposed colonies of birds or seals. Acclimatisation of introduced plants or animals could affect ecological integrity. All introductions, including micro-organisms, and even those that are not directly harmful to natives, detract from Antarctica’s scientific and intrinsic values. Increasing potential for translocations within the Antarctic adds to the problems.

**PATHOGENS**

Recently, research discovered serological evidence of Infectious Bursal Disease Virus (IBDV) in Adélie and emperor penguins in the vicinity of Australia’s Antarctic Mawson Station (*Nature* 15 May 1997). The biological significance of IBDV in those species is not known at this stage. In poultry it is a serious disease, causing immune deficiency and/or death in chicks. The impact of the disease in an immunologically-naïve population of birds could range from reduced productivity of the birds to local extinction of the species. Although clinical disease was not apparent in either species of penguin, further investigation is warranted. The presence of seroreactors in the population near Mawson station and their absence in the chicks from a remote colony suggest that the introduction is related to human activity. Many avian pathogens can contaminate the meat or eggs of poultry as well as food products containing these substances. Cooking or freezing does not necessarily kill the virus. A possible source of introduction could be careless or inappropriate disposal of poultry products, allowing access by scavenging birds such as the south polar skua.

Australia has agreed to host a meeting (see box opposite) in Hobart to consider options for monitoring and managing responses to the disease. Meanwhile, the Australian Antarctic Division has recommended that its researchers and visitors not take poultry products into the field, and that they thoroughly clean all footwear, clothing, and field gear before going from one site to another. Of special concern are tourists or researchers who travel from one colony to another, and who may spread the pathogen to other colonies, or even to regions a great distance away.

**INTRODUCED ORGANISMS**

Nowadays, if Antarctic research discovers micro-organisms that also occur in temperate zones, it has become quasi-impossible to determine whether such species occur naturally, or whether they have been introduced stuck to skin, boots, helicopter skids or airplane wheels of a previous generation of researchers or explorers. The
Antarctic Continent is vast, but the icefree zones are limited—and hardly any have been untouched by humans. At the micro level, Antarctica has already lost its pristineness.

The introduction of higher taxa into the Antarctic includes accidental imports like insects (cockroaches), rats and mice on ships, and non-accidental presences such as plants and 'pets' on tourist ships and Government Stations. Recent anecdotal information confirms that pets may include a dog, budgerigars and tropical fish; even a cat has apparently been seen. Rats, mice, and insects are an obvious threat to subantarctic islands as they may "escape" and become established. Cats or dogs, even as pets, could do damage to native birds anywhere. More surprising is the increasing evidence of higher organisms able to establish themselves in the Far South. Of particular concern are grasses and other plants reported growing "wild" in the vicinity of several Stations, not just on King George Island, but also on Continental Antarctica. Live invertebrates, including earthworms, potworms, mites and fly-larvae were discovered in imported soil discarded by a Station in the Schirmayer Oasis.

RULES AND REGULATIONS
The “Agreed Measures for the Conservation of Antarctic Flora and Fauna” and more recently the Antarctic Environmental Protocol Annex II (Conservation of Antarctic Flora and Fauna) expressly prohibit the introduction of non-native flora and fauna, except in accordance with a permit. Permits may only be issued for the importation of domestic plants, and laboratory animals and plants including viruses, bacteria, yeasts and fungi. Any introduced flora or fauna must be incinerated or removed from the Antarctic Treaty area. In addition, Annex II requires the incineration or removal of all poultry parts (originally brought into Antarctica for food) to avoid the spread of disease.

CONCLUSION
On paper, the measures to prevent introductions in Antarctica appear strong, and indeed there have been fewer introductions into this region than we might have feared. But this is no time for complacency. At present, compliance is not absolute and accidental introductions add to the concern. Climate has "ameliorated" in many locations, allowing new species to take hold. Increased numbers of people are visiting Antarctica, thus increasing the potential for introduction as well as translocation. We can only expect that the threat from invasive organisms in Antarctica will grow.

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**Workshop: Diseases of Antarctic Wildlife**

25-28 August 1998
Australian Antarctic Division Headquarters,
Hobart, Tasmania, Australia

The Australian Antarctic Division's homepage states: "The objectives of the workshop are to identify the potential for disease incursion into Antarctica's wildlife, and to develop a series of recommendations to be presented to the Antarctic Treaty Consultative Meeting to reduce the risk of such introductions and limit the consequences of any disease establishment and spread. The workshop will focus on diseases of birds and seals breeding within the Antarctic Treaty area and will consider both endemic and exotic diseases. It will also take into account scientific information relating to diseases of wildlife in the subantarctic". One specific topic to be addressed is the changing risks in introduction of disease, such as tourism and global climate change. Read more at: [http://www-aadc.antdiv.gov.au/human_impacts/disease_workshop/](http://www-aadc.antdiv.gov.au/human_impacts/disease_workshop/) or fax Dr Kerry Knowles at +61-3-6232-3351
New Zealand's National Institute of Water and Atmospheric Research (NIWA), based in Wellington, should have been included in the *Aliens* 6 register of institutions with Pacific taxonomic expertise:

In 1992, NIWA subsumed the former NZ Oceanographic Institute, the foremost repository in New Zealand for oceanographic data.

NIWA:
- holds New Zealand's largest wet collection of marine invertebrates: from the entire New Zealand region, tropical Pacific islands, and the Ross Sea (more than 100,000 jars, and several million specimens);
- has both specialist expertise in a number of marine groups (Bryozoa, Polychaeta, Porifera, Echinodermata, Copepoda, Cephalopoda and toxic microalgae) and generalist taxonomic expertise in additional groups;
- publishes a major taxonomic monograph series: Memoirs of the NZ Oceanographic Institute, recently renamed NIWA Biodiversity Memoirs.

For further information, consult:
http://www.niwa.cri.nz,
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Christopher Lever has been commissioned to write a book with the working title "The Cane Toad: the history and ecology of a successful colonist". He would welcome notification, at the following fax number or e-mail, of any references in the literature of the early 1980s, as well as recent personal information on any naturalised populations.
Fax: +44-1344-891744
E-mail: Christopher@linnean.demon.co.uk
Brown Treesnake Research Symposium

27-29 July
Tapa Tower, Hilton Hawaiian Village,
Waikiki, Hawaii

"Researchers developing techniques to control brown treesnakes (Boiga irregularis) have not met in an organised forum since 1993. There have been substantial advances in the understanding of brown treesnake biology and the development of control techniques for this pest species since then. The 1998 Brown Treesnake Research Symposium is intended to provide such a forum. Over thirty federal, territorial, state, university, military and private researchers have committed to present the results of their efforts in a public forum."

Alien Introductions Symposium in Wales

10 September 1998

The Zoological Society is organising a day-long symposium on "Alien introductions and their impact on native species" at the British Association meeting in Cardiff, UK.
Speakers will include David Macdonald, Paul Pearce-Kelly, Digger Jackson, Morris Gosling, Johnathon Baillie and Baz Hughes. For further details contact:

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Aliens newsletter to appear on WWW

Tom Moritz, affiliated with the California Academy of Sciences and University of California at Berkeley, has kindly offered to post Aliens to the web. The newsletter will be accessible, in a few weeks time, as either a .gif file, or a plain text file, at web address: http://elib.cs.berkeley.edu/docs/query.shtml (under "newsletters"). Links will be set up from both the SSC pages and ISSG's own website.

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Central Africa is a region characterised by dense humid forest ecosystems. The two main activities in this region are manifested in the exploitation of this great tree-covered massif by forestry and agriculture.

Today, more than in the past, several species of plants are attracting the attention of farmers, foresters and other related interest groups. Two of these plants may be considered invasive in central Africa due to their spread and dominance within the region: *Chromolaena odorata* and *Eichornia crassipes* (water hyacinth). These can be observed, respectively, associated with human activity, and in most of the waterways of the region.

*Chromolaena* is native to tropical America. According to Gautier (1992), this plant was introduced to central Africa from the 1960s onwards (Cameroon from 1961, Central African Republic 1963, Congo-Brazzaville 1965, and Congo-Kinshasa from 1975).

In the waters of central Africa, *Eichornia crassipes* has shown itself in recent years to be a dominant aquatic plant. Not only has it blocked certain waterways, but has also contributed to the decline of certain freshwater fish species as a result of the lowering of oxygen levels in freshwater bodies.

While it is true that traditional medicine utilises the young leaves of *Chromolaena odorata* as an infusion for the treatment of abdominal colic, coughs and fever, the quantity used is minimal and will not contribute to any reduction in the plant's dominance.

While the countries of central Africa link their efforts through the Conference sur les Ecosystèmes de Forêts Denses et Humides d'Afrique Centrale (CEFDHAC) for sustainable management of forest ecosystems, *Chromolaena odorata* could be perceived as a type of "gangrene" which prevents natural regeneration of forests. In the meantime, in the fallow plots of itinerant agriculturalists in the rainforest regions, this plant has become a significant component of natural succession and many peasants consider it to be, at once, one of the worst weeds and one of the plants that improves soil quality for the growing of specific crops such as groundnut and maize.

Invasive plants are also aggressive in certain protected areas of savanna and even forest, and cause damage to natural resources. The transformations effected by the presence of these species may be as far reaching as the disturbance of decades of equilibrium between flora, fauna, soil and waters. And this often results in a reduction of species and in modification of tourist itineraries dependent on visual values. But managers of central African protected areas are already confronted with numerous problems such as the preservation of their sites against poaching. As the battle against invasive species has not been prioritised, it's usually the case that no action is taken until it's too late to repair damage caused by these species. This has become a real challenge in the daily management of the protected areas.

Even if *Chromolaena odorata* is not on the agenda of the Second CEFDHAC, the participants at this meeting, and notably the ministers in charge of central African forests, parliamentarians, technicians, ONG, and the private sector, won't miss the chance for discussions in the corridors about this important question of invasive species. Isn't this a challenge for terrestrial and aquatic biological diversity?

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