NEWS S1: Facebook news provided to students

THE CURSE OF THE BLACKWATER RIVER

Tuesday, 12 April 2019 98100 Compartes



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1 EL SE LOS (de Es ayuda

2 PRIMI CHILE mayo, llamad

3 LOS F APAR junio segur

4 PRIMI ESPA mayo, llamad

5 ¿CUA BLAC dos g muche

En la Red



Internet en ca sorprenderlo

Paquete de cable e





Vilar: Los elevadores de escaleras pueden ser un lujo



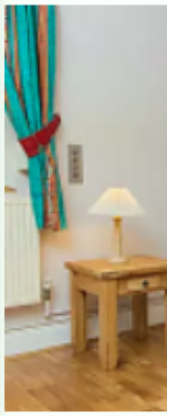
Un método sencillo para combatir los dolores



Las personas que padecen dolores de cadera y rodilla



Vilar: Liquida
precios podrí
Ofertas de coches |



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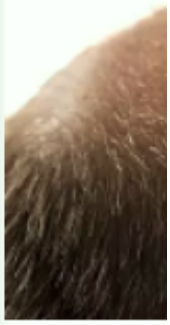

Los precios d
sorprenderle

Many socio-economic activities threaten human and environmental health. Among them is the use of pesticides in agriculture, which has quadrupled in the last four years in the region of Támara. This has ended up affecting food, soil, air and water, as denounced by Ecologists Without Borders in a report on the region (see technical report). Many of these substances have been classified as carcinogenic and/or endocrine disruptors (affecting the endocrine and reproductive systems) by the World Health Organisation (WHO). Their impact extends to both rural and urban environments and the different species that inhabit them.

The WHO also points out that water pollution is one of the main causes of death and disease worldwide, with alarming global figures amounting to fourteen thousand people per day. Rivers are one of the main environments affected. Thus, when chemicals from agriculture are released into rivers, they are rapidly transported along their course, reaching different organisms. Humans may be more or less exposed to pollutants depending on where they live (distance between home and source of pollution), where they work (in this case, they are more exposed if they work in agriculture), or what food they eat (the source of the food).

Numerous cases of water pollution around the world have been reported in the media, raising public concern about water quality. Among the most famous cases is the contamination of the Blackwater River (Tamara's region) and rural localities close to agricultural fields (1), which has caused breeding problems in part of the population and in other organisms such as the Chironomus riparius. This is a species known as the harlequin fly, the larvae of which develop in aquatic or semi-aquatic environments such as river mud (2). In the field of toxicology, they are used as sentinel organisms, as they provide an early warning of danger to humans by manifesting symptoms early.

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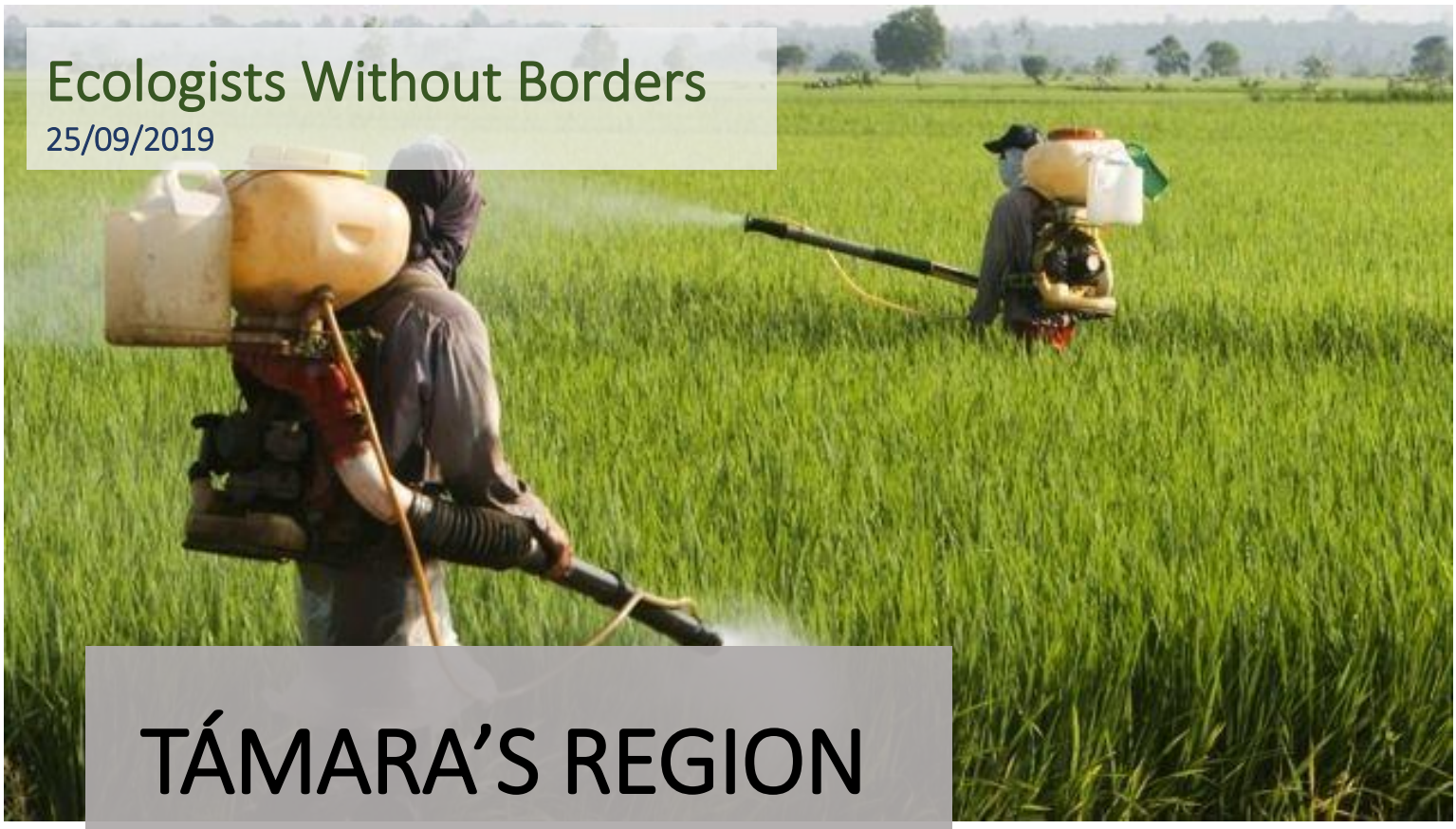
REPORT S2: Technical report provided to students

Ecologists Without Borders

25/09/2019



TÁMARA'S REGION

Technical report

There are **notable differences in reproductive problems and miscarriages** among the populations of the **six cities** that make up the region of Támara. This is due to the fact that there is a **gradient of environmental** pollution between them. The following table demonstrates this:

City	Food source	Human miscarriages (%)	Human reproductive problems (%)	MN in 1000 spermatogonia of *C. riparius*	Viable eggs per clutch of *C. riparius*
Volantis		5,00	12,01	1	149
Qarth		4,15	50,62	7	115
Sun Lance		3,30	61,35	12	83
Meereen		4,28	65,24	14	79
Braavos		3,75	62,17	13	75
King's Landing		4,51	60,08	11	78

Wild agriculture / Home garden | Polluted agriculture | MN= micronuclei

Unpolluted fish | Semi-polluted fish | Polluted fish

TÁMARA'S REGION
Technical report

01 Polluted and non-polluted power supplies

02 Miscarriages and reproductive problems in humans

03 Micronuclei in spermatogonia of *Chironomus riparius*

The **data table** on the previous page **refers to:**

1. The main **food sources** of the six cities (including water consumption/surface water use), linked to the **work activity** of a large part of their inhabitants.

2. The **percentages of miscarriages and reproductive problems** of the populations in 2019.

3. The **reproductive problems of *Chironomus riparius*** in 2019.

Food sources for the inhabitants of the region

In the Támara's region, the **main activities that supply the different cities are agriculture** in the crop fields near Qarth and Sun Lance, **and fishing** in the Blackwater River**. Except for Volantis**, where most of the population is vegan and feeds on the fruits and vegetables that they gather in their own home gardens.

Rates of humans' miscarriages and reproductive problems

While **there are no significant differences in the miscarriages' percentage** (only natural terminations of pregnancy were considered), **the reproductive problems' percentages** (those that prevent a zygote from forming) **do differ significantly** among cities**.**

Micronuclei in 1000 spermatogonia of *Chironomus riparius*

Micronuclei (MN) are extranuclear chromosome fragments or whole chromosomes, sometimes surrounded by their own envelope. They are **formed as a result of cell division with errors. Exposure to pesticides has led to an increase of MN** in the spermatogonia (cells that enter meiosis to produce spermatozoa) of male *C. riparius*. **This has caused a decrease in the number of viable eggs per clutch of the harlequin fly**, whose larvae are commonly referred to as bloodworms due to their red colouring. Therefore, **the emergence of MN can lead to problems in the division of the cells containing them.**

TABLE S3: Summary of the data provided in the first phase of the activity on the causes and effects of the pollution problem in Támara

Textual data are enclosed in quotation marks. Numerical and visual data are described under a heading. Example of useful relationships that could be established between them to justify the ranking of cities.

CAUSES	**News**	"Pesticide use has quadrupled in the last four years in Támara's region" "Pesticide use affects food, soil, air, and water" "Human exposure to pesticide depends on where they live, where they work, or what they eat"
	Table	Polluted or unpolluted food sources in each city
	Report	Job ("main supply activities: agriculture in Qarth and Sun Lance and fishing in the Blackwater River")
	Map	Location of fields, river, and cities
EFFECTS	**News**	"When agricultural chemicals are released into the river, they are quickly transported, reaching different organisms" "Water pollution is one of the leading causes of death and disease globally and rivers are one of the main environments affected" "Many pesticides have been classified as carcinogenic and/or endocrine disruptors, affecting the endocrine and reproductive systems" "Pollution has caused reproductive problems in humans and other organisms such as *Chironomus riparius"*
	Table	Percentage of human reproductive problems in each city Number of micronuclei per 1000 spermatogonia of *Chironomus riparius* in each city Number of viable eggs per clutch of *Chironomus riparius* in each city
	Report	"Relative frequencies of reproductive problems (those that prevent zygote formation, not miscarriages) among cities do differ significantly from each other" "Pesticide exposure has resulted in increased micronuclei in spermatogonia (cells that produce spermatozoa during meiosis) of male *Chironomus riparius"* "Micronuclei formation as a result of mitosis with errors can cause problems in the division of the cells containing them" "Increase in micronuclei causes decrease in number of viable eggs per clutch"
APPLICATION EXAMPLE	**Students should realise that Volantis is less exposed to pesticides than cities near or downstream of farmland, as the river carries these pollutants. In addition, its inhabitants are fed by unpolluted wild agriculture. This explains why the lowest percentage of reproductive problems in humans and the lowest micronuclei formation in *Chironomus riparius* occurs in Volantis. Related to this, the number of viable eggs per clutch of the harlequin fly in Volantis is highest because there are fewer micronuclei hindering meiosis of the parents**	