

Checklist of Vertebrate Damage to Agriculture in Israel, Updated for 1993–2001

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The checklist of vertebrate pest species responsible for economic damage to agriculture production in Israel, which was first published in 1993, has been updated for 1993–2001. During this period new crop types have been damaged by these pests, and they have been added to the checklist. Four new bird pest species were also added: *Carduelis chloris*, *Anas platyrhynchos*, *Larus ridibundus* and *Pelecanus onocrotalus*. Thus the number of economically significant vertebrate species is now 65 (27 mammalian, 36 avian and two reptilian species). Cases of depredation in forestry and pasture, which were not included in the former list, were also added. The significance of the compiled data in assisting with farm management decision is also discussed.

KEY WORDS: Vertebrate pests; checklist; mammalia; Aves; orchards; field crops; livestock; forestry; commensal rodents; field rodents; vertebrate damage.

INTRODUCTION

Although vertebrate species inflict considerable damage to agricultural production around the world, country-wide damage assessments are rare. Recording damage in the form of a checklist can be alternatively useful as an index of the economic importance of the pest species concerned, and provides a tool for monitoring the potential development of additional pest species, or changes in the impact of these pests.

In 1993 the first checklist of vertebrate pest damage to agriculture in Israel was published by Moran and Keidar (5). That report listed the vertebrate species that inflicted commercially significant damage to agriculture, including crop, equipment and products. It listed the type of crop involved, or other human properties affected, and the type of damage in each case. Accidental and non-commercial damage cases, such as in municipal and home gardens, or to individual trees, were not listed. The authors verified the cases of vertebrate damage included in the table, except for cases included in the 'References' column. Sixty-one vertebrate species were classified as pests, including 27 mammal species, 32 bird species and two reptiles. Since then, the damage caused by vertebrate pests in Israel has been continuously monitored and recorded by the Vertebrate and Snail Section, Plant Protection and Inspection Services.

UPDATE 1993–2001

The updated checklist (Table 1) is arranged in the same format as the earlier list. Only new cases, observed since the former publication (5), are included in this list. Since 1993,

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Fig. 1. Systematic composition of vertebrate pest species causing significant damage to agriculture in Israel. Data show the former published list (5) and the additional species added since 1993.

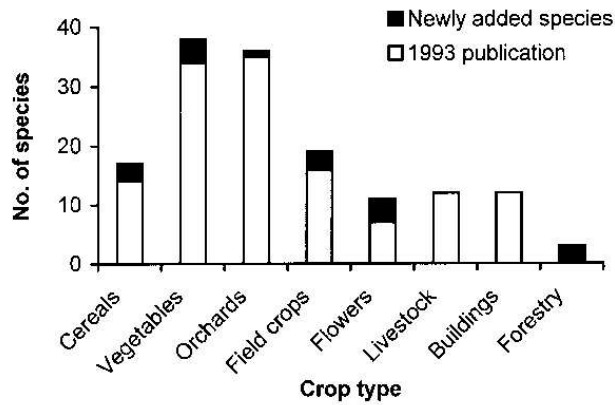


Fig. 2. Distribution of the damage caused by vertebrate pest species in Israel according to crop types. Based upon the former published list (5) and the additional species added since 1993. Field crops – include chickpea, sunflower, sugar beet, cotton, etc. Orchards – include grapes. Livestock – includes damage to animal feed and pasture, contamination, and predation.

new types of crop damage caused by several vertebrate pest species have occurred, and they were verified and recorded by the author as before. Some instances, not included in the previous publication, are added to the list: vegetables damaged by *Fringilla coelebs* that were reported by Smolly (9), and damage to forestry (Y. Sela, personal communication) and pasture (6).

Four new vertebrate pest species have been added to the checklist, all of them birds: *Carduelis chloris*, *Anas platyrhynchos*, *Larus ridibundus* and *Pelecanus onocrotalus*. Including these birds, the number of economically significant vertebrate pest species is now 65: 27 mammalian, 36 avian and two reptilians (Fig. 1).

TABLE 1. Updated checklist of vertebrate damage to agriculture in Israel, 1993-2001

Vertebrate species		Type of organism damaged		Part of crop or type of damage	Remarks ^z	References
Scientific name	Common name	Common name	Scientific name			
CLASS AVES						
ORDER GALLIFORMES						
Family Phasianidae						
<i>Alectoris chukar</i> Gray	Chukar partridge	Small radish	<i>Raphanus sativus</i> var. <i>radicula</i>	Sprouts	p	
ORDER GRUIFORMES						
Family Gruidae						
<i>Grus grus</i> (L.)	Crane	Wheat	<i>Triticum</i> sp.	Seeds	sd, l	
		Corn	<i>Zea mays</i>	Seedlings	l	
		Peanut	<i>Arachis hypogaea</i>	Fruit	l	
ORDER ANSERIFORMES						
Family Anatidae						
<i>Anas platyrhynchos</i> L.	Mallard	Pea	<i>Pisum sativum</i>	Sprouts	l	
ORDER CHARADRIIFORMES						
Family Laridae						
<i>Larus ridibundus</i> L.	Black-headed gull	Hothouses (fbwers)		Plastic sheets	t, sp	
ORDER PELECANIFORMES						
Family Pelecanidae						
<i>Pelecanus onocrotalus</i> L.	White pelican	Hothouses (vegetables)		Plastic sheets	t, sp	
ORDER COLUMBIFORMES						
Family Columbidae						
<i>Columba livia</i> Gm. – feral	Feral pigeon	Chickpea	<i>Cicer arietinum</i>	Fruit		
Family Psittacidae						
<i>Psittacula krameri</i> (Scopoli)	Rose-ringed parakeet	Litchi	<i>Litchi chinensis</i>	Fruit		
		Avocado	<i>Persea gratissima</i>	Fruit		
ORDER PASSERIFORMES						
Family Alaudidae						
<i>Galerida cristata</i> (L.)	Crested lark	Melon	<i>Cucumis melo</i>	Sprouts	l	Y. Mordechai, pers. comm.
<i>Alauda arvensis</i> Bp.	Skylark	Wheat	<i>Triticum</i> sp.	Seeds, sprouts		
Family Pycnonotidae						
<i>Pycnonotus xanthopygos</i> (Hemp. & Ehr.)	African bulbul	Cucumber	<i>Cucumis sativus</i>	Fruitlets	sp	
		Campanula	<i>Campanula</i> sp.	Flower stalks		

^zba, debarking; br, breakage; f, forestry; g, gnawing; l, local; m, mass outbreaks; p, pecking; r, rooting; s, spillage; sd, soil destruction; sp, sporadic; t, trampling; ?, in doubt.
^y'Microtidae' in Moran and Keidar (5).

Table 1. (cont'd.)

Vertebrate species		Type of organism damaged		Part of crop or type of damage	Remarks ^z	References
Scientific name	Common name	Common name	Scientific name			
Family Corvidae						
<i>Garrulus glandarius</i> (L.)	Jay	Persimmon	<i>Diospyros kaki</i>	Fruit		
<i>Corvus corone</i> L.	Hooded crow	Sunflower	<i>Helianthus annuus</i>	Fruit, sprouts		
		Cabbage	<i>Brassica oleracea</i> var. <i>capitata</i>	Head	p	
<i>Corvus ruficollis</i> Les.	Brown-necked raven	Grevillea	<i>Grevillea</i> sp.	Seedlings	r, sp	
		Grapes	<i>Vitis vinifera</i>	Fruit	sp	
		Almond	<i>Amygdalus communis</i>	Fruit	l	
Family Turdidae						
<i>Turdus merula</i> L.	Blackbird	Nectarine	<i>Prunus persica</i> var. <i>nicipersica</i>		(4)	Moran <i>et al.</i>
Family Fringillidae						
<i>Fringilla coelebs</i> L.	Chaffinch	Pea	<i>Pisum sativum</i>	Seeds, sprouts		Smolly (9)
		Radish	<i>Raphanus sativus</i>	Seeds, sprouts		Smolly (9)
		Small radish	<i>Raphanus sativus</i> var. <i>radicula</i>	Seeds, sprouts		Smolly (9)
		Garden beet	<i>Beta vulgaris</i>	Seeds, sprouts		Smolly (9)
		Spinach	<i>Spinacia oleracea</i>	Seeds, sprouts		Smolly (9)
		Lettuce	<i>Lactuca sativa</i>	Seedlings		Smolly (9)
		Radish	<i>Raphanus sativus</i>	Seeds, sprouts		Smolly (9)
<i>Carduelis chloris</i> (L.)	Greenfinch					
CLASS MAMMALIA						
ORDER CHIROPTERA						
Family Pteropodidae						
<i>Rousettus aegyptiacus</i> (Geofroy)	Rousette fruit-bat	Mango	<i>Mangifera indica</i>	Fruit		
ORDER LAGOMORPHA						
Family Leporidae						
<i>Lepus capensis</i> L.	Hare	Wheat	<i>Triticum</i> sp.	Shoots	sp	
		Eggplant	<i>Solanum melongena</i>	Seedlings	l	Y. Mordechai, pers. comm.
ORDER RODENTIA						
Family Arvicolidae^y						
<i>Microtus guentheri</i> Danford & Alston	Levant vole	Coriander	<i>Coriandrum sativum</i>	Fruit		
		Sweetie	<i>Citrus grandis</i> × <i>paradisii</i>	Trunk	ba	

^zba, debarking; br, breakage; f, forestry; g, gnawing; l, local; m, mass outbreaks; p, pecking; r, rooting; s, spillage; sd, soil destruction; sp, sporadic; t, trampling; ?, in doubt.

^y'Microtidae' in Moran and Keidar (5).

Table 1. (cont'd.)

Vertebrate species		Type of organism damaged		Part of crop or type of damage	Remarks ^z	References
Scientific name	Common name	Common name	Scientific name			
		Parsley	<i>Petroselinum sativum</i>	Shoots	sp	
		Cabbage	<i>Brassica oleracea</i> var. <i>acephala</i>	Shoots		
		Indian dalbergia	<i>Dalbergia sissoo</i>	Trunk	ba	
		Chickpea	<i>Cicer arietinum</i>	Fruit		
		Pasture	<i>Graminae</i>		m	Noy-Meir (6)
		Asparagus	<i>Asparagus</i> <i>myriocladus</i>	Roots	sp	
<i>Meriones tristrami</i> Thomas	Tristram's jird	Lemon	<i>Citrus limonia</i>	Trunk		
		Bean	<i>Phaseolus vulgaris</i>	Fruit		
		Sweet pepper	<i>Capsicum annuum</i>	Seedlings		
		Gypsophila	<i>Gypsophila</i> <i>paniculata</i>	Shoots		
		Kohlrabi	<i>Brassica oleracea</i> var. <i>caulorapa</i>	Seedlings		
		Leek	<i>Allium porrum</i>	Seedlings		
Family Muridae						
<i>Rattus rattus</i> L.	Roof rat, ship rat	Asparagus	<i>Asparagus officinalis</i>	Shoots		
		Pomegranate	<i>Punica granatum</i>	Fruit		
		Date	<i>Phoenix dactylifera</i>	Fruit,		
				protective net		
				gnawing		
		Stored crops		Gnawing		
		Silk tree	<i>Albizia julibrissin</i>	Trunk	ba	
		Carob	<i>Ceratonia siliqua</i>	Trunk	ba	
		Prickly pear	<i>Opuntia vulgaris</i>	Fruit		
<i>Mus musculus</i> L.	House mouse	Broccoli	<i>Brassica oleracea</i> var. <i>italica</i> , subv. <i>cymosa</i>	Edible flower		
		Cauliflower	<i>Brassica oleracea</i> var. <i>botrytis</i>	Edible flower		
		Corn	<i>Zea mays</i>	Seeds, sprouts, fruit		
		Gerbera	<i>Gerbera</i> spp.	Flower		
		Kohlrabi	<i>Brassica oleracea</i> var. <i>caulorapa</i>	Edible stem		
		Tomato	<i>Lycopersicon</i> <i>esculentum</i>	Fruit		
		Hot pepper	<i>Capsicum frutescens</i>	Fruit		

^zba, debarking; br, breakage; f, forestry; g, gnawing; l, local; m, mass outbreaks; p, pecking; r, rooting; s, spillage; sd, soil destruction; sp, sporadic; t, trampling; ?, in doubt.
^y'Microtidae' in Moran and Keidar (5).

Table 1. (cont'd.)

Vertebrate species		Type of organism damaged		Part of crop or type of damage	Remarks ^z	References
Scientific name	Common name	Common name	Scientific name			
Family Spalacidae						
<i>Spalax ehrenbergi</i> Nehring	Mole-rat	Chickpea	<i>Cicer arietinum</i>	Roots, shoots	sp	
		Eryngo	<i>Eryngium planum</i>	Roots		
		Buttercup	<i>Ranunculus asiaticus</i>	Shoot		
		Onion (for seeds)	<i>Allium cepa</i>	Roots		
		Garlic (for seeds)	<i>Allium sativum</i>	Roots		
		Aspidistra	<i>Aspidistra eliator</i>	Roots		
		California fanpalm	<i>Washingtonia filifera</i>	Seedlings		
Young pines	<i>Pinus</i> spp.	Root collar, roots	Y. Sela, pers. comm.			
Family Hystricidae						
<i>Hystrix indica</i> Kerr	Indian crested porcupine	Eggplant	<i>Solanum melongena</i>	Shoots	1	Y. Mordechai, pers. comm.
		Squash	<i>Cucurbita pepo</i>	Shoots	1	Y. Mordechai, pers. comm.
		Young pines	<i>Pinus</i> spp.	Trunks	ba, sp,f	Y. Sela, pers. comm.
		Oak	<i>Quercus calliprinos</i>	Seeds		Y. Sela, pers. comm.
Family Capromyidae						
<i>Myocastor coypu</i> Molina	Nutria	Water lily	Nymphaeaceae	Leaves	sp	
		Beet	<i>Beta vulgaris</i>	Edible stem		
		Fennel	<i>Foeniculum vulgare</i>	Shoots		
ORDER CARNIVORA						
Family Canidae						
<i>Canis aureus</i> L.	Jackal	Deer (husbandry)	<i>Cervus elaphus</i>	Cub predation	1	Remark 'h' in Moran & Keidar (5) is void
Family Felidae						
<i>Felis caracal</i> Schreber	Caracal	Ostrich (husbandry)	<i>Struthio camelus</i>	Fledgling predation	1	

^zba, debarking; br, breakage; f, forestry; g, gnawing; l, local; m, mass outbreaks; p, pecking; r, rooting; s, spillage; sd, soil destruction; sp, sporadic; t, trampling; ?, in doubt.
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Table 1. (cont'd.)

Vertebrate species		Type of organism damaged		Part of crop or type of damage	Remarks ^z	References
Scientific name	Common name	Common name	Scientific name			
ORDER HYRACOIDEA						
Family Procaviidae						
<i>Procavia capensis syriaca</i> Schreber	Rock hyrax	Grapes	<i>Vitis vinifera</i>	Leaves		
ORDER ARTIODACTYLA						
Family Suidae						
<i>Sus scrofa</i> L.	Wild boar	Wheat	<i>Triticum</i> spp.	Shoots	t, sd	
		Melon	<i>Cucumis melo</i>	Polyethylene sheets	l	Y. Mordechai, pers. comm.
		Tomato	<i>Lycopersicon esculentum</i>	Fruit?	l	Y. Mordechai, pers. comm.
		Grapes	<i>Vitis vinifera</i>	Fruit, branches	br	
		Forestry		Seedlings	r	Y. Sela, pers. comm.
Family Bovidae						
<i>Gazella gazella</i> Pallas	Mountain gazelle	Peach	<i>Prunus persica</i>	Trunks	ba	
		Date	<i>Phoenix dactylifera</i>	Seedling leaves	l	
		Bean	<i>Phaseolus vulgaris</i>	Shoots		
		Grapes	<i>Vitis vinifera</i>	Fruit		

^zba, debarking; br, breakage; f, forestry; g, gnawing; l, local; m, mass outbreaks; p, pecking; r, rooting; s, spillage; sd, soil destruction; sp, sporadic; t, trampling; ?, in doubt.

^y'Microtidae' in Moran and Keidar (5).

DISCUSSION

Compared to many other countries, the number of 65 vertebrate pest species in Israel is exceptionally high, considering the relatively small size of the country: 2,245,000 ha, of which only 411,000 ha are arable land (8). This relatively large number of pest vertebrates is the result of several factors. The influence of the geographical position of Israel between Europe, Africa and Asia on the composition of the Israeli fauna (1). Israel is located on one of the main bird migration routes. All together 121 bird species, of approximately 470, regularly migrate through Israel (7). Another factor affecting the diversity of fauna is the variability in soil types, and in geographical regions, which differ in climate and rainfall (2). Most horticultural plots are based on subtropical and deciduous fruits, and a large selection of vegetables and flowers is grown under plastic cover or in greenhouses as well as in open areas. However, most of these crops are cultivated mainly under irrigation (8). The increased diversity of the vertebrate fauna as well as of agricultural crops, has multiplied the chances for encounters between a crop and a suitable vertebrate pest, and thus increased the types of crop damage.

In some cases new plant species, which have been introduced into Israel, were exposed to the local vertebrate population, and consequently were attacked and have been added to this list. For example, the introduction of *Aspidistra eliator* as a green ornamental brought it into contact with a resident rodent – *Spalax ehrenbergi*, and this has resulted in significant damage to this ornamental on many occasions. Sometimes a cultivar has been introduced into a new region in Israel, and thus created a greater potential for damage. For example, the damage caused by *Mus musculus* to the fruit of pepper (*Capsicum frutescens*) has been recorded previously (5). However, when sweet and hot peppers became major crops in the northern Negev region, *M. musculus* outbreaks in the summer of 2001 caused ca US\$ 1.2 million damage to pepper production in 190 ha of pepper fields and greenhouses (S. Moran, unpublished data). In other cases the addition of a pest species to the list resulted from a new encounter between a resident vertebrate species and a common crop. For example, only in 1996 was *Pycnonotus xanthopygos* first recorded to cause damage to cucumbers in hothouses by pecking the fruitlets.

Examining the number of vertebrate pests vis-à-vis the type of crops damaged reveals that the main crops damaged were vegetables (38 cases) and orchards (36) (Fig. 2). This means that vegetable and fruit growers have to contend with a relatively large number of vertebrate pest protection problems. For example, grapes are depredated by *Pycnonotus xanthopygos*, *Sylvia atricapilla*, *Onycognathus tristramii*, *Passer domesticus*, *P. hispaniolensis*, *Corvus corone*, *Lepus capensis*, *Microtus guentheri*, *Rattus rattus*, *Canis aureus*, *Vulpes vulpes*, *Gazella dorcas*, *G. gazella*, *Capra ibex*, *Pocavia capensis syriaca* and *Sus scrofa* – a total of 16 species. However, some of these species are restricted to exotic localities, e.g. *O. tristrami* and *G. dorcas* are distributed near vineyards in the Dead Sea Valley and Northern Arava Valley areas only (1,3,5).

Table 1 lists the cases of damage in commercial crops only. Damage rates were variable, ranging from small proportions (1–5%) to total crop loss, as occurred with *M. guentheri* in wheat fields during the rodent outbreak in 1996. Partial damage also can be economically disastrous, as was noted in the level of crop losses caused by *M. musculus* in the pepper crops mentioned above. Those growers lost 50–60% of their pepper crops due to mouse damage. For these reasons a checklist of the crops susceptible to damage by vertebrate pests

does not attempt to extrapolate the damage assessment to economic loss. Such a checklist does, however, provide a valuable aid when producers are planning future agricultural enterprises.

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