A bibliographic database on stoats and weasels

DOC RESEARCH & DEVELOPMENT SERIES 217

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Published by
Science & Technical Publishing
Department of Conservation
PO Box 10-420
Wellington, New Zealand

DOC Research & Development Series is a published record of scientific research carried out, or advice given, by Department of Conservation staff or external contractors funded by DOC. It comprises reports and short communications that are peer-reviewed.
Individual contributions to the series are first released on the departmental website in pdf form. Hardcopy is printed, bound, and distributed at regular intervals. Titles are also listed in our catalogue on the website, refer www.doc.govt.nz under Publications, then Science and research.

ISSN 1176–8886
ISBN 0–478–14019–3

This report was prepared for publication by Science & Technical Publishing; editing and layout by Amanda Todd. Publication was approved by the Chief Scientist (Research, Development & Improvement Division), Department of Conservation, Wellington, New Zealand.

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ABSTRACT

This paper describes an international bibliographic database of 1213 papers, notes, books and unpublished reports dating between 1877 and 2004. It includes all available information on stoats and weasels (*Mustela erminea, M. nivalis* and *M. frenata*) ranging from casual observations to high-powered analyses. The database is listed in a searchable, interactive form on a website, www.feral.org.au, and as a simple reference list at bio.waikato.ac.nz/staff/bibliography.pdf. The listing will be regularly updated, but this introductory analysis reveals some interesting general trends so far. (1) Most of the world literature on small mustelids (53% of 1213 entries) describes work done outside New Zealand before 1990. This international literature offers a very large resource to mustelid biologists in New Zealand, which we should not ignore and cannot afford to repeat, although it should be treated with caution. The database is intended to provide easy access to this important background information. (2) New Zealand is now the world centre for research on mustelids, especially stoats: more papers on stoats have been published here—mostly (243 of 321) since 1990—than in the whole of Europe over a much longer period. (3) The database illustrates some major differences in the type of papers published about small mustelids in different parts of the world, and historical trends in publication rates by geographic region (steady in Europe; declining in America and Russia; accelerating in New Zealand). It also provides a useful framework within which to examine some historical trends in conservation priorities within New Zealand.

Keywords: literature review, stoat, *Mustela erminea*, weasel, *Mustela nivalis*, long-tailed weasel, *Mustela frenata*, research planning, searchable bibliography

King, C.M. 2005: A bibliographic database on stoats and weasels. *DOC Research & Development Series 217*. Department of Conservation, Wellington. 21 p.

1. Introduction

Since all advances in knowledge must build on existing data, there are many dangers in starting new work based on an insufficient literature review, including the risk of repeating work already done or not needed. However, literature review is very time-consuming if the extensive information is widely scattered. We need an easier way to find out what information is already available in the literature, and cannot assume that more recent papers will have tracked down and summarised all relevant previous information.

The present paper describes a tool designed to help resolve this problem: a searchable electronic bibliographic database on the international literature describing the three smallest mustelids (the stoat or short-tailed weasel, *Mustela erminea*; the least or common weasel, *Mustela nivalis*; and the long-tailed weasel, *Mustela frenata*). Most of the database is mounted on a website based in Australia, www.feral.org.au (Lapidge et al. 2004–present), which provides information on invasive pest animals in Australia and New Zealand. The website includes similar databases on other invasive species, e.g. rabbits and foxes. The complete bibliography is also available as a simple reference list at bio.waikato.ac.nz/staff/bibliography.pdf.

There is extensive information available on mustelids, from New Zealand and around the world. New Zealand researchers and project designers cannot afford to ignore this huge resource. Unfortunately, most of these papers are hard to find because they were published in international books and journals before the advent of on-line databases (few of which go back far into the 1980s), but many contain irreplaceable information. In this paper I demonstrate how a bibliographic database can help readers find existing information. It can also be used to investigate variation in research focus through time and in different countries.

In any research field, the accepted theories of the time govern what ideas are considered worth pursuing, which projects get funding, and, especially, what kinds of papers are likely to be published. The database offers a chance to distinguish them and, more importantly, to illustrate some major historical and personal shifts in attitudes to the study of stoats in New Zealand. To demonstrate this, in the second part of this paper I use the database to investigate how our perception of the impact of stoats on the endemic avian fauna of New Zealand has changed over the last 20 years, and how this change has influenced the development of new monitoring tools and control methods since the 1980s.

2. Methods

To compile the database, I used two main sources of information. The earlier publications (1877–1993) were entered by hand from my own personal collection, which I started in 1967 as a new graduate student using the unique collection of the Elton Library at Oxford. Later citations have been downloaded from online resources such as *Web of Science*, and include abstracts if copyright rules permit. Materials not on any library database, and many of the publications of the New Zealand Department of Conservation (DOC) which were not accessible on-line until recently, were also entered by hand. The listing is reasonably comprehensive, including everything from casual observations to high-powered analyses, and includes entries that are of historic interest only. I have often found that a simple description of what someone observed by chance can throw up ideas to illuminate a technical puzzle.

To assist classification and searching, I then added keywords describing, for every paper, the geographical location of the animals dealt with (even if the author lived elsewhere), the species, and the main subject. Searching a large database is simpler if the subject of every entry is classified, and the list of keywords used by the compiler is available to the searchers (see Appendix 1 for a complete list of keywords). Keywords are especially important to standardise searches for papers on a given subject in any language (e.g. to find papers on stoats written in Europe or North America the search term 'stoat' is often less useful than 'hermelin', 'ermine' or 'short-tailed weasel'). However, it should be noted that the allocation of keywords is always a matter of personal choice, and the logic of the choices is difficult to standardise between persons. Therefore, the following analyses may well come out differently if repeated by a different user.

The database analysed here, as at 31 January 2005, included a total of 1213 entries on the three species (*M. nivalis, M. erminea, M. frenata*). New entries are being added all the time, and will be posted on the website periodically. Hence no analysis of it can be definitive, but the following examples of its use are offered as an introduction.

3. Results

3.1 GEOGRAPHIC VARIATION IN RESEARCH FOCUS

3.1.1 Study species

Most of the world literature on small mustelids (644 of 1213 (53%) entries in this database) describes work done outside New Zealand in or before 1989 (Table 1). Changes in patterns of research interests and funding have increased

New Zealand's research contribution to nearly half the 485 papers that have appeared in or since 1990.

There is great geographical and historical variation in the proportion of research effort allocated to each of the three mustelid species considered here.

The European literature (Table 2) is roughly evenly divided between stoats and weasels, and around 60–70 papers per decade have been produced on each species since 1970. This substantial resource reflects the long history of ecological research in Europe, where stoats and weasels are not only native mammals but also (by carnivore standards) relatively common, and where many people working in well-established institutions have long been interested in studying them.

The North American literature (Table 3) is the only one to include the third species, *M. frenata* (long-tailed weasel), which is confined to the Americas. Many of these are descriptions of chance observations that are now seldom reported (Murie 1935; de Vos 1960), but which provide an insight into the behaviour of animals in the wild that would be impossible to induce deliberately. Because *M. frenata* was never introduced to New Zealand, or indeed anywhere outside America, it does not count as an invasive mammal. It is included in the database because long-tailed weasels are in many respects quite

TABLE 1. LOCATION OF STUDY AREAS IN PUBLICATIONS ON SMALL MUSTELIDS (ALL SPECIES).

	IN OR BEFORE 1989	IN OR AFTER 1990	TOTAL	%
In New Zealand	84	240	324	26%
Elsewhere	644	245	889	74%
Total	728	485	1213	
%	60%	40%		

TABLE 2. THE EUROPEAN LITERATURE (*n* = 481 PAPERS, MANY COVERING BOTH SPECIES).

	IN OR BEFORE 1969	1970–79	1980–89	1990–99	IN OR AFTER 2000	TOTAL
Stoat	84	61	70	59	39	313
Weasel	90	67	66	71	47	341

TABLE 3. NORTH AMERICAN LITERATURE (*n* = 291 PAPERS, MANY COVERING MORE THAN ONE SPECIES).

	IN OR BEFORE 1969	1970–79	1980–89	1990–99	IN OR AFTER 2000	TOTAL
Stoat	59	30	39	25	12	165
Weasel	41	30	39	9	2	111
Longtail	73	20	22	12	13	140

similar to stoats, and some of the early work that was done, for example on the reproductive biology of long-tailed weasels (28 entries in the database), is relevant to stoat biologists. Unfortunately, there has never been as much interest in small mustelids in America as in Europe, and, for unknown reasons, the number of American papers published per decade has declined over the last 40 years.

The Russian literature (Table 4) is the smallest, and almost all of it pre-dates 1980. During the first half of the 20th century the Soviets took great interest in the ermine (the stoat in white winter dress) as a fur-bearer. Ermine were never as valuable as sable or marten, but they were an important economic resource because they were trapped in huge numbers across the boreal regions. This harvest varied enormously from one year to the next. State-funded research programmes documented these population fluctuations from the 1930s, and were the first to explore the link between the numbers of stoats and their rodent prey. Some of these papers are available in English translations (King 1975, 1980a). After the collapse of the Soviet Union, the withdrawal of research funding virtually eliminated further publication of stoat research in Russia (Polkanov 2000). Weasels were never as important as stoats as fur-bearers, in either Russia or North America.

The chronological trends in the New Zealand literature are the opposite of those of Russia (Table 5). The number of publications before 1980 was small, but since 1980, and especially since 1990, the number of publications on stoats has increased almost exponentially. The total number of published papers describing studies done on stoats in New Zealand (n = 321) exceeds even the number published in Europe over a much longer period (n = 313). Three-quarters of the 321 New Zealand papers on stoats have appeared over the 15 years 1990–2004. New Zealand has become, without doubt, the world centre of research on stoats, even though many papers describing New Zealand work are published elsewhere (Linklater & Cameron 2001). Only a few papers mention weasels, which are much less common; therefore, little is known about their effect on native fauna.

TABLE 4. RUSSIAN LITERATURE (n = 58 PAPERS, MANY COVERING BOTH SPECIES).

	IN OR BEFORE 1969	1970–79	1980–89	1990–99	IN OR AFTER 2000	TOTAL
Stoat	27	17	3	2	3	52
Weasel	12	7	3	1	1	24

TABLE 5. THE NEW ZEALAND LITERATURE (n = 324 PAPERS, MANY COVERING BOTH SPECIES).

	IN OR BEFORE 1969	1970–79	1980–89	1990–99	IN OR AFTER 2000	TOTAL
Stoat	13	18	47	143	100	321
Weasel	8	5	14	17	2	46

3.1.2 Research topic

The database shows, clearly and unsurprisingly, that most research on control and management of small mustelids anywhere in the world is being done in New Zealand: 152 (81%) of the 186 papers classified under the keywords 'Control / management of pests' were published here. Naturally, research topics follow the distribution of funds and the interests of researchers. But all rational management depends on a good knowledge of the system being managed. Effective population control of an animal pest by artificial means can be designed only in the light of adequate knowledge of what controls those populations naturally. New Zealand's strong contemporary focus on management of stoat populations assumes that the necessary background information is available. In fact, all the subjects that are ultimately relevant to control are better researched in the Northern Hemisphere than here (Table 6); only in the key subject of predation impact, on both nests and populations, has research in New Zealand begun to catch up.

An important example of the difference in emphases between the international and New Zealand literature concerns research on the predation impact of stoats compared with weasels (Table 7). Interest in stoats is high in both the Northern Hemisphere and New Zealand, but for different reasons. Stoats in Europe and North America have long been regarded as significant native predators of introduced game birds and pest rodents, whereas their effect on native birds is seldom mentioned. In New Zealand, their role as introduced predators of native birds over-rules all other considerations, including any interest in the theoretical aspects of adaptation by stoats to their new environment, or of the introduction of stoats and other predators as an unplanned ecological experiment.

By contrast, interest in weasels is much higher in the Northern Hemisphere than here, especially in the boreal regions. There, weasels are specialist predators of small rodents, and competing ideas about the potential impact of their activities under the snow form part of a long-running theoretical debate about the control of the multi-annual population cycles of voles and lemmings (Norrdahl 1995; Korpimäki et al. 2002). There are no voles or lemmings in New Zealand, and very little is known about the conservation or theoretical significance of weasels. Interestingly, there are hints that where stoats are effectively removed, local numbers of weasels may increase (T. Beauchamp & P. de Monchy, DOC, pers. comm.).

TABLE 6. SOURCES OF INFORMATION ON THE BIOLOGY OF STOATS (TOTAL NUMBERS OF PAPERS 1877–2004; NEW ZEALAND (NZ) VERSUS ELSEWHERE IN THE WORLD).

	REPRODUCTION/ LIFE HISTORY STRATEGY	PARASITES/ DISEASE	HOME RANGE/ ACTIVITY	PREDATION IMPACT ON NESTS	PREDATION IMPACT ON POPULATIONS	DIET	POPULATION BIOLOGY
NZ	26	14	19	19	36	26	33
Elsewhere	98	37	40	21	43	51	76
% NZ	21	27	32	48	46	34	30

TABLE 7. STUDIES OF THE IMPACT OF SMALL MUSTELIDS ON THEIR PREY WITHIN AND OUTSIDE NEW ZEALAND.

The key word 'impact' was confined to studies that actually measured the proportion of the bird's population or productivity removed by stoats, compared with other sources of mortality (hence not lists of items eaten, which are listed under the key word 'diet').

	NEW ZEALAND	ELSEWHERE
Stoat	36	44
Weasel	4	67

3.2 HISTORICAL VARIATION IN RESEARCH FOCUS

3.2.1 Attitudes to stoats

Historical shifts in perceptions of, for example, the significance and role of pests, can often seem amazing in retrospect: see, for example, Graeme Caughley's trenchant summary of changing attitudes to deer in New Zealand, in his book *The Deer Wars* (Caughley 1983). For stoats, changes over the last 40 years—in whatever kind of science was considered to take top priority—can be detected from the bibliographic database, or, more easily, from comparing how review papers or books published some time ago appear to contemporary readers. Analysis of the book *Immigrant Killers* (King 1984) provides historical insight into what sort of information was available in the published literature in the early 1980s compared with now.

Stoats were among the last of the predators to be introduced into New Zealand, after much of the historic damage had already been done. Furthermore, they never reached many of the offshore islands from which endemic species have disappeared for other reasons. It would therefore be inappropriate to include these species among the total number of separate bird populations which might have been affected by stoats. King (1984) calculated that, of 135 separate island populations then listed as extinct, 96% had never come into contact with stoats. (Each island population is counted separately, so this is not equivalent to the number of *species* that met stoats.) The other 4%, plus 61% of 18 populations then listed as endangered, encountered both stoats and ship rats, but apparently none were in contact with only stoats. The few clear cases in the literature, e.g. that of Big South Cape (Bell 1978) and Lord Howe Island (Hindwood 1940), leave little doubt that rats could have achieved the same effect alone.

Research since 1984 on the history and distribution of our endemic bird fauna changes the percentages somewhat (Tables 8 and 9), but does not materially alter the result. Stoats were clearly *not* innocent of playing their part in the historic extinctions. Yet the more comprehensive recent data still show that the great majority of the separate island populations that are now extinct were lost despite never encountering stoats. Therefore, although the counter-intuitive conclusion of two decades ago that 'The part played by stoats in the *total* history of extinctions in New Zealand appears almost insignificant' (King 1984: 106) now sounds somewhat exaggerated, it is still largely true.

The greatest change over the last 20 years has been in the growth of information about the impact of contemporary populations of stoats on the surviving bird species, and in priorities for research and conservation action. The New Zealand literature on the effects of stoat predation on native birds can be retrieved from the database by entering the three keywords 'stoat', 'predation impact' and 'NZ' (Table 7). At the date of this analysis (January 2005) this combination of keywords produced a list of 36 publications (and 44 referring to elsewhere). The earliest of the New Zealand papers described studies on the populations of small passerines at Big Bush, near Kaikoura, and showed that these birds could compensate, at least to some extent, for the heavy toll of predators on their nests by repeat breeding (Flack & Lloyd 1978; Moors 1983a, b). My own 'predation index' (King 1983) could only suggest that the regular irruptions of stoats in Fiordland beech forests after a seedfall were probably associated with increased predation on birds, but confirmation from the birds' side of the equation had to await the beginning of Graeme Elliott's work on mohua / yellowhead in the same area in the late 1980s (Elliott & O'Donnell 1988). So at the time the literature search for *Immigrant Killers* had to be closed in late 1983, there were hardly any hard data available suggesting that any species was in immediate danger.

The ideas and hypotheses we had then were, of necessity, influenced by theoretical ecological research done in the very different environments of the Northern Hemisphere. The weasels I had studied in England were minority members of a large predator guild, and contributed only a small proportion of annual consumption of prey biomass (King 1980b). Theoretical ideas capable of interpreting similar relationships in New Zealand were then in their infancy. There were some prophetic warnings (Elton 1958; O'Regan 1966), but they had little influence in determining operational priorities. The largest-scale small-mammal research programmes of the 1960s and 1970s were concentrated on the population biology of rabbits (Gibb et al. 1978; Gibb & Williams 1994) and

TABLE 8. CURRENT ESTIMATES OF THE DISTRIBUTION OF EXTINCT AND THREATENED BIRD POPULATIONS ON ISLANDS IN NEW ZEALAND IN RELATION TO THE DISTRIBUTION OF STOATS (FROM HOLDAWAY 1999 AND PERS. COMM.).

Stoats reached Resolution, Secretary, Maud and other islands off the South I., but no islands off the North I. or in the Stewart or Chatham groups.

		ISLANDS AND ISLAND GROUPS						TOTAL
		NORTH I.	OFF NORTH I.	SOUTH I.	OFF SOUTH I.	STEWART GROUP	CHATHAM GROUP	
Never in contact with stoats	Extinct	39	8	40	5	11	11	114
	Rare or Endangered	0	2	0	0	0	16	18
Possibly affected by stoats	Extinct	11	–	11	6	–	–	28
	Rare or Endangered	9	–	13	1	–	–	23
Total								183

TABLE 9. CHANGES IN PERCEPTION OF THE POTENTIAL ROLE OF STOATS IN THE HISTORIC EXTINCTIONS OF BIRD POPULATIONS IN NEW ZEALAND. INFORMATION PRESENTED BY YEAR FOR WHICH DATA ARE AVAILABLE.

	1983	2005
Number of separate island populations now extinct	135	142
Populations that have never been in contact with stoats	130 (96%)	112 (79%)
Number of separate island populations listed as threatened	18	41
In contact with stoats	11 (61%)	23 (56%)
Source	King 1984	Table 8

on the community dynamics of native and introduced species in the forests surrounding the Orongorongo Valley field station (Brockie 1992; Fitzgerald & Gibb 2001). My contribution to the Orongorongo Valley study was intended to measure predation pressure by stoats on forest birds, but there were so few stoats there that I had to set up a survey of stoats in national parks instead (King & Moody 1982). That study eventually produced a lot of interesting data on stoats, but without supporting data on bird populations it could not say anything about predation rates.

So, amazing as it seems now, in the early 1980s there was simply no quantitative evidence of what effect stoat predation could be having on the surviving contemporary birds, and therefore nothing on which to justify the considerable expense of effective control. The only alternative was to assume, as seemed reasonable at the time, that most of the damage that could be done by an invader would be done when it first arrived. Therefore, presumably, no species that was being seriously affected by stoat predation could have survived for as long as 100 years (the publication of *Immigrant Killers* in 1984 was timed to coincide with the 100th anniversary of the first arrival of stoats in New Zealand). That was probably true of some species, but not all; and the corollary that the surviving species could cope was, for many species, simply wrong. Only in the last 10–15 years have we begun to assemble the data required to test and reject it, species by species (O'Donnell 1996; Wilson et al. 1998; Dowding & Murphy 2001).

3.2.2 Documenting the value of new monitoring tools

Documenting the effects of predation on birds by monitoring *populations* is very difficult and often leads to inconclusive results. A standard method for estimating a relative index of bird density is to take systematic five-minute bird counts (Dawson 1981). However, studies in the Eglinton Valley in the mid-1970s detected no clear difference in counts of forest birds between areas with and without stoat trapping and before and after trapping (Efford & Morrison 1991). Similarly, counts on Little Barrier Island before and after the eradication of cats in 1980 (Veitch 2001) could not demonstrate the expected benefit to birds (Girardet et al. 2001). Over the last decade, the advent of new technology, especially time-lapse video cameras, has made it possible to monitor breeding performance at nests, and this has led to very different results. It has not only allowed systematic accounting for the productivity (numbers of eggs laid and chicks hatched) and mortality (of eggs, young and sitting adults) associated

with every nesting attempt; it has also proven beyond doubt the link between all these factors and the abundance of particular predators. Stoats are certainly a serious threat to hole-nesting birds (O'Donnell 1996) and brown kiwi (McLennan et al. 1996). On the other hand, the prime threat to North Island kokako is from possums and ship rats (Innes et al. 1999); and nests of ground-nesting birds in the MacKenzie country are most often lost to cats, hedgehogs and ferrets (Sanders & Maloney 2002).

The alliance of these new data with another new tool, computer modelling of the consequences of prolonged breeding failure, has meant that ornithologists are now able to estimate both the effects of predation on a given population and the degree of reduction in the density of a specified predator needed to prevent it (Elliott 1996; Basse et al. 1999). This information provided essential technical support for the arguments that eventually persuaded the New Zealand government to allocate very large amounts of public money to biodiversity protection programmes from the late 1990s onwards. As the database shows, all this new information has changed our view of what sort of stoat research should be considered top priority for funding.

3.2.3 Tracing improvements in control technology

New Zealand has relied upon traditional pest management tools for 50 years, using skills acquired from trappers in Europe and North America. Until very recently, trapping has been the only option available for controlling a local stoat population. Leg-hold traps are still legal in New Zealand, but the Fenn trap, passed by the British government as humane in 1958 and introduced to New Zealand in 1972 (King & Edgar 1977), has proven to be a better alternative for rats and stoats (King 1981). Therefore, ever since their introduction, Fenn traps have been used by wildlife officers and park rangers in New Zealand (Sim & Saunders 1997).

However, trapping with single-catch traps is labour-intensive and inefficient, especially under the Animals Protection Act 1960, s.6, which specified that '*any* trap, noose or similar contrivance' had to be inspected daily. The requirement for daily inspections imposed a severe limitation on the total area that could be covered by a trapping campaign, which in turn meant that trapping alone could never fully protect a reserve large enough to support a viable breeding population.

Eventually, this limitation was recognised and removed by new legislation. The Animal Welfare Act 1999, s.36, says that: 'A person who, for the purposes of capturing *alive* a mammal … sets … a trap, must inspect that trap … within 12 hours after sunrise on each day'. Because the Fenn trap is very obviously not designed to catch alive, it is considered exempt from this provision; therefore, conservation officers can cover much larger areas with traps checked at less frequent intervals. However, controlled tests (B. Warburton, pers. comm.) and field observations (Purdey et al. 2004) show that the Fenn does not meet the more stringent current standards for a humane kill, or the demands of animal ethics committees. In response, many new designs for more efficient and humane traps are now being developed (Murphy & Fechney 2003).

Poisoning is an obvious alternative to trapping. This technique has been used against rats, rabbits and possums for decades. Provisional licences have been

granted for the trialing of new poisons for use against mustelids, and the secondary poisoning of mustelids during campaigns against rats and possums has turned out to be an unexpected ally (Gillies & Pierce 1999; Alterio & Moller 2000). Publications on control technology listed in the database reflect these changes well, especially the demand for more humane and cost-effective methods of lethal control (Table 10). For example, before 1970, there were only nine publications on killtrapping, all from outside New Zealand; however, between 1970 and 2000, there were 122, of which only 19 were from outside New Zealand. Similarly, before 1990 there were no publications on poisoning; however, since then there has been a total of 59 papers, 53 of which have arisen from research conducted in New Zealand.

There is increasing public disapproval of the extensive use of lethal methods in New Zealand, especially over the use of 1080 distributed from aircraft. In anticipation of a possible ban on both killtrapping and poisoning, or pressure from our trading partners to that effect, funds are being invested in other strategies, including new methods of biological control. New Zealand scientists are virtually alone in this endeavour, at least with respect to stoats (although New Zealand stands to gain from the experience of other countries in developing novel means of dealing with other pests, such as foxes, rabbits and mice in Australia and feral horses in the United States).

The world literature describes at least some of the vital background data needed to develop a biocontrol technology for stoats. Basic data on seasonal cycles of reproduction and delayed implantation in stoats and long-tailed weasels are contained in 122 of the publications listed on the database under the keyword 'Reproduction'; however, 96 (78%) of these were published before 1990, and only 19% of them refer to stoats in New Zealand. Work is in progress, but we do not have time to repeat the older studies, either intentionally or not. So far, the published literature on biocontrol is small, but ten of 11 papers covering the subject in any way have come from New Zealand.

TABLE 10. LITERATURE ON CONTROL METHODS (ALL SPECIES). POISONING INCLUDES SECONDARY POISONING, WHETHER DELIBERATE OR ACCIDENTAL.

	KILLTRAPPING		POISONING		BIOCONTROL	
	NZ	ELSEWHERE	NZ	ELSEWHERE	NZ	ELSEWHERE
Before 1969	0	9	0	0	0	0
1970–79	4	3	0	0	1	1
1980–89	6	3	0	2	1	0
1990–99	34	0	30	2	1	0
Since 2000	48	15	23	2	8	0
Total	92	30	53	6	11	1

4. Discussion

It is a truism that the conservation policies of a given time must necessarily be based on the knowledge of that time, and that contemporary knowledge is never sufficient to answer all our questions. The gaps have to be filled from theory, based on data but often extended into predictions by reasonable inference. It is a matter of common experience that inferences from the same data can vary between people, and in individuals from one decade to the next, according to the constantly shifting background of other available information.

Our basic data on the biology of stoats in New Zealand often needs to be supplemented from elsewhere. The dilemma is that information from outside New Zealand is not necessarily applicable here, since this country is very different from anywhere in the stoat's native environment; and in some aspects of their biology and behaviour, the stoats resident here have adapted in response. Data that seem to be applicable to stoats living in any habitat, e.g. on fixed species characters such as physiology, age determination and reproduction, can usefully be mined from northern-hemisphere sources; but ecological concepts, especially on predator-prey relationships, are less easily transportable. To help distinguish these different sources, in the first year of the Stoat New Initiative Fund, DOC commissioned careful and critical reviews of available information on stoats from outside New Zealand (Hinds et al. 2000; McDonald & Larivière 2001), aided by a specific comparison between stoat management in the United Kingdom and in New Zealand (McDonald & Murphy 2000).

The present paper shows that use of a readily available bibliographic database not only allows easier and wider access to published literature on a particular subject, but also enables us to track historical shifts in research focus. This database may help to remind us that the new ideas of the past did not always produce the results intended, and we should therefore take a long and careful view of the new ideas of the present. For example, stoats were the very first biocontrol agents deliberately brought into New Zealand by Government authority against cogent objections (Buller 1877; Martin 1885). Taking a long view of such issues with the help of a comprehensive database allows us not only to update our current views on a particular topic, but also helps with making decisions about what sort of research should have top priority funding.

5. Conclusions

1. The regularly maintained on-line bibliographies posted on www.feral.org.au (Lapidge et al. 2004–present), concerning stoats and some other species, should save New Zealand researchers time when planning new projects, and facilitate access by researchers elsewhere to work done in New Zealand.
2. International literature often supplies important background information for New Zealand studies, but can be misleading. We cannot afford to ignore it, because we do not have time to repeat the basic studies described (and in some cases could no longer do so); but conclusions reached from work done in other countries must be applied with caution.
3. The database illustrates some major differences in the type of papers published about small mustelids in different parts of the world, and historical trends in publication rates by geographic region (steady in Europe; declining in America and Russia; accelerating in New Zealand). Over the last decade there has been a great increase in the number of papers documenting the impact of predation by stoats on native birds in New Zealand. New Zealand is now the world's leading centre for research on stoats.

6. Acknowledgements

For funding to support the assembly of the stoat database, I thank the Pacific Conservation and Development Trust, the Department of Conservation and the J.S. Watson Trust. The grant from the Watson Trust specified that the finished bibliography be mounted on a searchable website allowing free access. The main purpose of this condition was to help researchers and field workers planning projects to be done in New Zealand, but it will also make the results of New Zealand studies accessible internationally. This paper was first presented as a contribution to the New Zealand Ecological Society's annual conference at Hamilton, November 2000. I thank K.R. Ayers for months of help with data entry. The manuscript benefited from constructive comments by S. Sarre, J.E.C. Flux, B.M. Fitzgerald, C. Gillies, an anonymous referee and the DOC Science & Technical Publishing team.

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Appendix 1

KEYWORDS FOR SEARCHING THE DATABASE

Age determination
America
Anatomy
Antipredator behaviour
Australia
Bait markers
Baits / lures
Biocontrol
Biogeography
Black stilt
Body size
Captive observation
Cat
Character displacement
Colonisation
Competition
Conservation of native mustelids
Conservation theory
Control / management of pests
Craniometry
Cycles
Dens
Diet
Distribution
Ecology
Energetics
Eradication
Europe
Evolution
Ferret
Foraging behaviour
Fossils
Fox
Fur
Game management
Genetics
Geographic variation
Habitat
Hedgehog
History
Home range / activity
ID guides
Introductions / invasions
Ireland
Islands
Japan
Kaka
Kakapo
Killtrapping
Kiore
Kiwi
Kokako
Kuri
Life history strategy
Literature review
Livetrapping / handling
Longtail
Martens
Mice
Mink
Modelling
Mohua
Mongoose
Monitoring
Moult / colour change
Nest predation
NZ
NZ biota
Other mustelids
Otter
Pacific
Parasites / disease
Physiology
Poisoning
Polecat
Populations
Possum
Predation impact
Predation on (not by) mustelids
Rabbits / hares
Radiotracking
Rats
Reproduction
Research planning
Russia
Scent
Seedfall
Senses
Sexual dimorphism
Silver spoon
Snow
Stoat
Takahe
Taxonomy
Tracking
UK
USA
Voice
Weasel
YEP