

ALIENS

NUMBER 3 / MARCH 1996



Invasions Guidelines

This year, the Invasive Species Specialist Group has funding to compile draft guidelines on species introductions for presentation at the IUCN World Congress in Montreal, October 1996.

Resolution 19.51 of the 19th IUCN General Assembly (Buenos Aires, January 1994), amongst other points, requests the Director General to: "strengthen...in particular SSC's work on:

- developing guidelines on the pre-introduction screening of species proposed for intentional introduction outside their natural range, and on the control and eradication of introduced species that have become invasive;
- developing guidelines for the repatriation and disposition of confiscated specimens;
- ensuring that issues of risk and health associated with the reintroduction of species are fully addressed in any guidelines developed".

ISSG is coordinating this work from its office in Auckland, and outlines of progress so far can be obtained from the address below. All group members, and other experts concerned with species invasion, are invited to contribute comments concerning the content and presentation of these guidelines. The deadline for a finished first draft is the end of July 1996, and by then we hope to have received responses to the outline, and offers to help construct and flesh out the missing parts. Please take the time to add your voice to this important document.

Thank you very much to all the contributors who have written for this issue. *Aliens* Number 4 will be out in September 1996. Please start thinking about articles now, and encourage your colleagues to do so too. A potential topic to consider might be: the use of chemicals for invasives control, and the minimisation of harm to native biota. Please send contributions by the last day of July.

Please note: we are reviewing our mail-out. If you would like to continue to receive *Aliens*, please see the cut-out slip at the bottom of page 15.

Autumn greetings (Southern Hemisphere) and Spring greetings (Northern Hemisphere) to you all!

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In this Issue:

Trade
House Crows
Ants
Crickets
Crayfish
Weeds
Prosopsis
EPPCs
Symposia
Tropical alga
Amphibians
Antigua
Norway rat
Notes
Guidelines
Conferences
Starfish

ISSN: 1173-5988

C O N T E N T S

- | | |
|---|--|
| 2.....Indian house crow control | 10...Exotic Pest Plant Councils |
| 3.....Tramp ants, Argentine ants | 11...Weeds Symposium report, starfish |
| 4.....Trade and invasion | 12... <i>Caulerpa taxifolia</i> |
| 6.....Native cray waves the white claw | 13...Pond management for amphibians |
| 7.....Reptile report, Australian crickets | 14...Antiguan racer and rat control |
| 8.....Weed scientists & biological pollution | 15...Norway rat eradication / Brittany islands |
| 10... <i>Prosopsis</i> in the Sultanate of Oman | 16...Notes and letters |

Indian House Crow control in Zanzibar

The Indian house crow *Corvus splendens* was almost certainly introduced to the island of Zanzibar in 1891, when a request was sent to the Indian Government in Bombay to ship fifty of them to help clean up the town's garbage. By 1916 they had increased to such an extent as to be declared a pest species, and a bounty was offered by the Government of Zanzibar for their destruction. Between 1916 and 1990, various methods of control were tried, including trapping, shooting and poisoning, while the bounty continued. Little impact was made, however, except in early 1972 when many thousands were shot in Zanzibar town by police and army under a directive from the President. It is believed that this onslaught drove many house crows into the rural areas where hitherto they had been absent.

By 1990 the impact of this pest on indigenous birds, particularly in Zanzibar town, was very considerable, with the town being virtually devoid of all birds other than house crows. Furthermore, the production of free-range poultry had become greatly reduced due to predation of both eggs and chicks by this menace. The house crow is omnivorous, and germinating maize, sorghum and other crops are eaten, together with soft fruits and chillies. Newborn calves and kids are frequently attacked. The negative influence of crows on both agricultural and livestock production is very substantial.

As a result of the massive escalation in house crow numbers it was decided that a programme should be launched in an attempt to eradicate the pest, or at least reduce it to tolerable levels. This began under my direction in September 1990 and followed nearly two years of experience with house crow control by me on the Kenya coast.

Initially, the problem was tackled by using a wire-mesh trap of 3m x 2.5m x 2m high. The design comes from Malaysia and operates on the same principle as a fish trap, the victim being lured into the trap by bait: once inside it is unable to get out. Although highly effective to begin with (as many as eighty being caught in a day in a single

trap), trap shyness developed after a while and catches were greatly reduced. After nine months over 14,000 house crows had been destroyed by this method, but the reduced effectiveness meant the introduction of poison was needed, although selected traps were still operated.

The initial poisoning success was the result of experimental use of the chemical DRC 1339 (3-chloro-P-Toluidine-Hydrochloride, or "Starlicide"), developed in the USA for use by the US Department of Agriculture on the closely-related pest starling *Sturnus vulgaris*. They arranged for a sample to be made available to me for trial. It was highly effective on the house crow with no secondary poisoning, as the chemical is metabolised during the twenty or more hours that it takes to have effect after ingestion. Various baits were tried, with chopped raw meat being the best. Due to very close supervision when poisoned bait was set out, coupled with the house crows' own greed and aggression, only three non-target birds, two being chickens, were known to have died compared with over 36,000 house crows destroyed by poisoning.

Trapping and poisoning were combined with a breeding season bounty on the collection of eggs and chicks. In three seasons 266,500 eggs and 12,600 chicks were collected, but the birds were re-laying rapidly, so for the last two seasons only chicks were accepted (for a higher bounty payment), resulting in a further 24,750 chicks. The total killed by all three methods is over 102,000 (65,000 being adults) - and this is not counting the potential chicks from over a quarter of a million eggs! The house crow population in Zanzibar town has been reduced by about 95%, while over the whole island the reduction is probably between 75-80%.

This project continues under me and is funded by the Finnish International Development Agency.

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Tramp ants

The social lifestyle of ants makes them one of the most dominant players in almost any terrestrial ecosystem in the world, including man-made habitats. More than thirty percent of the total animal biomass can be made up with ants alone.

Within the ants, there is one group - the tramp species - characterized as being unicolonial (having multiple nests which function as one large colony and thus are not competitive between themselves). They have multiple queens per nest, reproduce by splitting one nest into two, and finally, are largely dispersed around the globe in man-made habitats.

The Pharaoh ant *Monomorium pharaonis*, the Argentine ant *Linepithema humile* and the fire ants (which include several species of the genera *Solenopsis* and *Wasmannia*) are the most well-known, and have the most impact wherever they occur. But there are in total about thirty species with the above-mentioned characteristics.

Whereas the Pharaoh ant is mainly confined to human buildings, the Argentine ant and the imported Fire ants do have a serious, and often tremendous impact on the local fauna. The general pattern is that these species outcompete the local fauna, including both

ants and general invertebrates, in man-made habitats, and thus should be watched closely. The Argentine ant, originating from the vicinity of Buenos Aires, has now been recorded from West Australia, California and the Mediterranean parts of France, where in some cases large but unsuccessful campaigns have been undertaken to stop the expansion of their range. Recently-invaded areas include coastal Peru, North Western Italy and the United Arab Emirates. Most likely, the colonies are mainly carried to new places in containers, as they often first appear in the vicinity of harbours. Quarantine is probably the only means of stopping their well-documented impact on local fauna, as all other ways of control have not worked so far.

The Social Insects Specialist Group of the SSC is currently building up a Web Site where information on tramp species will be available.

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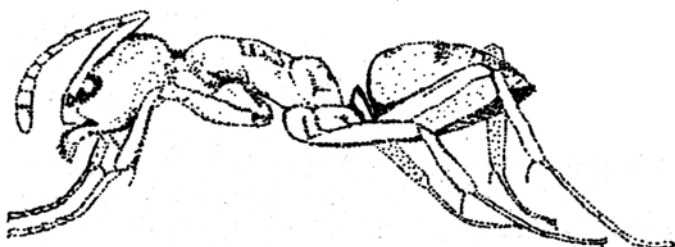
Argentine ants

The Argentine ant, *Linepithema humile* (Hymenoptera: Formicidae), was first discovered in New Zealand by O.R. Green in 1990. Its spread since then has been casually monitored. To date, it is widespread in a patchy distribution over Auckland, and established at Mt Maunganui, Tauranga. Overseas it is reported to be one of the most troublesome pest ants, with a reputation for being very invasive. Its natural ability to spread is limited by the lack

of flight dispersal by the queens when starting a new nest.

In areas of Auckland with heavy infestations of Argentine ant, it has been noted that no other ant species are present, which for Auckland is exceptionally unusual. The authors are concerned at the implications Argentine ant may have on New Zealand endemic ant species and other fauna. We would be interested in hearing of other instances where Argentine ant has completely displaced endemic species in their natural habitats. Please write or e-mail to the address below:

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Free Trade and Exotic Species Introductions

Both intentional and unintentional releases of exotics have led to serious problems globally. In addition to the extensive damage caused by exotic pests and weeds to forestry, agriculture, and other economic interests, exotics have been a major cause of native species endangerment and extinction, particularly on islands and in other isolated habitats. Exotics are recognised as one of the most pervasive and insidious threats to biodiversity. Yet some authors fail to consider exotic species introductions when discussing the environmental impacts of international trade liberalisation.

The most important pathway of harmful exotics into the United States is neither intentional releases nor contraband brought in by international travellers. It is unintentional importation through international trade. Exotics frequently "stowaway" in ships, planes, trucks, shipping containers, and packing materials, or "hitchhike" on nursery stock, fruits, vegetables, seeds, and other imports (U.S. Congress 1993, Table 3-1: 38 of 47, or 81%, of the harmful new exotics detected from 1980 through 1993 with identified pathways, were unintentional imports). The General Agreement on Tariffs and Trade (GATT) should lead to even more unintentional imports of exotics. Trade liberalisation stimulates greater trade volume.

Perhaps the assumption of those advocating trade liberalisation is that risk analysis, inspection, and enforcement to prevent harmful introductions somehow will keep pace with the volume increase. However, the U.S. government response appears inadequate to prevent increased trade from resulting in more harmful introductions. The

government has been slow to prevent the introduction or spread of several harmful species that have arrived through international trade in recent years, such as the zebra mussel *Dreissena polymorpha*, introduced via ship ballast water, and the Asian tiger mosquito *Aedes albopictus*, introduced via used tyre imports. This is despite warnings about these species. In the past, biological considerations regarding pest risks have not necessarily outweighed economic considerations in the U.S. Department of Agriculture as its Animal and Plant Health Inspection Service (APHIS) regulated trade:

"[I]n controversial trade matters, top management outside of APHIS may "weigh" the biological position against the economic or other



Aedes mosquito

positions, and the short-term decision made by non-biologists may in some instances prevail regardless of the probability of long-term adverse consequences" (Kahn 1991).

In other words, ultimate decisions about exotic species risks have a political component that can vary from administration to administration, depending on the value placed on "free trade" versus the value placed on preventing biological damage.

An example of the danger faced from new trade pathways is the Siberian

timber case. A few US timber brokers and lumber companies promoted the importation of unsawn Siberian timber from Far East ports to West Coast sawmills. One test shipment was allowed without prior risk analysis. Several potentially serious pests were discovered, including the Siberian gypsy moth, *Lymantria dispar*, a strain more mobile and potentially damaging to US coniferous forests than the European gypsy moth strain. Only strong criticism by academic scientists and pressure from a few members of Congress prevented APHIS from allowing further timber shipments. After this pressure compelled a formal risk assessment, APHIS determined that no more raw log shipments from Siberia should be allowed. Yet Yu (1994) held up the future prospect of liberalised trade in unsawn timber as a benefit of trade distortion elimination under GATT.

International law regulating the unintentional introduction of harmful exotic species through trade is weak. Existing legal instruments have the potential to protect biodiversity from exotics, but they have lacked strong implementation in that direction. There are two major conventions with provisions on exotics. One is the International Plant Protection Convention, which presently addresses crop pests only. The IPPC could be expanded in scope to explicitly protect native (non-agricultural) plant life from introduced pests. Efforts to do so should be undertaken.

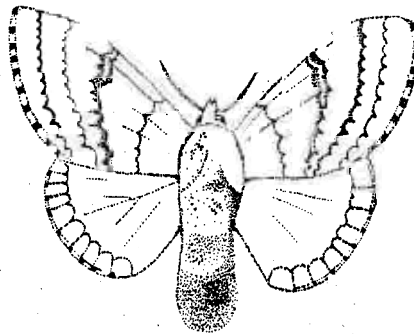
The other major international agreement addressing exotic species, the Convention on Biological Diversity (CBD), lacks teeth. Article 8(h) addresses "alien" species by calling for parties to: "as far as

possible and as appropriate:.... Prevent the introduction of, control, or eradicate those alien species which threaten ecosystems, habitats or species". Initial drafts of the CBD included a relatively strong exotics provision (IUCN 1989). It would have established a scientific authority styled after the Convention on International Trade in Endangered Species approach, and a listing process focussing attention on high-priority exotic species threats to biodiversity. However, the finally adopted, watered-down, Art. 8(h) CBD language lacks specificity, lacks a listing process, and lacks enforceability due to its vagueness. Further, some countries have yet to join it, including the United States, where it awaits Senate ratification.

The difficult job of reducing harmful introductions carried by international trade would be served by more proactive risk analysis, stronger enforcement of existing laws, and amendments to existing laws, or entirely new laws, specifically intended to protect biodiversity. Ecological risks from exotics should provide a clear legal basis to stop shipments of new trade items (as eventually occurred in the Siberian timber case), or even to stop the opening of a new international trade route, until the risks are reduced to a level acceptable to the importing nation. However, data gaps and uncertainty may prevent precise risk description. Thus, broad tools such as bans or restrictions of imports may be necessary to protect biodiversity in those countries that care to do so. However, such measures could be considered unfair restraints on trade under GATT and other international agreements.

Under GATT, bans and restrictions

may not discriminate needlessly against imported goods, that is, they may not be merely protectionist trade barriers disguised as environmental protection measures. This means that bans and restrictions must be founded on "science-based" risks or they could be challenged before the regulatory body that administers the trade agreement, the newly-established World Trade Organisation (WTO). It will fall to the WTO to determine whether particular bans or restrictions are supportable in view of the risks posed by exotic species. Yet, it remains unclear how the WTO will make such decisions in view of the tremendous scientific uncertainty involved.



Siberian gypsy moth (female)

Science-based risks should be interpreted to mean only that a well-considered risk of ecological harm exists. To be science-based should not require that detailed scientific research and risk analysis have been undertaken because often the data gaps and uncertainty would make such research and analysis prohibitively expensive, especially for developing countries. For example, the risk assessment for the proposed importation of raw Siberian larch, *Larix* spp., cost the US Federal government approximately \$500,000.

Deciding upon acceptable methods and costs to determine such risks should remain sovereign decisions for individual governments. If international trade authorities set standards to determine how exotic species risks should be measured or assessed, then trade regulation decisions based on these standards could overrule tougher national, state and local regulations. The result could be weaker standards overall and greater threats to biodiversity from exotic species carried in trade. Creation of an international advisory panel of experts on exotics under the auspices of the Convention on Biological Diversity could inform the trade regulation organisations about both the biological risks and the degree of scientific uncertainty.

Macroeconomic effects of trade liberalisation in relation to exotic species and biodiversity issues have not been adequately examined. Yu (1994) finished his "Free trade is green" paper by "speculat[ing] on possible indirect benefits to the environment of more liberal trade, emphasising the benefits of de-ruralisation, rising standards of living, and reforestation. He is unconvincing. He does not consider the following points related to exotics and biodiversity: As developing countries pursue export markets, traditional agroecosystems are increasingly converted to large, exotic monocultures. Global homogenisation reduces the diversity of crops and livestock and can increase their vulnerability to both native and exotic pests, compelling increasing reliance on pesticides potentially damaging to biodiversity and to humans.

Increased standards of living in developing countries are associated

Native Cray Waves the White Claw

developing countries are associated with increasing demand for imported products of all kinds, thereby increasing the likelihood of harmful unintentional introductions through the import process. Further, such imports include exotic foods, horticultural products, pets; and so on that may become invasive later. Much of Hawaii stands as an example of virtual replacement of vulnerable native plants and animals by exotics as trade volume and living standards have increased. Deruralisation and the (often exotic) reforestation of abandoned farmland that Yu touts as benefits of increased standards of living in industrialising countries may not benefit *native* biodiversity.

In conclusion, increased international trade has the potential to cause more harmful exotic species introductions. More proactive, more comprehensive, better-funded, international efforts are needed to ensure that widely-adapted invasive exotics do not further homogenise biological systems on a global scale.

Abridged, from a paper in Conservation Biology 1996

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Over-aggressive, over-sexed and over here. The North American signal crayfish is taking English rivers by storm, marginalising our native white-clawed cray to the point of extinction in many areas.

At 15 cm, the signal is half as long again and much heavier than our white-clawed variety. Introduced into England via crayfish farms for the table, the signal soon cried freedom and climbed out of its tanks and into our southern rivers and streams.

It carried with it an aggressive attitude, immense fertility, an enormous appetite and a killer disease, crayfish plague. The signal is immune to it, but the native crayfish had no defence. Whole populations can die within days.

The white-clawed crayfish is running scared and *English Nature* is working with the National Rivers Authority, the Ministry of Agriculture, the Joint Nature Conservation Committee and others on an all-Britain emergency package which could be ratified by Government this month (November).

Proposals centre on creating no-go zones where the signal has not yet been seen. Within those boundaries, measures will include:

- a ban on transporting non-native crayfish into these areas;
- asking markets, restaurants and hotels to work to a code of practice to prevent further escapes of signals reared for the table;
- banning the trade in non-native crayfish as pond or tank pets; and
- possible banning of non-native crays as angling livebait.

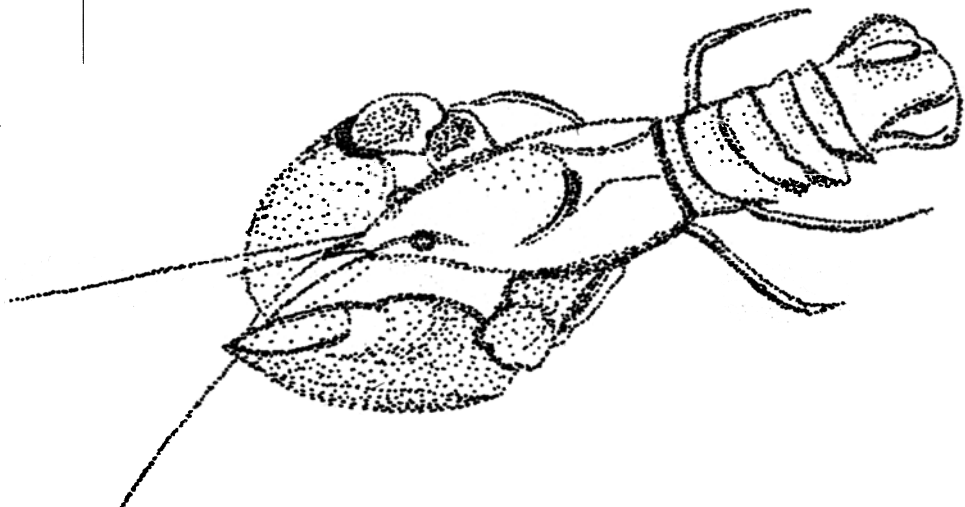
"The situation is desperate", says Mary Gibson, *English Nature* Freshwater Ecologist. "We're looking at ways of improving the habitat for native crays, but what suits them also suits the signal. Our best hope is making people in signal-free river catchment areas realise the dangers of introducing non-native species and in making crayfish farms as secure as possible. Signals are great escapers and soon colonise the nearest waterways".

If the onslaught is not stopped, the white-clawed crayfish will be one more important name absent from the roll call of wildlife in this country.

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U.S. Reptile Trade Report

Allen Salzberg, author of *The Humane Society of the United States' "Preliminary Report: Live Freshwater Turtle and Tortoise Trade in the United States"* (1994), and 10 year member of the Board of Directors of the New York Turtle & Tortoise Society, is expanding his report to include all reptiles. Like the turtle report, the reptile report will try to act as a "baseline" for what we know

about the trade, what we don't know, and will make suggestions for future study and actions. For example, the report will detail the trade's tremendous growth and its potential impact on the environment and human health, as well as including numerous charts detailing exactly what reptiles, and how many, have been traded. Allen has also co-written a children's book called "Turtles" with his wife, Anita

Alien Crickets in Australia

The identification of a pest species of mole cricket, the Changa, *Scapteriscus didactylus* (Latreille), prompts this discourse on crickets that have been "introduced" into Australia. The Changa had been misidentified as a "native" Australian species and had been represented in collections for some 13 years before it was "discovered" that it was not an Australian cricket. It is a major pest in northeastern South America and the Caribbean where it damages turf, pasture, rice, sugar cane and many crops such as capsicums. It attacks crops in two ways: by feeding on the seedlings above ground as well as feeding on the roots of the plants. In addition these crickets are a major concern to the golfing fraternity because the tunneling activities of the crickets cause unevenness of the surface of the putting greens.

This situation begs comments on the methodology dealing with the recognition of pest species, the protocols that need to be followed and the value of taxonomic "specialists".

First some thought should be given to the terminology we use. When I began to investigate this problem I communicated with Howard Frank, who suggested we be more precise with our terms. He feels that the term

introduced has been misused in the literature. As early as 1948, my colleague E.C. Zimmerman suggested a restricted use of the word *introduced* for organisms that were introduced deliberately. For organisms that were not imported deliberately Frank suggests *immigrant* be used. This separates those creatures that were introduced on purpose from those which gained entry from some other means. That is, those that have drifted, swum, flown, arrived by phoresy, hitch-hiked etc. This is worthy of consideration, especially in this forum. We are nearly all concerned, therefore, with *immigrant species* in the context of this newsletter.

That the Changa was represented in collections of the New South Wales Department of Agriculture for almost 15 years, and that people in the New South Wales Department of Agriculture were employed to study "mole crickets" without really knowing what they were dealing with, seems incredible. The Changa mole cricket is very distinctive; it has two large claws on the foreleg while the other Australian representatives, all in the genus *Gryllotalpa*, have four. In addition, the Changa has prominent markings on the pronotum that are equally distinctive. The Changa could have been recognised by an

orthopterist (one who studies grasshoppers, crickets and their allies) and an economic entomologist should have sent specimens to an orthopterist for an accurate determination. Recent cut-backs in jobs in quarantine services and surveillance, and the general attrition of jobs in taxonomy could be responsible for this situation.

The only proper procedure for dealing with any biological entity is to know **what** you are studying. The control measures for the Changa will be very different from those used to control a native *Gryllotalpa* species. Each has quite different, and specific, parasites and pathogens. Had the cricket been sent to any number of orthopterists the species would have been accurately identified and may have been eradicated by now. This further points out the utility of persons with an extensive knowledge in one group or another. In these days of diminishing funds for science, this is a cause for concern.

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Weed scientists need to start lobbying for a centre to combat biological pollution in the United States

When the public perceives environmental issues, it generally concerns itself with how these issues directly affect human health and welfare. For example, after a series of local and national news reports about the dire affects of dumping hazardous waste in US landfills and public lands during the 1970s, the US Congress, reacting to public outcry, quickly passed legislation to manage materials that are harmful to human health. Likewise, air and water pollution concerns have received substantial legislative attention during the past thirty years, and great improvements have been made in air and water quality. Non-game wildlife issues, however, have not been a priority in the public's mind when it comes to environmental protection and legislative attention. The woefully inadequate funding for managing US national parks is a good example. Even wildlife game interests may be on the decline in many states as their wilderness areas are converted to agricultural lands and urban centers. Sales of hunting and fishing licences in Florida have declined during the last 13 years as Florida's human population has dramatically increased.

With the exception of "warm and fuzzy" endangered species like manatees, public interest in wildlife matters usually concerns some perceived threat to humans. Cougar and bear attacks on humans usually receive national news attention. Many of television's most successful wildlife documentaries are those that show predator-prey relationships, eg. a lion chasing and catching a gazelle on the Serengeti Plains, and not those that focus on broader ecological issues like habitat loss and degradation.

Consequently, when a new environmental problem like invasions of non-indigenous plant species is recognised by weed scientists as a serious threat to the US biological heritage, it is difficult to generate the needed public support to manage these problem species. Plants simply are not perceived to be a threat to human welfare. No matter how many symposiums and meetings weed managers have, invasive plant species will

always take the public back-seat to critters, especially those critters that crawl, sting or bite. Worse, invasive weeds don't respect jurisdictional boundaries. A weed invasion within a natural area can encompass city, county, state and federal jurisdictions. Although efforts to keep such species out of the US are among the largest federal programs, at least 20 federal agencies have regulatory oversight concerning research, use prevention, or control of non-indigenous species, the results of these efforts have been fragmentary at best. In addition, this patchwork of agency involvement has often prevented a prompt and timely reaction to the introduction of harmful non-indigenous species, thus allowing their establishment and subsequent spread. In western states, invading weeds can quickly spread from state to state.

If weed managers ever want to get the funding and attention this problem deserves, weed scientists need to form alliances with other groups that deal with non-indigenous animal invasions. People and politicians generally have more concern with Africanised bee spread than with kudzu covering more than 2 million acres of the southern states. That means that we, as weed scientists, can no longer hold the narrow view that the problem of non-indigenous weeds can stand on its own. Despite the fact that plants form the biological matrix of most communities, and invasions of foreign plants can seriously disrupt and/or destroy endemic ecosystems and render productive rangelands useless, the public simply won't buy the concept that weeds are a serious threat to the environment of the United States for reasons stated earlier.

So, what do we need to do to create positive change in this war against non-indigenous invaders? First, all of the concerns about plant and animal invasions need to be linked under one term: biological pollution. This is a term the public and politicians can understand and will likely respond to. Second, is there a US governmental coordinating body that already exists that deals with prevention of new invaders, monitors existing outbreaks,

conducts research, develops and advocates good management practices, implements prevention strategies, deals with state and local governments, and provides leadership and training that we can learn and copy from? Yes, there is, it is called the Center for Disease Control and Prevention (CDC). Although the invaders in this case are different, being diseases rather than invasive non-indigenous plant and animal species, the problem is essentially the same. The CDC has to coordinate prevention and management efforts with foreign governments, numerous federal agencies, 50 state agencies, and countless local governments and private organisations. Why not copy the CDC concept in our war against biological pollution in the United States?

I propose weed scientists in the US start lobbying their Congressional Representatives for the establishment of a small National Center for Biological Pollution Control and Prevention, using employees from existing federal agencies. The benefits of such a center would be immense. This new center would support surveillance, research, prevention efforts, and training on how to deal with new infestations before they become a permanent fixture of the landscape. This center would work to help coordinate federal, state, and local efforts to remove problem species. A

worldwide data base could be established on invasive plant and animal species that could help alert various agencies to potential future problems. This center would be a single governmental entity where federal, state, local governments, and the news media could obtain current information and educational materials on biological pollution in the United States. More importantly, the center could provide the leadership that is critically needed in our fight against non-indigenous species invasions. No war has ever been won without clear and decisive leadership.

The environmental problem of biological invasions has been recognised as a serious issue only during the last ten years or so. It is up to scientists and government officials to meet this onslaught with innovative ideas. Remember, doing the same thing the same way and expecting change is a good definition of insanity.

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Upcoming Events

Broom Symposium, April 1996, Portland, Oregon, USA

Contact: Dennis Isaacson at E-mail: disaacson@oda.state.or.us

Conference on Alien Species, 1-5 July 1996, Trondheim, Norway

Historical, ethical and socio-economic, ecological, legal, education aspects etc. It is intended that perspectives from developing countries on alien species be fully included.

Contact: ISSG office, for further details

VIII Pacific Science Inter-Congress. July 1997,

University of the South Pacific, Suva, Fiji

It is hoped that an Invasives Session will be organised.

Contact: Lucius Eldredge: psa@bishop.bishop.hawaii.Org

Invasive *Prosopis* in the Sultanate of Oman

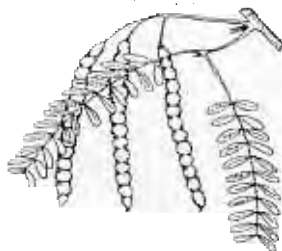
One wouldn't expect, in an arid country such as the Sultanate of Oman, where the environment in several regions is too hostile for the growth of plant life, that exotic species might pose the threat of invasion.

Prosopis juliflora was introduced to Oman no more than 20 years ago as a landscape tree for its fast, luxuriant growth, tolerance to saline soils, and to some extent, tolerance to drought. The tree is hardy, and with irrigation, it flowers and fruits in two to three years, producing copious quantities of seed pods. In Oman, unlike the Thar desert of India (see *Aliens* No. 2), domestic livestock (goats, cattle and camels) prefer *P. cineraria* (the only native species of *Prosopis* here) and *Acacia* species and leave *P. juliflora* alone: neither the leaves nor the pods are browsed. In areas where there is a runoff from irrigation, or in small depressions where water may intermittently accumulate, *P. juliflora* is weedy and dominant over other natural vegetation. In the few natural, open, *Acacia* woodlands, *P. juliflora* now forms dense thickets and threatens the regeneration of the native species.

The problem is more severe in the southern region of Oman, where there is a regular monsoon season from June to August, providing sufficient moisture for seed germination and seedling establishment. Also, there is extensive grazing in most regions in southern Oman, which leaves the unpalatable species such as *P. juliflora* to thrive and take over the natural vegetation.

The invasive properties of *P. juliflora* and its threat to the diversity of the natural flora is now being recognised by the landscaping division of the Ministry of Regional Municipalities and Environment. They have now limited the use of this tree in landscaping projects and in several areas, *P. juliflora* is being replaced by native trees such as *Ziziphus spina-christi* and *P. cineraria*.

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Exotic Pest Plant Councils

The "National Association of Exotic Pest Plant Councils" is a newly formed US organization. It is committed to raising public awareness about invasive alien plant species as a threat to natural areas (rather than agriculture), and to facilitating improved programs to prevent their introduction, or to effect their control or eradication. Four regional EPPCs exist: California, Florida, Pacific Northwest, and Tennessee. Each promotes research, information transfer, and coordination of programs. The National Association works with the federal US government and other allies. Currently, there is greatly increased attention to invasive exotic plants in the US Government. A "summit" on the impacts of "noxious weeds", and development of coordinated responses was held in Colorado in September; an eastern and US tropics "summit" will be held in Florida at the end of the month. The NAEPPC is working closely with federal agencies in planning the summits and in developing programs. We are also asking Congress to strengthen the Federal Noxious Weed Act.

We are working with the Departments of Agriculture in Oregon and Washington to hold a workshop on management of European brooms next April.

Finally, we have developed a working list of plant species invasive in natural areas. The continental list contains over 700 species, of which between 250 and 300 are considered to be "serious" invaders. The list from Hawai'i contains about 130 of the species considered to be most troublesome there.

For copies of the lists or to initiate cooperation in other areas, please contact me.

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Weeds in a changing world:

Report from an International Symposium, Brighton, UK, 20 November 1995

This meeting, organised and chaired by Charles Stirton of the Royal Botanic Gardens Kew, comprised the opening day of the annual British Crop Protection Conference and was organised to highlight the threat that weeds pose to natural ecosystems, especially areas rich in biological diversity.

The following six papers were presented :

"Changing worlds and changing weeds" by Q C B Cronk - highlighted the relationship between evolution, environmental change and economic botany in the fast-changing landscape which is being created in destabilised natural environments.

"Changing perspectives on risks to biodiversity and economic development" by C E Hughes - presented guidelines to follow when introducing new species which attempt to reduce the threat of invasiveness while recognising the desire of researchers to investigate the potential of new species.

"A feasibility study into the creation of a database on weeds and invasive plant species" by H M Frost, P J Terry and P Bacon - presented ideas for collating the global information resource on weedy species into an easily accessible form.

"Origins and evolutionary effects of invasive weeds" by R J Abbott and R I Milne - outlined examples of where molecular techniques have been used to determine the ecological and evolutionary origins, using the example of

two invasive *Senecio* species and *Rhododendron ponticum*. "Understanding the processes of weed invasions: the influence of environmental stochasticity" by R N Mack - described how introductions commonly do not become naturalised due to the combination of small founder population size and severe environmental conditions.

"Biological control of weeds: the way forward, a South African perspective" by J H Hoffmann - used several examples from one of the countries most active in biological weed control to illustrate how management regimes for biocontrol agents have to be carefully matched to pest problems.

The symposium was designed to stimulate debate on a number of issues of critical importance to weed scientists, botanists, entomologists, conservationists and others. The short amount of time allocated to the meeting provided only a limited opportunity to discuss aspects of weed research in detail, but nonetheless managed to highlight many of the concerns which face us in our attempts to reduce the negative environmental impact of introduced species.

Copies of the symposium proceedings can be obtained from BCPC Publication Sales, Bear Farm, Binfield, Bracknell, Berks RG42 5QE.

Alan Pottinger

Stowaway drives fish to brink of extinction

A tiny fish which crawls along the seafloor on hand-like fins and lives only in the coastal waters of southern Tasmania may be heading for a dubious scientific honour - the first known species of marine fish to become extinct since biological records began.

Marine biologists say that the population of the spotted handfish, *Brachionichtus hirsutus*, has plummeted since the Northern Pacific starfish, *Asterias amurensis*, appeared on the scene. The starfish arrived 10 years ago in the ballast water of ships. Jon Bryan from the Tasmanian Conservation Trust says biologists believe the starfish, now established along the coast near Hobart, is devouring the eggs of the handfish.

The handfish, which grows up to 10 centimetres long, was once plentiful on the bottom of the Derwent estuary, but is now rarely seen: there have been only four confirmed sightings in the past five years.

The Australian Society for Fish Biology, in Queenscliff, Victoria, has put the fish on its endangered list - the first time this has been done for a marine fish in Australian waters.

Bryan says that research is urgently needed to determine how many handfish remain and where they are. Biologists would like to set up a captive breeding programme, but they have no idea whether there are enough fish left to work with.

"Unless a research and recovery programme is initiated soon, Australia may well have the dubious honour of presiding over the first known extinction of a marine fish during the course of recorded history", says Bryan.

Written by Ian Anderson and reprinted with permission from New Scientist, 24 February 1996.

The spread of the tropical alga *Caulerpa taxifolia* in the Mediterranean Sea

Caulerpa taxifolia (Vahl) C. Agardh is a green alga (Chlorophyta, Ulvophyceae, Caulerpales) with a pantropical distribution, that was accidentally introduced into the Mediterranean Sea.

The spread of *C. taxifolia* in the Mediterranean has been very rapid. In 1984 it covered 1 m², in 1990 3 hectares, in 1993 1300 hectares, and in 1994 approximately 1500 hectares. Monaco, France, Italy, Spain and Croatia are affected. Rapid dispersion of the alga to new sites is mostly by natural methods of dissemination from near the central invasion zone, and also by anthropogenic factors for sites further than 5 km from the central zone. Regression has not been observed since the initial introduction in 1984.

The growth of this alga is seasonal, occurring from June to November; during the colder season the fronds persist, but may show chlorosis, particularly in places most affected by lower temperatures, such as near the sea surface. This species can colonise most types of substrate (sandy, rocky, phanerogam or seaweed bed) and most types of habitat (polluted, clean water, exposed, sheltered) between 0 and 50 metres depth.

In the Mediterranean this alga is much more robust than in tropical seas: the blades can measure 20-40 cm, in contrast to 2-15 cm in tropical seas; and the populations are very dense: up to 8225 blades and 244 metres of stolon per m². The acclimatisation of *C. taxifolia* on the Mediterranean French coasts, in waters which have recorded winter minima of between 11 and 13°C from 1984 to 1991, is surprising and suggests that the stock which is colonising the Mediterranean may have different characteristics from that of the tropical regions of origin.

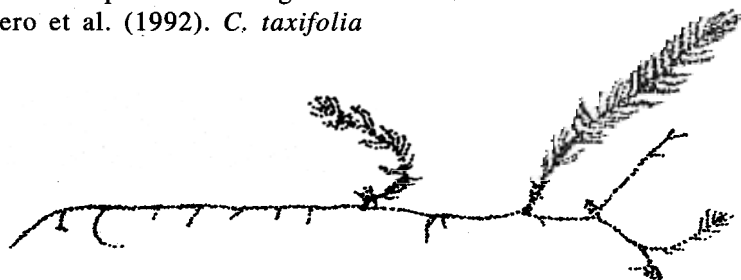
C. taxifolia contains both toxic substances, (caulerpenyne in particular), which constitute a defensive mechanism against grazers, and antifouling compounds against epibionts.

Mediterranean populations of *C. taxifolia* produce the toxic metabolite caulerpenyne in higher concentration than tropical populations. Five new toxins present in this alga were described by Guerriero et al. (1992). *C. taxifolia*

populations appear to replace the indigenous infralittoral communities at between 5 and 20 metres depth; this replacement results in an impoverishment of the flora and fauna. There is strong competition between *C. taxifolia* and *Posidonia oceanica*. In view of the biological characteristics of the two plants, the situation is of grave concern, particularly with respect to the continued existence of seagrass beds, which constitute an important Mediterranean ecosystem.

Due to the impact of *C. taxifolia* expansion in the Mediterranean Sea, the DGXI of the European Community supported a LIFE Programme "The spread of the tropical green alga *Caulerpa taxifolia* in the Mediterranean" from 1992-1994. Twenty-eight laboratories or organisations from France, Italy and Spain participated in this programme. The aims were: to delimit the real extension of *C. taxifolia* patches, to control their evolution, to evaluate the competition with the indigenous ecosystems, to analyse their toxicity, to study the biology and ecology of this species and to establish the technological bases for its possible eradication. The results have been presented in two scientific workshops; the first held in Nice (France) in January 1994 and the second, the final meeting of this programme, in Barcelona (Spain) in December 1994. The spread of *C. taxifolia* has served to warn both scientists and politicians of the problem of aquatic biological invasions. In consequence an expert workshop on "Introduced Species in European Coastal waters" took place in Monaco in March 1993 jointly organised by EEC/DGXII and CIESM (Commission Internationale pour l'Exploration Scientifique de la Mer Méditerranée). The participants called for the launch of a European research programme in order to provide reliable tools for the proper management and monitoring of this problem.

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Pond management for amphibians

In the fall of 1995, biologists at the Shawnee National Forest in southern Illinois proposed to manage their many small ponds for amphibians by eliminating introduced fish populations through the use of rotenone. These ponds are man-made but over the years many have been stocked with fish, mostly largemouthed bass, *Micropterus salmoides*. Dr. Ronald Brandon and his students at Southern Illinois University have documented the presence of 18 species of frogs and 15 species of salamanders at the Shawnee Forest. Biologists there have noticed that in ponds where there are fish, there are no amphibians. Amphibians are native to the forest, bass are not, and these biologists have a mandate to manage for native species. In September Shawnee Forest biologists asked for public feedback. In response I posted a request for input through the amphibian decline discussion group (amphibiandecline@ucdavis.edu) and received about two dozen replies.

On November 24th, I wrote to Michael Spanel, Forest Wildlife Biologist at Shawnee National Forest, 901 South Commercial, Harrisburg, IL 62946, with the following recommendations:

We are in unanimous agreement that managing for amphibians by restoring habitat can and should be done. We are divided about the use of rotenone. While fisheries managers often rationalize the use of rotenone by inferring that it is some sort of

“magic bullet” to be used on rough fish, or when gamefish population structure is out of balance, rotenone’s effects on a range of aquatic animals, covering all trophic levels, have long been known.

Our dilemma is that we would like to see the fish populations eliminated, and at the same time see the deleterious ecosystem effects minimized. If it could be shown that the ecosystem recovers rapidly and fully, our support for your program would be unanimous. As it now stands, some of us would like to see you try some less invasive measures to eliminate fishes, such as gill nets - a slow treatment because it would need to be repeated for several years. Another option would be a series of fishing derbies that would put the game fish to use and could be held in conjunction with a public education program.

If you decide that rotenone is the best option, I would like you to consider the following procedures.

1) Rotenone in the winter. This is when the fewest amphibians will be present; the tadpoles of most species will have metamorphosed, newts may be in hibernacula. It may also be that rotenone’s effects on amphibians may be ameliorated by cold temperatures. One downside is that rotenone may not degrade rapidly in cold water. This will need to be examined.

2) Implement a two year program: rotenone every other pond the first year, treat the remaining ponds the following year. This should ensure a

local source of animals to re-establish affected populations.

3) For each pond, or subset of ponds, to be rotenoned, sample invertebrates and vertebrates before and after the treatment, and do a body count. These data could form the basis of a great master’s thesis. One of the reasons that the scientific community is divided on the use of rotenone is that studies such as this are not generally done, and therefore the scientific data needed to make wise management decisions are just not available.

4) Continue to monitor pond populations. This effort would not only allow you to follow post-treatment recovery, but would also inform you about unauthorized fish reintroductions.

Management of the Shawnee Ponds has not yet begun. Public comments have been assembled and will be used by Shawnee Forest biologists to formulate either a draft Environmental Assessment or an Environmental Impact Statement. Once this document has been filed and approved, a management program can begin.

Michael J. Lannoo

Declining Amphibians Task Force (DAPTF) Liason to the Invasive Species Group.

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Rat eradication to conserve the Antiguan Racer

Many alien species were either deliberately or accidentally introduced during human colonization of the West Indies, especially following the arrival of Europeans in 1492. As transatlantic trade prospered, black rats *Rattus rattus*, brown rats *Rattus norvegicus*, and house mice *Mus musculus* were frequent stowaways, and became rapidly established throughout the West Indies.

Antigua, in the north-eastern Caribbean, bore the brunt of all three rodent species as well as the Indian mongoose. Great Bird Island, a small rugged limestone island (0.083 square kilometres) in the North Sound of Antigua, retains the sole surviving population, since its rapid extirpation from the main island by mongooses, of the harmless endemic colubrid snake, the Antiguan racer *Alsophis antiguae*. The mongoose *Herpestes auro-punctatus* was released at the turn of this century to control both rats and snakes in sugarcane plantations, but also had a catastrophic impact on many other reptiles and ground-nesting birds.

Fauna & Flora International, working with the Environmental Awareness Group of Antigua & Barbuda, the Antiguan Forestry Unit, and the Island Resources Foundation, embarked upon the first phase of a long-term conservation project for Antiguan racers in October 1995. Mark-recapture techniques estimated the racer's population to be 60-100 individuals. This great rarity and its existence on a single tiny island qualify it for the highest IUCN category of threat "Critically Endangered".

Black rats occur on Great Bird Island, and were believed to be adversely affecting the Antiguan racers. Before determining the feasibility of removing the rats, it was necessary to establish the *need* for their removal, as this technique requires prolonged intensive efforts, and the accompanying risks of introducing a powerful biocide. A qualitative ecological impact assessment of rats was made by direct observation.

It was rapidly determined that rats were significantly affecting a wide range of plants and animals, including Antiguan racers. Of the 42 snakes captured, 18 (43%) had tails shortened as a result of rat bites, and more than 50% had bite scars on their body or tail attributable to rats. As male reproductive organs are located in the tail, such damage can cause castration. Rats are capable of killing juvenile or adult snakes, as well as ground lizards *Ameiva griseivittata* and tree lizards *Anolis bimaculatus* and *A. wattsi*

the racer's primary food source. Studies elsewhere indicate that rats significantly reduce lizard densities. Eggs of lizards, snakes and birds are prized as a major source of proteins, fats and water. An egg of another threatened species, the West Indian whistling duck *Dendrocygna arborea* was found with characteristic teeth-marks, and the crevice-nesting red-billed tropic birds *Phaeton aethereus* are also believed to lose eggs and chicks. The remains of various types of seeds were found with diagnostic teeth marks, and rat faeces contained mainly vegetable matter from leaves and shoots. Rats also gnawed exposed tree roots, as a water and food resource.

Given the rats' broad ecological impact, it was decided to immediately undertake an eradication programme on Great Bird Island and the two adjacent Galley Islands. Zeneca Agrochemicals loaned their Rodenticide Technical & Development Manager, Dr Alan Buckle, to visit the island, assist in the feasibility study, and advise on an optimal eradication protocol. Dietary studies had eliminated rats as a major prey item of the snakes, and no primary or secondary non-target species were identified. Of concern were fauna on the many inaccessible vegetated ledges of Great Bird's eastern cliffs, and the safety of tourists visiting the island (estimated at 20,000 per annum).

Rats were eradicated over a 30 day period, using a system of 730 bait stations placed at 10 metre intervals across the three islands. Such intensive baiting was necessary to minimize the completion time and reduce potential problems for tourism. Staff from all project partners baited, then replenished each station using low-melt wax blocks of Klerat D4 rodenticide, containing the anticoagulant, Brodifacoum. The 27 metre cliffs were baited by lowering bait on monofilament lines. Hermit crabs, the islands' major scavengers, also consumed bait, but were unaffected by the rodenticide. Dead rats were located after 6 days and 11 corpses were incinerated. All obvious rat activity had ceased after 2 weeks, but baiting was prolonged due to concern about pockets of rats possibly remaining on the cliffs. Rat eradication was verified by placing softwood "chew sticks" soaked in vegetable oil across each of the islands over a 5 day period. These remained untouched, after which all remaining bait was removed.

Because the majority of the islands in the North Sound still possess rats, a "rolling front" method will be operated in 1996 to eradicate rats from additional islands close

to Great Bird. This will reduce the risk of rats recolonizing, reduce predation pressure on a wide range of species on each additional island, and contribute to the preparation of an island for the establishment of a second population using captive-bred snakes in the future. Additionally, the Environmental Awareness Group are undertaking a public awareness programme targeting boat operators and visitors to the offshore islands to minimize the chance of rats

being reintroduced from boats.

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Norway rat eradication from Brittany islands

In taking the decision whether or not to eradicate the Norway rat *Rattus norvegicus* from islands (marine bird reserves) off the coast of Brittany in France, some aspects of the general subject of alien species eradication were examined, in an attempt to answer the following questions:

- Can we accept the concept of the "naturalisation" of an alien species, and if so, how do we recognise it?
- What are the criteria on which we base a decision to eradicate a species in place for a "long time"?

It appears in conclusion that, as far as we know, the house mouse *Mus musculus*, the ship rat *Rattus rattus* and the Norway rat, did not reach the coast of Brittany before 3,000, 2,000 and 500 years BP respectively, that is to say, after the last quaternary transgression which induced the insularity of the Brittany islands. Consequently, there is a great probability that the spread of these species onto the Brittany islands was caused by human activity. Moreover, the literature gives no evidence that any of these species fills any of the criteria quoted by Usher (1989) and Chapuis et al. (1996) preventing its eradication. Conse-

quently, the decision was taken to eradicate the Norway rat from eight islands belonging to two archipelagoes off the Brittany Channel coast (Sept-Iles Archipelago (36.1 hectares), Cancale Archipelago (2.7 hectares)).

The eradication took place in September-October 1994 and long term control started in the same season in 1995. The eradication was carried out in less than 17 days, within one month. The use of trapping and poison (chlorophacinone) successively, permitted the reduction by 76% of the input of poison into the food web and reduced by the same percentage the secondary poisoning hazard. There was no evidence of impact on the native mammals (shrews) but 31 birds belonging to 4 passerine species died in traps. These accidental deaths had no serious effect on the species.

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California Wilderness Reports

The Pacific Institute, a non-profit natural resources research group, has published two reports on problems with non-indigenous or introduced species in aquatic and riparian habitats in California, entitled:

"Biological Invasions in California Wetlands: The Impacts and Control of Non-Indigenous Species in Natural Areas" and "Non-indigenous Species in Wilderness Areas: The Status and Impacts of Livestock and Game Species in Designated Wilderness in California".

These reports are based on surveys of resource managers throughout the state of California. They include lists of introduced species, along with discussion of the nature of problems posed by such species to wetland ecosystems and native biodiversity.

Both reports are available from Tom Dudley, Pacific Institute, 1204 Preservation Park Way, Oakland, CA, USA, 94612; e-mail: tdudley@violet.berkeley.edu. US\$3 for each, plus postage (US\$3 in North America, \$5 International).

Letter

Congratulations on the quality and contents of Aliens No. 2. On two points I must, however, take issue with some contributors.

The term "feral" should only be used to describe domesticated animals or plants that have reverted to the wild (eg. cats, dogs, goats, etc.) and never for naturalised wild species (eg. "feral mice" page 7). Nor is it correct to describe as "alien fishes" and "exotic invaders" fish which have been transferred from one watershed to another within the USA (page 17). These are not alien or exotic introductions, but "translocations".

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Marion Island seabirds

John Cooper (with JCP van Wyk and DC Matthewson) of South Africa offers some more information on the "Effects of small-mammal trapping on birds at sub-Antarctic Marion Island". This is to be found in the *South African Journal of Antarctic Research* Vol 24 No 1 & 2, 1994. The article starts: "Trapping methods used to study, control or eradicate introduced mammals at oceanic islands can have deleterious effects on the naturally occurring avian fauna, unless procedures are adopted to reduce incidental mortality", and includes details of Sherman live traps and the interest shown in them by lesser sheathbills *Chionis minor*, Subantarctic skuas *Catharacta antarctica* and, less often, kelp gulls *Larus dominicanus*.

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