Artículo de investigación
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Gestión medioambiental sostenible en el turismo

Damages by Oligochaeta in the Varadero Golf Club: a limitation for the playability of golf as a tourist product

Daños por Oligochaeta en el Varadero Golf Club: una limitación para la jugabilidad del golf como producto turístico

1. Perla Maricely Fragela Hernández
Facultad de Ciencias Agropecuarias de la Universidad de Matanzas, Autopista a Varadero Km 3 ½, Matanzas, Cuba
(perla.fragela@umcc.cu) ID ORCID: https://orcid.org/0000-0002-7537-6497

2. Leonel Marrero Artabe
Facultad de Ciencias Agropecuarias de la Universidad de Matanzas, Autopista a Varadero Km 3 ½, Matanzas, Cuba
(leonel.marrero@umcc.cu) ID ORCID: https://orcid.org/0000-0003-0791-473X

3. Grisel de la Caridad Cabrera Dávila
Instituto de Ecología y Sistemática, CITMA. Carretera Varona 11 835, Boyeros, La Habana, Cuba
(grisel17@ecologia.cu) ID ORCID: https://orcid.org/0000-0001-8642-8603

4. Cristian Carrasco Albelo
Facultad de Ciencias Agropecuarias de la Universidad de Matanzas, Autopista a Varadero Km 3 ½, Matanzas, Cuba
(cristian.carrasco@umcc.cu) ID ORCID: https://orcid.org/0009-0001-3222-1655

4. Yoana Rodríguez Rodríguez
Facultad de Idiomas de la Universidad de Matanzas, Autopista a Varadero Km 3 ½, Matanzas, Cuba
(yoana.rodriguez@umcc.cu) ID ORCID: https://orcid.org/0009-0001-0923-0676

Abstract

Tourism is a key to the development of the Cuban economy, Varadero is positioned as a preferred destination for international tourism, and the Golf Club complements the sun and beach destination. The objective of this work was to report the attack of Oligochaeta as a limitation for the golf play in the Varadero Club. Earthworms were collected using a cup cutter, green and soil samples were analyzed to determine density of species (ind.m-2) and biomass (g.m-2). Damages on greens and turf maintenance equipment were also evaluated. A high density (322 indiv.m 2) and biomass (4.4 g .m 2) of Oligochaeta species belonging to Megascolecidae and Glossoscolecidae families, associated on greens were found. They provoked chlorosis, casts on surface which disrupted the green aesthetic, caused surface softening, issue with the ball roll and playability. Damages on cutting machines were also observed with limitations on the maintenance course in the Varadero Golf Field. It is recommended to evaluate the soil conditions and the turfgrass management practices that may increase the populations of earthworms to decrease economic damage on the touristic activity.

Keywords*: Tourism, golf field, Oligochaeta, turfgrass damage, pests.*

Resumen

El turismo es clave para impulsar el desarrollo de la economía cubana; Varadero se sitúa como circuito preferencial del turismo internacional y cuenta con el Golf Club como atractivo producto turístico que complementa el destino de sol y playa. El objetivo del presente trabajo radicó en informar el ataque de Oligochaetos como plaga limitante del golf como producto turístico en el Varadero Club. Se examinaron tapetes de césped y muestras de suelo de los greens para determinar la densidad (ind.m-2) y biomasa (g.m-2) de oligochaetos. Se realizaron colectas mediante un cortador de copa y se describieron los daños ocasionados en el césped y en equipos de mantenimiento del césped. Se encontró una alta densidad (322 indiv.m 2) y biomasa (4,4 g .m 2) de oligoquetos. Se observaron crías de las familias Megascolecidae y Glossoscolecidae que provocaron castas superficiales en el césped, clorosis y la pérdida de firmeza, afectando la estética y la jugabilidad. Ademàs se observaron daños en las máquinas podadoras, todo lo cual limita la calidad del golf como producto turístico del Varadero Golf Club. Se recomienda evaluar las condiciones edáficas y prácticas de manejo del césped que incrementan las poblaciones de la plaga para mitigar los daños económicos en esta actividad turística.

Palabras clave: Turismo, campo de golf, Oligochaetos, daños al cesped, plagas

Introduction

Tourism is key to driving the development of the Cuban economy, and Varadero is positioned as a preferred destination for international tourism (Fernández, 2020). Golf has ceased to be simply a sport and has become a tourism product in many countries; in the United States showed an annual contribution of more than USD 84 billion (Ladevi, 2019).Golf Courses are a tourist product that attracts millions of fans, complements other sports, and brings significant economic growth to the host country, jobs, and quality services (Fernández, 2020).

The Varadero Golf Course (VGC) is the only professionally designed 18-holes Golf Course in Cuba and it is opened to professionals who wish to enjoy this fascinating sport amidst stunning beaches and wonderful Cuban culture. It has been hosted numerous international tournaments such as the European Challenger Tour Grand Final and the AUDI Golf Cup of Spain (Tripadvisor, 2025).

A diagnosis of VGC's environmental performance showed that several nonconformities persist, which prevent the entity from applying for environmental certifications in accordance with the NC ISO 14001:2015 (Fernández, 2020). The Varadero Golf Course has several environmental problems that are a consequence of a large extent of poor environmental management (Espinosa *et al.*, 2022)

Golf is a sport of precision where the fewer strokes the ball takes to reach the target hole, is better the outcome of the game or tournament (Fernández, 2020). On the golf course, the green is one of the main playing areas, where the turfgrass is cut almost to the ground and must be in excellent condition. However, several species of soil invertebrates attack the greens, and it has been reported as turfgrass pests.

The Oligochaeta Class includes a complex group of earthworms reported as beneficial to the soil; but not all species have beneficial effects on plants and the environment (Joshi *et al.*, 2024). Pheretimoid earthworms (Megascolecidae) form a large group of oriental earthworms with members are spread in the tropics (Blakemore, 2010) and have proved to be a serious pest of turfgrass (Aspe *et al.*, 2016).

O `Farrill (2007) reported several damages by earthworms in golf fields of Puerto Rico, because of the deposited fecal matter on the turfgrass surface, interfering with the playing, softening the turfgrass surface and disrupting the turf maintenance equipment, affecting the general appearance of golf course.

The United States Golf Association USGA (2019) outlined international standards for putting green quality, regulating the golf ball speed and includes the categories of Abnormal Course Condition or Impediments on the Green, related with hazards on the putting green caused by earthworm casts and ant hills.

An International Guide to the Rules of Golf was also released by the USGA (2022), which contains penalization of the golfer who touches a ball lying on these hazards, or moving them. So is very important to eliminate the negative effects of earthworms in golf courses; but unfortunately, there are no commercially registered pesticides labelled for controlling this group.

In Matanzas province few studies about Oligochaeta have been done (Garcia *et al.*, 2014) and until now there is no information related to the damage of earthworms in the Varadero Golf Club. Just few reports about damage caused by insects have been described (Marrero *et al.*, 2018). The objective of this work was to notify the attack of Oligochaeta species as a limitation for the golf play in the Varadero Golf Club.

Methods

During the research several papers were reviewed, mainly data of the Word Tourism Organization (OTW, 2022); Golf Course as a tourist product in Cuba (Fernández, 2020); Golf International Tournaments in the Varadero Course as complements of the sun and beach destination (Tripadvisor, 2025).

Oligochaeta reports as pests in Golf Courses, Economic damages and the description of Economic Thresholds (O´Farril, 2007), International standards of golf practice and putting green quality (USGA, 2022) were consulted. The criteria of golfers about the green speed and their variations (Karcher *et al.*, 2001); Infestation causes of the Oligochaeta in Golf Clubs and Management proposals of these pests were also studied (USGA, 2022).

For the diagnoses of Oligochaeta families, criteria of biologists at the Systematic Ecology Institute of Cuba (IES) were obtained. Group interviews to Varadero Gol Club greenkeepers for the recognition of earthworm damage were also developed.

Field samplings and observations

During December 2023 to December 2024 soil samplings in game areas (green, fairway) of the Varadero Golf Field, following the methods of Tropical Soil Biology and Fertility Project (TSBF) (Anderson, 1993) and O`Farril (2007) were carried out. Two randomly established plots 0.25m (length) x 0.25 m (width) x 0.20 m (depth) in greens were digged (Cabrera *et al.*, 2017) (figure 1 a). Soil samplings (0.2mdiameter x 0.2 m depth) and Bermuda 328 turfgrass (Cynodon dactylon (L.) Pers) root samples were obtained, using a hole cup curter (figure 1 b) .

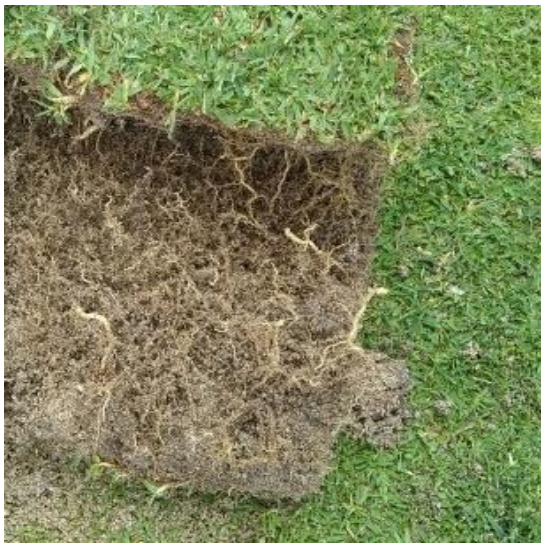
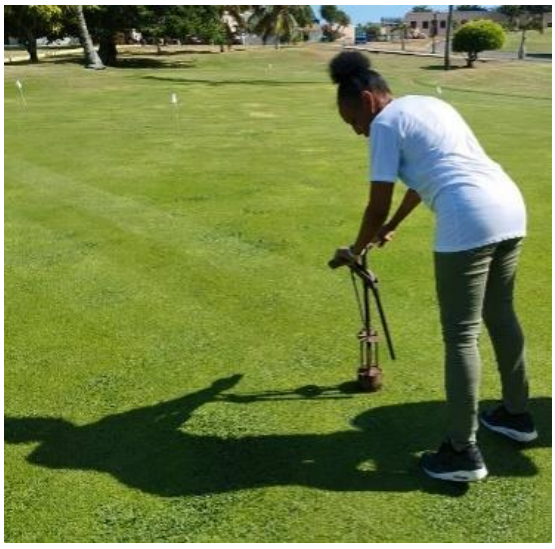
a)  b) 

Figure 1 (a) Samplings of earthworms in greens of the Varadero Golf Field; (b) use of cup curter

Digital photos of Oligochaeta species and description of damage

The Oligochaeta collected on greens were photographed using a Sony Camara. Body color based on living specimens and the length were described by means of a Photo stereomicroscopic Novel in the Entomology Laboratory of Matanzas University. The identification of families was carried out by means of taxonomic keys (Blakemore, 2010) and taxonomic criteria. To evaluate populations of earthworms, density (ind.m-2) and biomass (g.m-2) of species were determined and it was compared with the Economic Thresholds notifying for Oligochaeta in Golf Courses. Damages on green surface and turfgrass maintenance equipment, mainly on cutting machines Model Toro (R), were also described.

Results and Discussion

As a result of the field study and the lab evaluation of soil samplings small specimens of Oligochaeta of about 70–250 mm of length (average of 13.44), 5–6 mm of body diameter, with 95-150 segments were found. Species were detected from surface to 17 cm of depth showing the body recovered by sandy particles (figure 2 a). They also showed different color, which varied from pale gray (figure 2 b) to brown with red or light pink on the middle with yellow color on anterior and end body (figure 2 c).

In the diagnosis under microscopic several small sandy particles and turfgrass tissues in the digestive system of species were found (figure 2 c) which indicates their feeding activity on turfgrass. The microscopic photos showed a circular body in cross section with perichaetine setae regularly arranged around (figure 2 d), descriptions similar to the members of Glossoscolecidae and Megascolecidae families.

a) b) c) d)

Figure 2 a) Oligochaeta (Earthworms) in sands soils of the Varadero Golf Field; b, c, d) Species of Glossoscolecidae and Megascolecidae families.

Earthworms have been reported as rare species in coarse textured soils, because their cuticle is sensitive to the abrasiveness of sand particles, which probably irritate and repel them. However higher populations of Oligochaeta associated with C.dactylom turfgrass were found in the Varadero Golf Club.

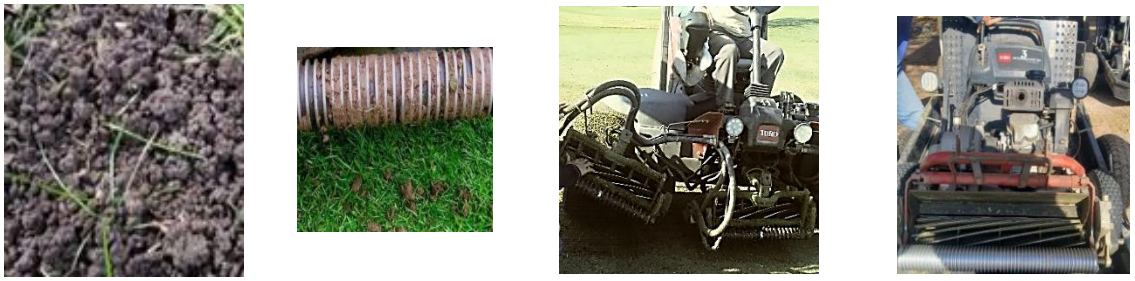
The Oligochaeta species were identified as a risk factor to the golf play in VGC, because a density of higher than 322,0 individuals.m^2 and biomass of 4,4 g. m^2 were found in greens (figure 3 a) of holes par 4 as well as par 5.

The earthworms provoked chlorosis and softening on green (figure 3 b, c) and several casts on the surface as the results of their fecal matter (figure 3 d), causing interference with the golf ball roll (figure 3 b). They also affected the green speed, the playability and the general appearance of the golf course contrasting with the uninfected holes (figure 3 e) where a clean green, with an uniformity color and good firmness were observed, in accordance with the international standards green quality described for Golf Clubs.

a) b) c) d) e)

Figure 3 a, b) Infestation of earthworms on turfgrass; c) damaged green (chlorosis and softening); d) earthworm casting on surface; e) aesthetic quality on uninfected green.

The wet casting produced by earthworms (figure 4 a) also formed clogged rollers (figure 4 b) on the cutting units of Toro machines and frequently dulled the blades (figure 4 c, d), affecting the turfgrass cutting and the golf course maintenance, incurring on economic damages for the Varadero Golf Club.



a) b) c) d)

Figure 4 a) Wet casting of Oligochaeta on green surface; b, c) Damages on rollers and blades d) of turf maintenance equipment in Varadero Golf Club.

In Golf Courses, golfers demand a clean green, of higher quality and without pest damages, in accordance with international standards (USGA, 2022).

While some researches have been conducted to investigate earthworms in turfgrass, relatively little is known about the species' composition. Earthworms have been evaluated as biological indicators of the conservation/ disturbance status of soil (Cabrera, 2017).

Generally, the Oligochaeta (earthworms) have been reported as beneficial to the soil, as they help to modify the biological properties, but they are considered pests for golf fields (O´ Farril, 2007).

Phretimoid group (Megascolecidae) has proven to be a serious pest of turfgrass (Aspe, 2016). They represent a second wave of earthworm invasions and there is a critical need for basic information pertaining to this group (McCay *et al.*, 2021).

The higher populations found in figure 3 a, are like the Economic Thresholds described for Golf Fields by O´ Farril (2007) who mentioned about 20 individuals. 900 cm^2. The apparition of highest earthworm populations on greens (figure 3 a) may be caused by parthenogenic reproduction of several species, they reproduce asexually, which means that even a single cocoon or worm could establish an entire population.

Their rapid breeding coupled with their voracious eating allows them to expand their habitat quickly, they also produce castings during day and night. This combination makes it difficult, at best, for crews to keep the greens playable, much less completely free of castings (Carson, 2025)

Oligochaeta has proved to be aggressively invasive, incurring a heavy economic cost to turfgrass. The incidence of species, such as Phretima hupeiensis L on greens of golf courses in United States of America, with immunity to pesticide treatments was reported (Shread, 1952).

The attack of Oligochaeta and the higher populations described in figure 3 differs from some authors who explained that generally, earthworms are rare in coarse texture and tend to be relatively scarce in sandy soils due to the abrasiveness of the sand particles for the cuticle of earthworms, which is remarkably sensitive and sand would irritate and repel them. Pott (2019) reported smaller populations of earthworms in sandy soils of golf course because of the susceptibility of such soils to drought. However, in the VGC, higher soil humidity levels of soil are supplied daily by means of a spreading irrigation system.

In the United Kingdon and Ireland Golf Courses, Oligochaeta has been considered as the most common pest of turfgrass and affected more than 81 % of greens (USGA, 2022).

Earthworm castings cause interference on golf play, with changes on position and ball roll, also affect green surface firmness, provoke weeds growth and disrupt the blades of cutting machines (Carr Golf, 2024).

Pettit (2019) reported earthworms as enemies for the turfgrass; fairway topdressing programmed as well as increasing acidity on the soil surface was recommended for declining pest populations. USGA (2022) also notified several casts on the surface of USA golf fields and recommends strategies to reduce the incidence of pesky earthworms, by sand topdressing of turf surfaces.

Turf managers have attempted to manage earthworms culturally by amending the soil with sand, acidifying soil, and other methods. Results of these programs have met with varying results and are not always reliable in reducing the cast problem.

The World Tourism Organization, WTO (2019) consider sustainable tourism as development that meets the needs of protecting ecological processes, biological diversity, and life-support systems. In Mexico, soil pests damage the turfgrass of Golf Course, and there is a Golf Industry which invests annually about 50 million USD for fields maintenance (Mexican Caribbean Golf, 2018).

Conclusions

The golf practice has become an important tourism product in Cuba and in the Varadero Golf Club golfers demand a green of higher quality in accordance with the international standards.

In the Varadero Golf Club the Oligochaeta incidence, represented by Glossoscolecidae and Megascolecidae families, constitutes a limitation for golf playability as touristic product.

Several casting on greens, density of 322,0 individuals.m^2 and biomass of 4,4 g. m^2 of earthworms were found causing chlorosis, turfgrass softening, disrupting the golf ball and damages on maintenance equipment.

The present work proves the potentialities of Oligochaeta as pest for the Varadero Golf Field and contributes to a sustainable tourism for protecting biological diversity in correspondence with the World Tourism Organization.

The use of this paper for training the green keepers in terms of the recognition of this pest in Varadero Golf Club is suggested.

Taking in to account that international tournaments such as the European Challenger Tour Grand Final and the AUDI Golf Cup of Spain are carried out in Varadero Golf Club, it demands a golf maintenance quality, further studies to determine the influence of soil conditions and turfgrass management practices on Oligochaeta incidence, will be carried out.

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Contribución autoral

Perla Maricely Fragela Hernández	Diseño de la investigación
Leonel Marrero Artabe	Adquisición de los datos
Cristian Carrasco Albelo	Análisis e interpretación de los datos
Yoana Rodríguez Rodríguez	Redacción y corrección del manuscrito
Grisel de la Caridad Cabrera Dávila	Revisión crítica de aspectos intelectualmente importantes del manuscrito

Conflicto de intereses

Los autores declaran que no existe conflicto de intereses.