Snowflower

Nordfolk

Evergrass

Sunsnake

Southstar

DiadESland

Explore management strategies
for diadromous fish and ecosystem services

DiadESland is a role-playing game for 5 to 10 players. For a better game experience, it is recommended to form five teams of two players. The smooth running of a game requires the presence of a Game Master and a Game Observer. The game lasts about 1 hour. It is followed by a debriefing.

GAME PRESENTATION

Equipment :

- A game box
- 4 explanatory booklets
- 5 *Catchment* cards
- 5 coloured counters
- 15 *Species* cards
- 92 *Action* cards
- 8 *Global Change* cards
- 216 *Fish* tokens for each species
- 30 Cursors to move on the edges of the cards

***Catchment* card**. Each Manager's passport. These cards describe the catchments and their characteristics, as well as the objectives of each Manager.
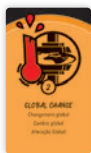
***Global Change* card**. Your common opponent. These cards show 4 levels of increasing difficulty (1 green card, 3 orange cards, 3 red cards, 1 crimson card). These represent the combined impacts of global warming and human pressures.

***Species* card**. Your species situation. Placed in front of each Manager, these cards develop the evolution of your stocks and the mortality rate for each species.

***Action* card**. Your individual or collective management choices. They describe how you will achieve your objectives as manager of a specific catchment in *DiadESland*.

RULES OF THE GAME

The game is played in 6 rounds, each round represents a decade. Achieve your goals by building your own management policy. At the end of the game, each Manager's *Action* cards will represent their 60-year management policy.

Summary - A round of play in brief:

- The Game Master unveils a *Global Change* card 🌡️.

- The Game Master places six local *Action cards* 👤 face down, on the centre of the table. When the Game Master gives a clear "Go!" signal, all Managers choose the management action they feel is appropriate to achieve their goals by placing their counter on the local *Action* card of their choice.

- The Game Master places three collective *Action* cards 👥, face down, above the local *Action* cards.

- Managers have 5 minutes to negotiate. Apply the effects of the *Action* card by moving the mortality 🐟 and ecosystem service point sliders ♻️ ⭕ 🌍 in the gauges.

- When dispersing, each Manager gives 10% of each species (rounded down) to their nearest neighbours in the North and in the South.

- Calculate the abundance of species in your basin for the next round, considering the maximum abundances 🐟MAX described on the *Global Change* card 🌡️.

- End of the round. Repeat until you have played 6 rounds.

- Debrief.

SET UP

Hand out a *Catchment* card to the Managers. The *Catchment* cards must be placed around the table in the following order, from North to South:

Snowflower

Southstar   Nordfolk

Sunsnake   Evergrass
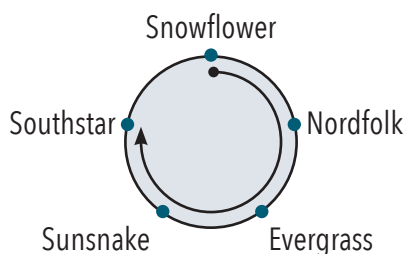
Place three sliders on the edges of the *Catchment* cards, one for each ecosystem service point gauge. In *DiadESland*, you can earn three different types of ecosystem service points: provisioning service points 🍽, regulating service points ♻ , and cultural service points 🌍. Collect ecosystem services by choosing *Action* cards that match your objectives.

Deal each Manager a *DiadES atlanticus* and *DiadES calidus Species* card. Not all Managers have the same species in their catchment at the beginning of the game. Refer to the table below:

	DiadES atlanticus	*DiadES calidus*
Snowflower	20	0
Nordfolk	20	5
Evergrass	20	10
Sunsnake	20	15
Southstar	20	20

Fish are represented by tokens. **Deal each Manager as many tokens as there are fish in their catchment.**

Place a cursor on the mortality gauge on the *Species* cards. All species have a mortality rate of 0.3. Move the slider each turn according to the *Action* cards you have chosen and according to the effects of human pressures.

Sort the *Global Change* cards by colour, in order of increasing difficulty (low to high: green (1), orange (2), red (3) and crimson (4)). Lay these cards face down in front of the Managers and discard one orange and one red card. The remaining six cards define the changing effects of global warming and human pressures during the game. Turn over one card at the beginning of each round.

Sort the *Action* cards and set aside the *DiadES tropicus Species* cards. The Game Master keeps the pile of *Action* cards that target *DiadES tropicus*, which he will add to the deck when the species' arrival is indicated on a *Global Change* card.

Sort the remaining local 👤 **and collective** 👥 ***Action* cards in two separate piles. You must have one pile of local *Action* cards and one pile of collective *Action* cards. Shuffle the different piles.** The game can begin!

PHASE 1 : GLOBAL CHANGE

Turn over the first *Global Change* card 🐟. Each card shows the effects of global warming 🌡️ on water temperatures in all catchments. These temperature changes impact the use of catchments by the species, which have different thermal preferences. Global warming changes the maximum abundance of each species in the catchments. The maximum abundance 🐟 of each species will be essential during the spawning phase to calculate the number of fish in your catchment at the end of the round.

In addition to the effects of global warming, there are also the effects of human pressures 🐟 on diadromous fish. Pollution peaks, hydro-electricity development, and epizootic diseases are all factors that can lead to increased mortality.

The effects of anthropogenic pressures are indicated on the *Global Change* cards, all Managers must increase the mortality rate for the species present in their catchment.

The increase in water temperature also favours the arrival of the *DiadES tropicus* 🐟 species in the southernmost basins. When the *Global Change* card indicates this, distribute a *Species* card and *DiadES tropicus* tokens 🐟 to all Managers concerned. The number of tokens to distribute and is indicated on the *Global Change* card.

Mortality 🐟 due to anthropogenic pressures applies to all species present in the catchment. This includes *DiadES tropicus*, although mortality increases as it colonizes the catchment.

PHASE 2 : MANAGEMENT ACTION

Action cards represent management actions that can be taken to meet your objectives. All *Action* cards earn and/or loose ecosystem service points. The number and type of points earned and lost vary depending on the management action.

DiadESland uses the Managers' expertise to guide their management choices. The effect of the *Action* card on mortality and the number of service points it yields will not be revealed until all Managers have chosen their card.

Local *Action* cards 🧑 can only be played by one Manager: the effects of the card apply only to his or her catchment. When a Manager chooses a local *Action* card, he places it in front of him. Collective *Action* cards 🧑🧑 can only be played if at least three Managers choose it: the effects apply to all the catchments of the Managers who chose it. The Game Master places it above the *Global Change* card of the current turn.

Action cards result in increased or decreased mortality 🐟⤳ for each species or for all species depending on the type of management action.

The Game Master reveals six local *Action* cards in the centre of the table, face up. At the same time, when the Game Master says "Go!" all Managers place their counters on the local *Action* card of your choice.

The Game Master reveals three collective *Action* cards in the centre of the table, face up, above the local *Action* cards.

Managers then have 5 minutes to negotiate if necessary and confirm your choice. When all Managers have chosen a card, turn the selected cards over to reveal their effects. Move the sliders on the mortality ⟪⟫ gauge and on the ecosystem service point gauges ♻ 🍽 🌍. Cards that are not selected are discarded. When the deck is exhausted, shuffle the discard pile and start over.

When weather conditions are favourable for *DiadES tropicus*, it colonizes the southernmost catchments. The arrival of *DiadES tropicus* will be indicated on one of the *Global Change* cards. When this happens, add the *Action* cards targeting *DiadES tropicus* to the deck and shuffle the cards.

NEGOTIATION

If two or more Managers choose the same local *Action* card, they must negotiate to determine who will play that card. Managers may change their minds and choose another card.

If there are not enough Managers to play a collective card, the others must be convinced to change their minds and place themselves on the collective card. Otherwise, the Managers concerned must choose another card.

After 5 minutes of negotiation, if no solution is found, do not play any *Action* cards and go to the next phase.

PHASE 3 : DISPERSAL

Diadromous fish, particularly the species presented in the game, have the particularity to return to the river where they were born to reproduce. All individuals of the same population do not respect this phenomenon, called philopatry or homing. Some fish, called strayers, wander off and get lost in neighbouring catchments yet close to their birth catchment, in the North and the South. *DiadESland* considers this crucial straying phenomenon in the networked dynamics of populations of the same species. Each Manager gives 10% of each of the species present in his catchment to his neighbours in the North and in the South, and this at each turn of the game.

Snowflower and Southstar are on the edge of the territory, so they are not connected and do not beneficiate from straying from each other.

Tip: To calculate 10%, look at the ten of the total number of fish in your catchment.
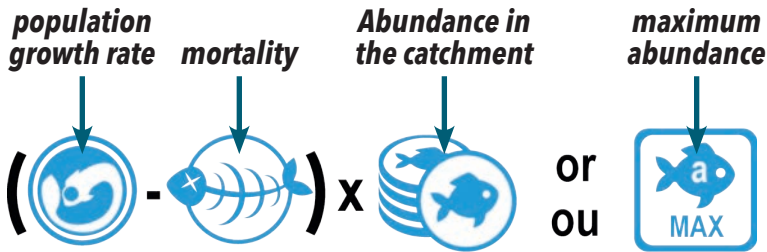
Example
The Nordfolk catchment Manager has 25 fish of the species *DiadES atlanticus* ⊕ in his basin. He therefore gives 2 *DiadES atlanticus* tokens to Snowflower and 2 *DiadES atlanticus* tokens to Evergrass.
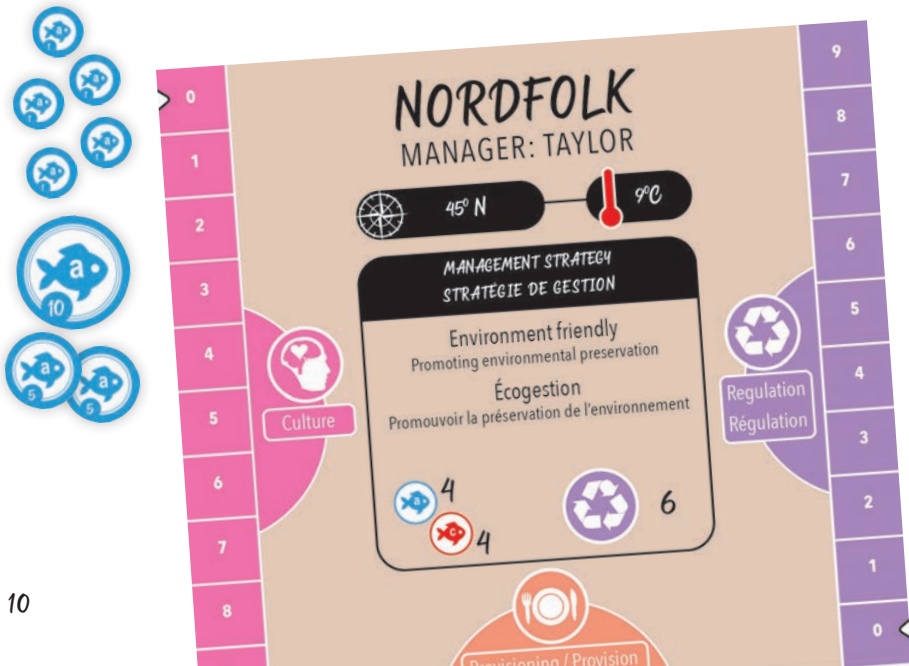
PHASE 4 : REPRODUCTION

The diadromous fish reproduce once they reach their spawning grounds. This is the time to calculate the abundance of fish in your catchments. The population of a species in a catchment allows calculating the progeny considering a population growth rate modulated by anthropogenic morality. The number of offspring is limited by the maximum abundance imposed by the climatic conditions.

The new calculated abundance is rounded down. To help you calculate the abundance of each species, use a calculator. The calculation is as follows for each species in the catchment:

population growth rate   **mortality**   **Abundance in the catchment**   **maximum abundance**

(● - ✕) x 🐟 **or ou** MAX

New abundance in catchment = minimum (offspring, maximum abundance capacity)

> **Worked example:**
> In Nordfolk, the abundance of *DiadES atlanticus* 🐟 is 15. The population growth rate of *DiadES atlanticus* is 1.3. The mortality 🐟 for this species is 0.2. Therefore, the offspring is calculated as follows:
>
> $$(1.3 - 0.2) * 15 = 1.1 * 15 = 16.5 \text{ (round to 16)}$$
>
> The *Global Change* card 🔥 for the turn indicates a maximum capacity of the catchment, abundance 🐟 of 30 for *DiadES atlanticus* in Nordfolk, so there are now 16 *DiadES atlanticus* in Nordfolk at the end of the turn.
> With another *Global Change* card, showing a maximum abundance of 10, there would, in this case, be 10 *DiadES atlanticus* in Nordfolk.
> Collect or discard *Fish* tokens according to the results. The round is over. Continue with the second round by revealing a new *Global Change* card.

DEBRIEFING

The debriefing (1,5 hour) encourages reflection and exchanges between the Managers. It is just as important as the game phase that precedes it, because it allows participants to reflect on their experience and identify elements that can be transferred to the real world. The Game Master conducts the debriefing with all the Managers. He is assisted by an observer, who takes notes on the exchanges made throughout the game and the Managers' observations, which are essential during the debriefing.

A debriefing methodology is presented to guide the Game Master and the observer. Ask the questions in the below table in the order in which they are given.

The "speed-debriefing" (0.5 hour) should be reserved for exceptional situations in which the players cannot participate in the full debriefing.

Phase	Topic	
Cooling down	Experience, emotions	
Data collection	Measurement of objectives	
Reliability Sensitivity	Decisions and choices	
Ecological and social validity	Realism, omission and processes	
Planning for action	Future research questions and actions	
Protect the instrument	Experience, emotions	

Questions	Time	Speed Debriefing (30 min.)
How did you feel? What did you think of the game experience? Why?	5	5
Were you able to achieve your goals? What was crucial for the success or failure? Are there some tensions between biodiversity and ecosystem services objectives?	10	0
What motivated your choices? How did you manage your ecosystem services objectives? How did you manage your biodiversity objectives? Why did you choose collective/local cards? What would have made you change your mind? Did you anticipate climate change? Why or why not? What would have made you change you mind? Did you consider all the species? Why of why not? What would have made you change your mind? Did you play "unacceptable" cards (in contradiction with your personal values system)?	30	15
How are the game and the reality connected? Do you see the same emergent stakeholder's behaviour in the game as we see in real life? (collaborative or competitive) What do you think about the simplified population dynamics simulated in the game? What do think about the climate change impact?	10	0
What can and cannot be fed back into the real world? What management recommendations can we make after this play session?	20	10
What did you get from that experience? What did it "cost" you? To what extend the game was controversial? Would you recommend this serious game to your colleagues and other partners? Why?	5	0

**For the speed-debriefing,
only ask players the questions that are written in red.**

OVERVIEW OF MANAGEMENT ACTIONS

In *DiadESland*, the *Action* cards have been designed to represent a wide range of management actions. *DiadESland* is a schematic representation of complex phenomena and is not intended to be realistic or reflect real world catchments.

Support commercial fishery - Supporting professional fishing through financial subsidies, fleet development, enhancement and increase of professional fishing activities.

Fleet reduction plan - Reduce professional fishing activities, including the number of boats allowed. Professional fishing is not banned, but greatly reduced.

Water Framework Directive - Ensure that water bodies achieve good ecological status.

Raising awareness program - Develop a large-scale awareness-raising programme, including the creation of a serious game, to make the public aware of the economic, ecological, and cultural issues associated with diadromous fish.

Climate information - Disseminate the climate trend scenario to anticipate the effects of global change in the next decade.

Climate prediction - Use climate projections and socio-economic scenarios to anticipate the effects of global change in the medium term.

Marine Protected Area - Create a protected marine area, within which the exploitation of diadromous fish is prohibited. No anthropogenic mortality occurs in this protected area.

Remove dam - Remove dams in your catchment and restore ecological continuity.

River restoration - Carry out restoration actions for freshwater habitats.

Reduce pollution - Implement new guidelines to control water quality by reducing pollutants discharged from industrial, agricultural, pharmaceutical, and urban sources.

Control invasive species - Reduce the impact of invasive species on diadromous fish in your basin by destroying key habitats for these invasive species.

Develop ecotourism - Develop tourism and cultural activities around diadromous fish in your basin. This includes public awareness activities, tours, building a museum or aquarium, creating awareness workshops.

Improve knowledge - Launch a research programme on amphibian migratory fish: mapping of key habitats, assessment of flows and stocks (fish pass counts, capture-mark-recapture), research on reproduction and rearing to adulthood, assessment of the impact of climate change.

Global fishery ban - Ban professional and recreational fishing activities for a decade.

Genetically modified fish - Develop migratory fish that are more resistant to climate change and human pressures through genetic manipulation.

Restricted fishing - Partially ban commercial and recreational fishing.

Artificial reproduction for stocking - Increase the abundance of diadromous fish through assisted breeding. This card can only be played if the species is still present in your basin.

Restore connectivity - Build fish passes to facilitate the migration of diadromous fish.

Support sustainable fishing - Promote sustainable fishing activities and the consumption of labelled and local products from these fisheries.

Support for angling - Organise sport fishing competitions and support recreational fishing activities in your catchment.

Gastronomic festival - Organise a festival to celebrate the gastronomic heritage of diadromous fish products.

Assisted colonisation in new habitat - Increase the abundance of amphibian migratory fish in your catchment by assisted migration if the species is present in another catchment.

Develop aquaculture - Develop stocking and consumer aquaculture in your catchment.

Freshwater protected area - Protect or restore critical habitats for the target species in your catchment.

ACKNOWLEDGEMENTS

Snowflower

Nordfolk