



INSTITUTO  
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UNAM



CENTRO DE CIENCIAS APLICADAS Y  
DESARROLLO TECNOLÓGICO

BILL & MELINDA  
GATES *foundation*

# Software to identify and quantify pathogenic helminth eggs

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# Irrigation with wastewater

## Case of the Mezquital Valley:

- 70-100 thousand hectares irrigated with Mexico City's wastewater.
- Water savings (clean water).
- Reduces production costs (lower fertilizer needs and \$\$).
- Increase in crop yields (150%).
- Increase in gastrointestinal diseases (16x more).



Worldwide:

- 3,500 million people infected with helminths.
- 80,000 annual deaths.
- Mostly children < 5 years old.



Malnutrition



Anemia

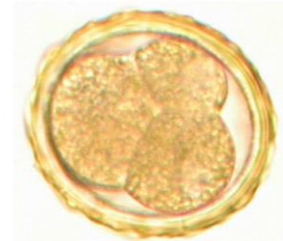
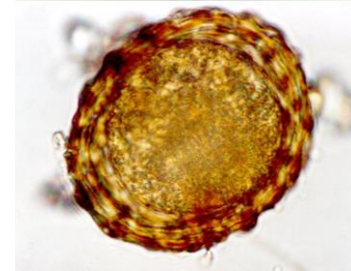


Gastrointestinal  
diseases



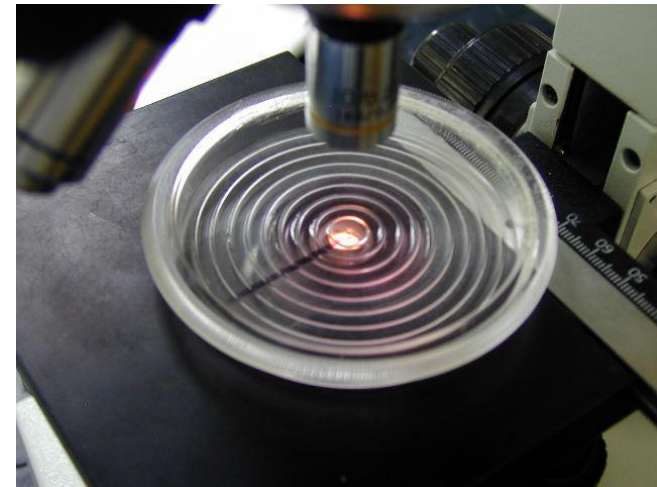
Malformations

- One-celled structures.
- Microscopic size ( $< 100 \mu\text{m}$ )
- Global threat.
- Highly resistant to conventional treatment processes (water and sludge).
- Affects children development.
- Regulations for water reuse (WHO, local standards, etc.).



# Traditional method for determination of helminths

- Visual identification (highly subjective).
- Time consuming technique.
- High error for the same sample.
- Alternative:
  - Digital image processing.
    - Algorithms, recognition, filtering, etc.





- Alternative and useful tool.
- Reduces subjective errors and processing time.
- Great applicability (different environmental samples).
- Identifies 7 genera of helminths (currently).
- Very easy to use (software only needs to load the image).
- Improves public health and quality of life.

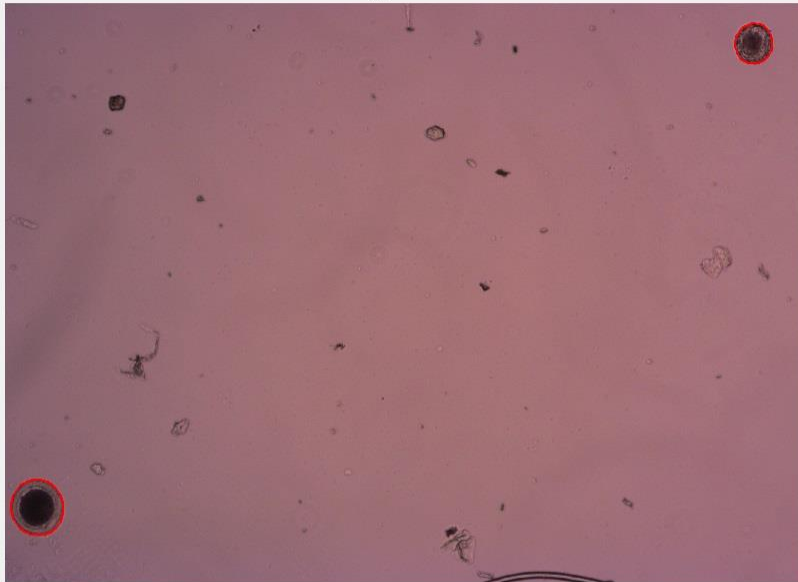


# Examples (2)

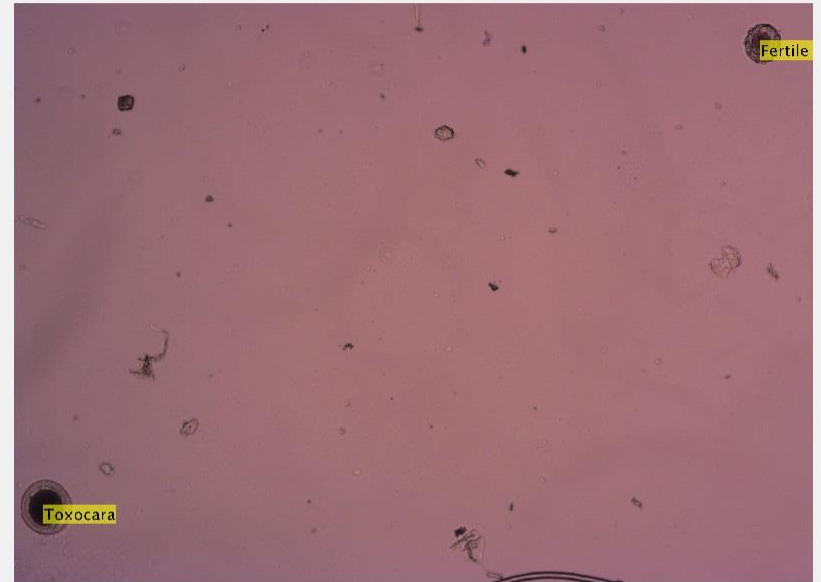
HED

## HELMINTH EGG DETECTOR

Possible eggs marked with red



Final classification



Load image

Find Eggs...

### Objects found in the image

Image	Fertile Ascaris	Infertile Ascaris	Toxocara	Trichuris	Tenia	Hinmenolepis diminuta	Hinmenolepis nana	Esquistosoma	Not an egg
1	1	0	1	0	0	0	0	0	0

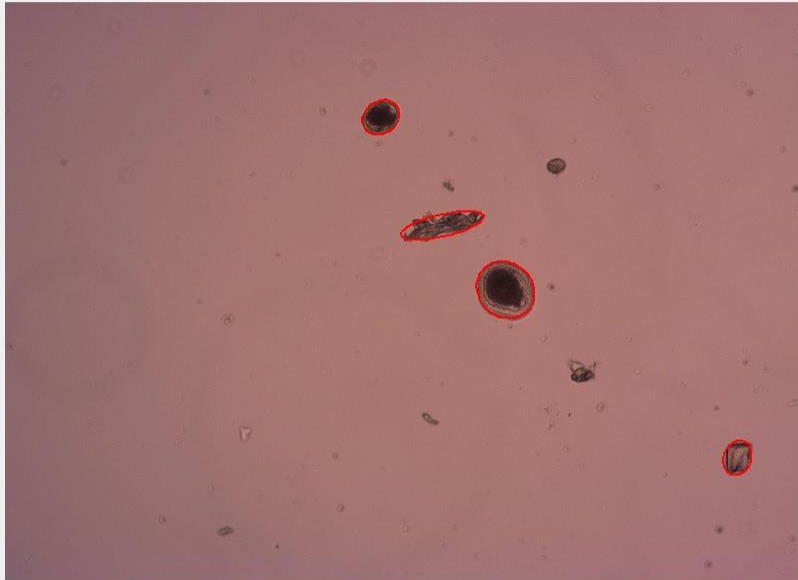


# Examples (3)

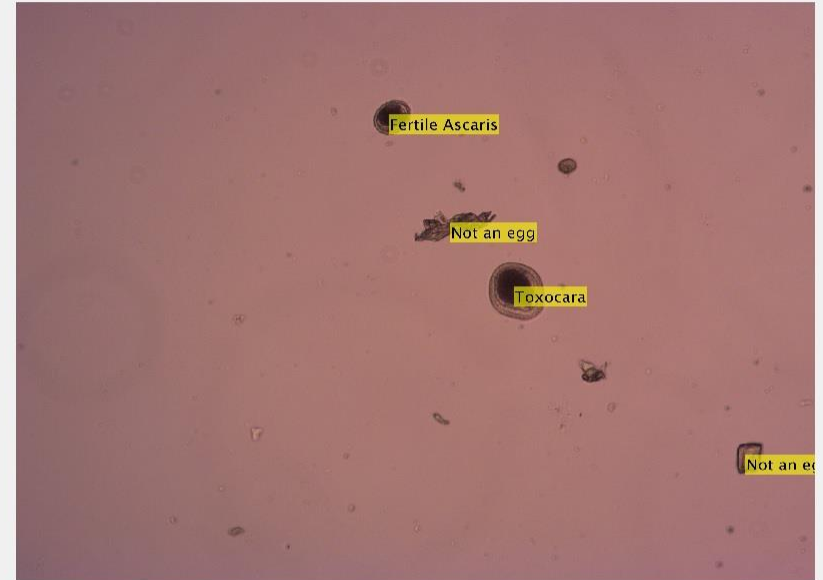
HED

## HELMINTH EGG DETECTOR

Possible eggs marked with red



Final classification



Load image

Find Eggs...

Objects found in the image

Image	Fertile Ascaris	Infertile Acaris	Toxocara	Trichuris	Tenia	Hinmenolepis diminuta	Hinmenolepis nana	Esquistosoma	Not an egg
	1	1	0	1	0	0	0	0	2

# Comparison

Issue	Conventional method	New system
Skills required for identification	2 to 3 weeks of personnel training at minimum	Not required
Time needed for identification	Clean samples 1 hour Dirty samples 3 hours or more	10 minutes
Additional cost of the system	NA	Est. USD \$ 800 (PC + camera) + Software
Cost for the identification step	Clear samples USD \$10; dirty samples USD \$35	USD \$2 at maximum (any type of sample)
Sensibility (Se)	Human skill dependent	>90%
Specificity (Sp)	Not determined	99%



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