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Earthworm Ecology in the Northern Part of Iran: With an Emphasis on Compost Worm *Eisenia fetida*

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Abstract: In the present study, Northern part of Iran was chosen as study area. Four hundred samples of earthworms were collected by three methods (hand-sorting, chemical and heat extraction) of which 352 and 20 were mature and immature earthworms, respectively from different parts of the area. Following the method introduced by Graff the earthworms were placed in formaldehyde (5 and 10%) and ethyl alcohol (60%). The morphological observations showed the presence of eight species including seven specimens of Lumbricidae: *A. caliginosa*, *A. kaznakovi*, *A. jassyensis*, *A. rosea*, *D. veneta*, *D. byblica*, *E. fetida* and a specimen of Megascolecidae: *P. indica*. The abundance of *E. fetida* was 18.1% with large distribution over the area that makes this species an easily available earthworm in rearing industry and in organic waste management.

Key words: Cowdung, earthworm, horse manure, identification, species

INTRODUCTION

Earthworms occur all over the world, but only rarely in deserts, areas under constant snow and ice, mountain ranges and areas almost entirely lacking in soil and vegetation^[1]. Early research on Lumbricidae distinguished between surface-dwelling species that produce no burrows or casts and soil-swelling species that live within a defined burrow system^[2]. Bouche^[3] working with European lumbricids, also recognized three major ecological groups, termed as epigeics, anecics and endogeics. Earthworms play an important role in processing organic material derived from natural and anthropogenic substrates such as sewage sludge^[4]. It has been known that earthworms are able to accumulate heavy metals such as Pb, Cd, Cu and Hg in their body without any harm to them^[5].

The species most commonly used for management of organic wastes is *E. fetida*. There are several reasons why this species is preferred. It is ubiquitous and many organic wastes become naturally colonized by this species. It is a tough worm, readily handled and in mixed cultures usually becomes dominant^[1,6].

The purpose of this study was to identify the species living in northern part of Iran. This area has many raining

days throughout the year and covered with widespread forest, which makes environmentally suitable conditions for earthworms living.

MATERIALS AND METHODS

Environment condition: Being situated by the Caspian Sea, Gilan province has a temperate Khazari (Caspian) climate. Talesh Mountains extending from the north to the south and Alborz Mountains from the west to the east prevent the water vapor of the Caspian Sea and the northwestern humid winds from entering the rest of Iran. Also, the high altitude of these mountains causes enormous amounts of rain in the region. In some parts, relative moisture in warm months reaches 89 percent and this moisture is the same factor that modifies the temperature in the summer and winter. There are hardly any freezing days in this province. In Gilan, the greatest amount of rain falls Chaboksar and varies between 1000 and 2000 mm. Rudbar and Loushan, too, are among the regions having the most precipitation.

In general, Mazandaran has a moderate and humid climate known as the moderate Caspian climate. The effective factors behind such a climate are: Alborz mountain range, direction of the mountains, height of the

area, neighborhood to the sea, vegetation surface, local winds and altitude and weather fronts.

As a result of the above factors, three different climates exist in the region:

Plain moderate climate: It covers the central and western plains of Mazandaran. The average annual rainfall amounts to 1200 or 1300 mm and as we proceed to the east the amount decreases.

Mountainous climate: It covers the high mountains and northern parts of the Alborz range. In the heights, the weather is cold mountainous and most of the precipitation is in the form of snow.

Semi-arid climate: This climate prevails some parts of Gorgan valley (north of Gorgan Rud as far as the Turkmenistan border). In this area, the average annual rainfall stands at 500 mm.

In addition to the suitable climatic conditions of the Iranian coastal provinces of Gilan, Mazandaran and Golestan, this region enjoys a very fertile soil excellent for agricultural purposes. Therefore, this region has a special and prominent status in the country. In the plain region of Gilan, due to the wet climate, most of the soil is sedimentary with small grains. Also there are wet grassy and semi-wet soils as well. The sedimentary soils with small grains are the most appropriate kind of soil for agricultural purposes. This type of soil has covered vast areas of the central plains of Mazandaran, which is considered as one of the most fertile parts of this region. In the plains of Gonbad and Gorgan in the Golestan Province, due to the extensive evaporation and presence of semi-arid lands especially in the northern part of the province, there are vast salty and marshy lands without any agricultural value. Never the less, in the southern part of this province, near the Gorgan and Gonbad region, there are arable lands that are considered as the main center for cultivation of grain, cotton and oily seeds. The soil in the mountainous region of this province, due to the sharp slope of the mountains and the shallow depth of the soil is not very suitable for cultivation.

Three collection methods were used to identify the earthworm species in this study.

Hand-sorting: Soil was dug using a quick levering action to collect large worms. Then the collected samples spread on a sheet for hand sorting^[7].

Chemical extortion: The chemical extractants used to sample earthworms were formalin and potassium permanganate. The 0.55% formalin solution was prepared using 15 mL of 40% formalin in 4.56 L water applied to 0.36 m² of surface^[1].



Distribution of earthworm in studied areas in Iran

- * *A. caliginosa*
- * *A. rosea*
- * *A. kazmakovi*
- * *A. jasyensta*
- * *E. fetida*
- * *D. veneta*
- * *D. bybllica*
- * *P. indica*

Fig. 1: Distribution of earthworm in studied areas in Iran

Heat extraction: This method was used to obtain small surface-living species from soils. A container sizing 55×45 cm with a wire sieve of 5 cm from its bottom was used. Soil quadrates are placed on the sieve, immersed in water with fourteen 60 watt light bulbs suspended above and left for 3 h^[1].

This study was conducted from Aug. to Dec. 2003. The information included the place name, the sampling date, the soil properties was recorded during each sampling methods. The studied areas and the species found were shown in Fig. 1. Earthworms for reference collections and morphological studies should be relaxed before killing. In this regard, the earthworms were place in 5 and 10% formaldehyde solution and then stored in 60% ethyl alcohol^[8,9]. Firstly, the adults' specimens were selected and placed in water. Then the specimens were placed in a mixture of formalin and ethyl alcohol (a solution with 2 volumes formalin and 1 volume ethyl alcohol). The data were written on the designed record cards.

Because no investigation was conducted before Omrani^[9], it is possible that the identified species to be the native of this region. However, the region has been affected through environmental changes by residents.

***Eisenia fetida* rearing:** Two wooden boxes sizing 70×50×15 cm (length, width and depth, respectively) were

made for rearing *E. fetida*. The surface area of each box was 0.35 m². The cowdung and horse manure were used as feeding substrates. 100 clitellated *E. fetida* were added to each box incubated in a room temperature from 18 to 22°C. The moisture content of the substrates kept at 50-70% with regular sprinkling of water during the study.

RESULTS AND DISCUSSION

Families, Genera and species in Mazandarn: All the species were fixed in laboratory and send to Prof. Graff and Zicsi to be identified. Results of investigations revealed the presence of two families: Lumbricidae and Megascolecidae. The following genera and species were identified:

- Genus: Allolobophora
 - Species: *A. caliginosa*; *A. Kaznakovi*; *A. jassyensis*; *A. rosea*
- Genus: Dendrobaena
 - Species: *D. veneta*; *D. byblica*
- Genus: Eisenia
 - Species: *E. fetida*
- Genus: Pheretima
 - Species: *P. indica*

Rearing *E. fetida* in Cowdung and horse manure:

Cocoon production and hatchlings for two substrates over the 130 days are provided in Table 1 and 2. It is observed (Table 1) that the overall hatchlings in horse manure for *E. fetida* was 9025. In addition, the cocoon production in horse manure increased until day 80 and after that the number of cocoons decreased, so that the maximum overall cocoon production occurred in day 80 was 1143. The overall hatchlings in cowdung by the end of the study (day 130) was 10452 for *E. fetida*. As with the horse manure, the cocoon production in cowdung increased until day 80 after which a decreased was observed in cocoon production (Table 2).

The objective of the study was to identify the earthworm species with an emphasis on investigation of manure worm *E. fetida* characteristics. Samples were taken from the places where residents are living and wastes are disposed of throughout the region. Eight species were identified: *A. caliginosa*, *A. kaznakovi*, *A. jassyensis*, *A. rosea*, *D. veneta*, *D. byblica*, *E. fetida* and *Pheretima indica*.

The results showed that the abundance of each species is as follows. The results show the overall percent of the collected species throughout the region. *A. caliginosa* was the dominant species with an abundance of 23.7%. This species influences on soil

Table 1: Cocoon production and number of hatchlings of *E. fetida* in horse manure

Time duration	No. of initial earthworms	No. of Cocoon	No. of young
60	100	820	132
70	100	1029	1124
80	100	1143	2478
90	100	988	3563
100	100	746	5246
110	100	687	6273
120	100	453	7320
130	100	312	9025

Table 2: Cocoon production and number of hatchlings of *E. fetida* in cowdung

Time duration	No. of initial earthworms	No. of Cocoon	No. of young
60	100	1165	148
70	100	1323	1561
80	100	1415	2827
90	100	1161	4356
100	100	908	5823
110	100	747	7368
120	100	643	9012
130	100	346	10452

structure, increases soil macroporosity, aerates the soil and improves its water-holding capacity.

The abundance of *A. kaznakovi*, *A. jassyensis* and *A. rosea* were 7.3, 4.5 and 3.2%, respectively. These species were collected and identified from forest soils. In general, *A. rosea* were found in woods but *A. caliginosa* were found in farms.

The abundance of *E. fetida* was 18.1% that shows a wide spread distribution over this area. *E. fetida* species were collected from rich organic soils, municipal solid waste dumps and manure heaps. With regard to its high distribution and natural presence in organic wastes, *E. fetida* can be used in waste decomposition and treatment. This will result in waste minimization and decrease cost of waste handling.

The abundance of *D. byblica* and *D. veneta* were 17.7 and 7.3%, respectively and that of *P. indica* was 6.4%. The samples of *D. byblica* and *D. veneta* were collected from surface layers of forest soils and *P. indica* was taken from forest soils with high moisture content. It should be noted that 6.8% of samples was immature that was removed in identification stage and due to no taxonomy investigations on the samples 5% could not be identified by the available keys; thus further studies would be needed. *D. veneta* and *A. jassyensis* were generally identified in the samples from the soils of virgin jungles.

Most species are from epigeic species category but because parts of the samples were taken during high temperatures (>23°C) we had to dig the ground up to 30 cm.

On the basis of the results from cocoon production and hatchlings it might be concluded that the largest

number of cocoons produced in day 80 that was 1415 and 1143 for cowdung and horse manure, respectively. The number of young earthworms obtained after 130 days were 10452 and 9052 in cowdung and horse manure, respectively. The reason for decrease in cocoon production might be attributed to increase of hatchlings density in rearing wooden boxes. In general, it can be concluded that cowdung is more preferred for rearing *E. fetida*.

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REFERENCES

1. Edwards, C.A. and P.J. Bohlen, 1996. *Biology and Ecology of Earthworm*. 3rd Edn. Chapman and Hall, New York, London.
2. Satchell, J.E., 1983. Earthworm Ecology in Forest Soils. In: *Earthworm Ecology from Darwin to Vermiculture* (Satchell, J.E., Ed.), Chapman and Hall, London, pp: 161- 170.
3. Bouche, M.B., 1977. Strategies Lombriciennes. In: *Soil Organisms as Components of Ecosystems* (Lohm, U. and T. Persson, Eds.). *Ecol. Bull.* (Stockholm), 25: 122-132.
4. Mitchell, M.J., 1983. A Simulation Model of Earthworm Growth and Population Dynamics: Application to Organic Waste Conversion. In: *Earthworm Ecology from Darwin to Vermiculture* (Satchell, J.E., Ed.), Chapman and Hall, London, pp: 339- 349.
5. Graff, O., 1967. Uber, die verlagereng van Nahrelementen in den unterboden durch regenwurmer totigkeit. *Landw. Forsch.*, 20: 117-127.
6. Edwards, C.A., 1988. Breakdown of Animal, Vegetable and Industrial Organic Wastes by Earthworms. In: *Earthworms in Waste and Environmental Management* (Edwards, C.A. and E.R. Neuhauser, Eds.). SPB Academic Publishing, the Netherlands, The Hague, pp: 21-31.
7. Sims, R.W. and M.B. Gerard, 1985. *Earthworms Synopsis of British Fauna*. Nat. Hist. Mus., No. 31.
8. Omrani, G.A., 1973. *Bodenzoologische untersuchungen uber regenwurmer im zentral and nordiran*, Giessen, Germany.
9. Graff, O., 1953. *Die regenwurmer deutschlands*, Schrift. Forsch. Lan. Braunschweigh, Volkonrode.