Lumbricus terrestris **System:** Terrestrial

Kingdom	Phylum	Class	Order	Family
Animalia	Annelida	Clitellata	Haplotaxida	Lumbricidae

Common name green crawler (English), dilly worm (English), nitro crawler (English), night crawler (English), large crawler (English)

Synonym

Similar species

Summary Lumbricus terrestris is a common earthworm, or nightcrawler, which is native to Europe and has recently received attention for its invasion of North America. It has invaded areas of Canada, the northern United States and parts of northeastern Europe. Its invasion fronts aided by translocations via bait trade, agriculture, horticulture, and unintentional transport have introduced this species throughout Canada and northern hardwood forests of the United States. L. terrestris alters ecosystems by rapidly consuming leaf litter, thereby altering nutrient cycling and availability, affects seedling establishment and plant communities through its interaction with seeds. It may also displace native earthworm species.

[view this species on IUCN Red List]

Species Description
Lumbricus terrestris is a relatively large, anecic earthworm. It is pinkish to reddish-brown in colour and typically reaches 10-25 cm in length.

Uses
Lumbricus terrestris is an extremely common bait species, and was found to be the most common species sold in bait stores in a survey conducted in the Upper Midwest United States where *L. terrestris* is invasive (Keller *et al*, 2007)
L. terrestris is an anecic earthworm that removes litter from the soil surface, pulling it down into the mineral layer, and deposit casts of mixed organic and mineral material on the soil surface. It is important in nutrient cycling and soil aeration in agriculture (Addison, 2009).

Habitat Description
Lumbricus terrestris can inhabit all soil types except coarse sands, bare rock and acidic peat (*Sphagnum*). It has been found to be constrained by the -15 °C isotherm. It tolerate soils with pH values as low as 3.5–3.7 and as high as about 8. *L. terrestris* is not frost-tolerant indicating that it hibernates in deep soil layers during the winter (Addison, 2009; Tiunov *et al*., 2006; Wironen & Moore, 2006). Although often present in agricultural fields, it fares poorly due to herbicides, mechanical damage and lack of leaf litter (L. Frelich, pers. comm.).

Reproduction
Lumbricus terrestris is a reciprocally mating simultaneous hermaphrodite, which reproduces sexually with individuals mutually exchanging sperm. *L. terrestris* leaves its burrow to copulate on the soil surface. Sperm is stored, and mated individuals produce cocoons for up to 12 months after the mating. A study on the hatchability of cocoons found a range of 76 to 62% hatched over the 5 months following mating, which decreased to about 11% in the sixth month, and cocoons after that failed to hatch. Median total production of viable cocoons was 5 per individual, with a range of 0-21. Sperm may be stored for as long as 8 months (Butt & Nuutinen, 1998).

Nutrition
Lumbricus terrestris is a keystone detritovore that consumes leaf litter on the soil floor. *L. terrestris* leaves its burrow to rapidly consume leaf litter. Preference is related to high Ca and possibly N concentrations. Thus basswood, ash and aspen are most preferred, followed by sugar maple and maple species. Oak is less palatable due to its low Ca concentration, but will be consumed if no other leaves with higher Ca are present (Frelich *et al*, 2006; Suarez *et al*, 2006; Belote & Jones, 2009).

General Impacts
In many ecosystems and in agricultural systems earthworms are highly beneficial to soil processes (Hendrix & Bohlen, 2002). However in forest ecosystems with few or no native earthworms, introduced species can have negative effects. Earthworms are keystone detritivores that can act as “ecosystem engineers” and have the potential to change fundamental soil properties, with cascading effects on ecosystem functioning and biodiversity (Frelich *et al*., 2006; Eisenhauer *et al*., 2007; Addison, 2009)
Exotic earthworms are a particular problem in previously earthworm-free temperate and boreal forests of North America dominated by *Acer*, *Quercus*, *Betula*, *Pinus* and *Populus* (Frelich *et al*., 2006).
Earthworms are often classified based on their activity and feeding type, which affects their impacts on the soil (Bouché, 1977 in Addison, 2009). *Dendrobaena octaedra* and *Dendrodrilus rubidus* are epigeic species, which inhabit and feed at the soil surface. Epigeics physically disrupt the organic layer of the soil by consuming and mixing the F and H layers, producing a homogenous and granular form of organic forest floor (Addison, 2009). *Lumbricus rubellus* operates in two categories, 1) epigeic which inhabit and feed at the soil surface and 2) endogeic which live and feed in the mineral horizons below the organic (LFH) layer. Thus it is considered epi-endogeic in its habits, feeding on organic matter in the forest floor, but also mixing the organic material into the upper layer of mineral soil (Addison, 2009). *L. terrestris* is a deep-burrowing anecic earthworm, which create permanent vertical burrows in the mineral layer. They come to the surface to feed on litter and pull it down to their burrows, depositing casts of mixed organic and mineral material on the soil surface (Addison, 2009).
Thus earthworms in different functional groups have different impacts on the soil (Frelich *et al*., 2006; Hale *et al*., 2008). Often multiple earthworm species inhabit areas of forest, and studies suggest that impacts are greater when earthworms from more than one functional group occur together (Hale *et al*., 2005; Hale *et al*., 2008). Earthworm invasions typically occur in waves (e.g. Hendrix & Bohlen, 2002; Eisenhauer *et al*., 2007), with epigeic (e.g. *D. octaedra*, *D. rubidus*) or epi-endogeic (e.g. *L. rubellus*) species arriving first as they are able to utilise undisturbed forest floors. The first noticeable impacts tend to be physical disruption of the stratified humus layers on the forest floor. Endogeics generally only invade after the organic layer has been modified by epigeic or epi-endogeic species. Anecic species (e.g. *L. terrestris*) are usually last to arrive (James & Hendrix, 2004 in Addison, 2009).
The purported impacts of invasive earthworms are often varied between publications, and different soil types and soil layers may be affected differently by earthworm invasion. However the main effect of earthworms is to consume litter, and incorporate it into deeper soil layers, thus causing mixing of the A and O soil horizons. This causes extreme reduction of the litter layer and changes in nutrient concentrations and cycling in the soil. Other soil characteristics such as pH, porosity and decomposition rates may also be affected. Physical disruption of plant roots and mycorrhizal associations is also a common impact. These changes to fundamental soil properties have cascading effects on plant communities, microorganisms, micro and mesofauna, birds and mammals (Hale *et al*., 2008; Addison, 2009).
For a detailed account of the impacts of invasive earthworms please read Earthworms Impacts Information.

Management Info
There are currently no effective methods to eradicate established earthworm populations without unacceptable non-target effects. Thus the main technique for managing invasions is prevention of introductions, via various pathways (Cameron *et al*., 2007; Keller *et al*., 2007).
Preventative measures: One of the major pathways for earthworm introductions is believed to from release by anglers discarding unwanted live bait. Keller *et al*. (2007) suggest two alternatives to reduce the likelihood of further establishments while preserving the economically important live trade of earthworms. These are: 1) Replace the species currently sold with earthworm species that are unlikely to establish populations, e.g. *Eudrilus eugeniae* which has an extremely low invasion risk in the U.S. Midwest, and 2) Strengthen efforts to educate anglers to dispose of live earthworms responsibly, i.e. in the trash where landfill conditions are likely to kill them (Keller *et al*., 2007) or to prohibit the abandonment of live bait (Cameron *et al*., 2007).
Similarly, transport of cocoons and earthworms via vehicular transport is a major pathway for introduction to new locations. Thus construction of fewer roads, restricting the amount of traffic on roads or reclaiming roads where possible would minimize spread of earthworms (Cameron & Bayne, 2009).
Management and regulatory strategies should also take into account the fact that some earthworm species, such as *Lumbricus rubellus* have larger impacts than others. This species is less widely distributed than other exotic species. Thus preventing its introduction to new areas is important, even if those areas are already infested with other species (Hale *et al*., 2006). Similarly, some forests will be more susceptible to invasion than others. Litter calcium content is likely to be an important predictor of litter decomposition rates by exotic earthworms (Holdsworth, 2008).
Callaham *et al*. (2006) suggest various policy measures that could be adapted to prevent the spread of exotic earthworms. The authors suggest restrictions on transportation of soils from infested areas to non-infested areas, unless a special permit certifying that the material is free from earthworm propagules has been granted. Formalized earthworm introduction decision making tools are also recommended as an alternative to the *ad hoc* decisions made by regulating agencies at present. This decision-making process allows for the quarantine of materials containing propagules of earthworms that have not been identified or widely introduced previously. These quarantines would provide time to determine the ecological risk posed by the introduction of a given earthworm species into particular systems. Suggested types of information needed to determine ecological risk include mode of reproduction, number of embryos per cocoon, ecological “strategy”, and temperature, pH and moisture requirements (Callaham *et al*., 2006).
Cultural measures: Successful establishment of earthworm populations is influenced by management of the site. For example, synergistic effects of the invasive weed buckthorn and exotic earthworms could be minimized by early control measures to limit the weed (Heneghan *et al*, 2006).
Chemical control: Where non-native earthworms are not well established or are found in discrete populations, the use of chemical treatments to eradicate undesirable worms may be successful. Chemical control have been used in the management of golf courses. While these treatments are highly effective, the non-target effects of chemicals should be examined before large-scale utilization (Callaham *et al*., 2006).

Pathway
Can be present in potted or ball and burlap nursery stock, and sod.*Lumbricus terrestris* is an extremely commonly used fish bait. Its use and abandonment as such constitutes a major method of its dispersal (Cameron *et al*, 2007).Industrial or recreational activities may transport of soil and plant materials containing cocoons or *Lumbricus terrestris* Cameron *et al*, 2007).

Principal source:

Compiler: National Biological Information Infrastructure (NBII) & IUCN/SSC Invasive Species Specialist Group (ISSG)

Review: Lee. E. Frelich, The University of Minnesota Center for Forest Ecology

Pubblication date: 2011-03-09

ALIEN RANGE

[12] CANADA
[1] RUSSIAN FEDERATION
[1] ROMANIA
[9] UNITED STATES

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