1. **CALCULATING THE INVASION THREAT SCORE (NIS-ITS) FOR EXOTIC SPECIES IN THE PORT OF GIJON (Examples).**
2. ***Bugula neritina***:
	1. **Habitat Suitability**:

This data can be obtained on the aquamaps web page (https://www.sealifebase.ca/summary/Bugula-neritina.html) where each species has a spreadsheet associated with the habitat suitability data for different geographic locations.

|  |  |
| --- | --- |
| Coordinates | Habitat suitability |
| 43.75; -5.75 | **1.00** |

 



* 1. **Invasion history:**

*B. neritina* is a species that has been introduced outside its native range and has shown the potential to perform biological invasions and produce environmental impacts. Following the EICAT categories, a **1.00** score is given to this species:

|  |  |  |  |
| --- | --- | --- | --- |
| **EICAT Impact category** | **Impact** | **Theoretical invasion history score** | **Final invasion history score** |
| Massive | Irreversible community changes and extinctions | 1 | 1 |
| Major | Community changes, which are reversible | 0.8 |
| Moderate | Changes to populations, but not to community composition | 0.6 |
| Minor | Fitness of individuals reduced, but no impact on populations | 0.4 |
| Minimal Concern | Discernible impacts, but no effects on individual fitness of native species | 0.2 | 0.2 |
| No Alien Populations | - | 0 | 0 |

* 1. **Maritime traffic:**

**Native  Introduced  Cryptogenic**

|  |  |  |  |
| --- | --- | --- | --- |
| **Origin of ships** | **Presence of the Species** | **Marine traffic arriving to the port of Gijon (KGT)** | **Traffic ratio** |
| South West Atlantic | YES | 223.170 | 0.41 |
| North East Atlantic | YES | 97.335 | 0.18 |
| Southern Pacific | YES | 85.975 | 0.15 |
| North West Atlantic | YES | 85.808 | 0.15 |
| South East Atlantic | YES | 34.995 | 0.06 |
| Mediterranean | YES | 14.865 | 0.03 |
| Northern Pacific | YES | 7.138 | 0.02 |
| **TOTAL** |  | **549.286** | **1.00** |

The species *B. neritina* is present in all the biogeographic areas with which the port of Gijon has maritime traffic, so that the maritime traffic score would be the following:

Maritime traffic score= 0.41 + 0.18 + 0.15 + 0.15 + 0.06 + 0.03 + 0.02 = **1.00**

**NIS-ITS = Habitat Suitability + Invasion History + Maritime traffic**

**NIS-ITS (B. neritina) = 1 + 1 + 1 = 3 100%**

1. ***Sabellastarte spectabilis***

2.1- **Habitat suitability:**

|  |  |
| --- | --- |
| Coordinates | Habitat Suitability |
| 43.75; -5.75 | **0.02** |



**2.2- Invasion history:**

*S. espectabilis* has been introduced in areas outside its native range, but there is no information on any impact it may cause in these areas, thus a score of **0.2** is given to this species regarding its invasion history.

**2.3- Maritime Traffic:**

**Native  Introduced  Cryptogenic**



|  |  |  |  |
| --- | --- | --- | --- |
| **Origin of ships** | **Presence of the Species** | **Marine traffic arriving to the port of Gijon (KGT)** | **Traffic ratio** |
| South West Atlantic | NO | 223.170 | 0.41 |
| North East Atlantic | NO | 97.335 | 0.18 |
| Southern Pacific | YES | 85.975 | 0.15 |
| North West Atlantic | NO | 85.808 | 0.15 |
| South East Atlantic | NO | 34.995 | 0.06 |
| Mediterranean | NO | 14.865 | 0.03 |
| Northern Pacific | YES | 7.138 | 0.02 |
| **TOTAL** |  | **549.286** | **1.00** |

The species is present in the Southern and Northern Pacific areas, thus, the traffic risk score for this species is the following:

Maritime traffic score= 0.15 + 0.02 = **0.17**

**NIS-ITS = Habitat Suitability + Invasion History + Maritime traffic**

**NIS-ITS (S. spectabilis) = 0.02 + 0.20 + 0.17 = 0.39 13%**

**B) CALCULATING THE INVASION THREAT SCORE (NIS-ITS) BUT THIS TIME INCLUDING INFORMATION RELATED TO BALLAST WATER AND HULL FOULING TREATMENTS (WHEN AVAILABLE) WITHIN THE MARITIME TRAFFIC SCORE USED FOR ESTIMATING NIS-ITS IN FUTURE PROJECTS.**

When calculating the NIS-ITS, the maritime traffic factor considers the presence of a species in a specific biogeographic area, and the number of ships coming from that area. Thus, the threat from maritime traffic is greater when the species is present in many biogeographic areas with high maritime traffic with the port under study.

However, this method does not take into account if vessels employ techniques for the prevention of biological invasions, such as techniques to release ballast water away from ports or to avoid fouling by using paints that cover the hulls. In these cases where these preventive measures are taken, the NIS-ITS should be lower than in cases where they are not.

Due to the lack of data, this method could not be implemented in this study, but we provide an example for its calculation so that it can be considered in future cases.

The current NIS-ITS follows this formula:

**NIS-ITS= Habitat suitability + Invasion history + Maritime traffic**

In order to consider the treatments that some boats perform to avoid biological invasions, the maritime traffic score needs to be modified, so it will depend on three factors:

1. **Traffic origin (TO):** This is the current factor employed for the maritime traffic score calculation, which is based on the biogeographic areas where a certain species is present and the amount of maritime traffic arriving to the port from these areas.
2. **Ballast Water Threat (BWT):** This new factor scores each boat as follows:
* Boats without Ballast Water exchange =0
* Boats with Ballast Water treatment =0.2
* Boats without Ballast Water treatment=0.5
1. **Hull Fouling Threat (HFT):** This new factor scores each boat as follows:
* Boats with Hull Fouling treatment = 0.2
* Boats without Hull Fouling treatment =0.5

Each boat will have a specific score based on these two new factors. This information can be compiled and converted to ratios to be employed in a specific port. At the end, the maritime traffic score can be calculated as the sum of these three factors. Each of these factors is calculated as follows:

**Traffic Origin (TO)**= ∑ traffic ratio where the species is present

**Ballast Water Threat (BWT)**= (Ratio of ships without exchange x 0) + (ratio of ships with treatment x 0.2) + (ratio of ships without treatment x 0.5)

**Hull Fouling Threat (HFT)**= (ratio of ships with treatment x 0.2) + (ratio of ships without treatment x 0.5)

In this way, the maritime traffic score can be calculated as follows:

$$Maritime Traffic score=\frac{\left(TO+BWT+HFT\right)}{2}$$

With this formula the maximum value for the maritime traffic is still 1, so that this factor is as important as the habitat suitability and the invasion history at the time of calculating the NIS-ITS.

**EXAMPLE:**

One species which is highly invasive and is present in all biogeographic zones with traffic with the port under study:

1. **Traffic Origin (TO)**: All the boats arriving to the port can be vector of the species, because it is present in all areas with traffic to the port. Thus:

Traffic Origin (TO)=1

1. **Ballast Water Threat (BWT)**: assuming that in this fictitious case the total number of ships coming from all these areas is 100 from which:

10 ships without Ballast Water exchange        ratio=0.10      (score=0)

85 ships with Ballast Water treatment ratio=0.85      (score=0.2)

5 ships without Ballast Water treatment ratio=0.05    (score=0.5)

BWT= (0.1x0) + (0.05x0.5) + (0.85x0.2) = 0 + 0.025 + 0.17= 0.195

1. **Hull Fouling Threat (HFT)**: assuming that in this fictitious case the total number of ships coming from all these areas is 100 from which:

90 ships with Hull Fouling treatment ratio=0.90      (score=0.2)

10 ships without Hull Fouling treatment ratio=0.10      (score=0.5)

HFT= (0.1x0.5) + (0.9x0.2) = 0.05 + 0.18=0.23

Thus, for this example, the maritime traffic score would be the following:

$$Maritime Traffic score=\frac{\left(TO+BWT+HFT\right)}{2}$$

$$Maritime Traffic score=\frac{\left(1+0.195+0.230\right)}{2}$$

**Maritime traffic=0.712**

In this example, when taking into account those ships that employ preventive measures against biological invasions, the maritime traffic score is lower, which in turn reduces the final NIS-ITS.