Rules and Assets for *Blue Expanse*

Produced by UNSW iGEM 2021

Context Education

The Great Barrier Reef is an invaluable part of Australia's natural heritage and is a significant contributor to our national tourism industry. However, the reef's continued survival is under threat, either directly or indirectly from anthropogenic causes. These primarily include pollution and rising sea temperatures. As the sea temperatures rise, the ecosystem faces challenges from increased corallivore activity – most notably from the Crown-of-Thorns Starfish – and coral bleaching. The observable rise in sea temperatures coupled with an El Nino event led to record high sea surface temperatures during 2016 and 2017. This resulted in mass bleaching events occurring in both years, with the 2016 event leading to coral mortality rates above 75% in some reefs. [1] This occurs as the algal symbionts, which coral depend on for nutrients, produces damaging reactive oxygen species (ROS). Without these algal symbiotes, coral lacks important nutrients and lose their characteristic vivid colouration, causing coral bleaching.

At UNSW, we've been working with the aim to modify a common symbiont, *Zooxanthellae*, to increase its tolerance to increasing temperatures, paired with a Glutathione system to suppress the production of ROS. But just how significant are the threats posed by climate change and pollution to a reef? How would improving the heat tolerance of a microscopic algae benefit the broader ecosystem? *Blue Expanse* places 2-5 players in charge of managing their own reefs, providing a simplified model of a reef ecosystem to ultimately help people better conceptualise the threats faced by the Great Barrier Reef and other reefs around the world.

Blue Expanse is a combination of two boardgame archetypes; roll and move games, which include *Monopoly* and *Ludo*, and deck-building games, like *Dominion*. Ultimately, by pairing a more widely recognised board design with the seeming complexity of the deck-builder, the boardgame will hopefully engage a wider audience.

Summary: Ultimately, the game seeks to provide a fun and educational experience to help members of the broader public better appreciate the difficulties in ensuring a healthy reef whilst also highlighting some of the approaches we believe can help.

[1] https://elibrary.gbrmpa.gov.au/jspui/bitstream/11017/3206/1/Final-report-2016-coral-bleaching-GBR.pdf

Glossary

To ensure understanding of some key ecological terms, a glossary has been provided as part of the package; as seen below:

Apex predator: A top predator of a food web. Their importance lies in providing ecological stability, controlling the abundance of prey in the ecosystem.

Benthic: Occurring at the bottom of the marine environment

Detritivore: An organism that feeds on detritus (waste and dead material).

Ecosystem transformers/Transformer species: Species that change the structure of the environment around them to suit their needs, which then impact other species

Habitat: The home of another organism

Herbivore: Organisms which feed on producers, such as sea-grass

Keystone species: An organism that plays a significant role in an ecosystem, more than other organisms

Niche: The specific role the organism plays in an ecosystem, for instance a day-time herbivore is in a different niche than a night-time herbivore.

Photosynthesis: The process where 'producers' use sunlight to make energy (food) in the form of sugar

Producers: Organisms that make their own food

Symbiont: A organism with a close and long-term relationship with another, such as, a coral and their algae symbiont

Symbiosis: A close interaction between two organisms. Ref. symbiont

Trophic levels: The position in a food chain. For instance, the first trophic level are plants or autotrophs which produce food and nutrition for the whole food web.

How the game works

Each player starts with their own deck, consisting of Currency cards, and their player token. The deck is placed in their own individual play area, and their token is placed on the board, initially at the start tile. The objective is to move their token around the board, then acquiring cards which correspond to the tile they land on. These cards will represent either the reef biosphere, the ways which humans interact with the reef and its surrounding resources, or temporary events. By building their own reef, players will be effectively building their own reef food web, which will have a total victory score. This is counted by adding up the victory points (VP) of all the cards in the player's reef at the end of the fourth stage.

Stages are determined by players circumnavigating the board. The game starts at stage 1, representing a pre-industrial environment, and progresses to stage 2 when any player first completes a loop around the board. Stage 2 represents growing industrialisation around the reef and introduces the pollution mechanic. Pollution is persistent but affects players individually. Stage 2 progresses to Stage 3 when any player completes their second circumnavigation of the board. Stage 3 introduces the rising temperature mechanic, which is like pollution in its persistence, but differs as rising temperatures affect all players. When any player completes their circumnavigation of the board, the game progresses to stage 4. Stage 4 represents a mass bleaching event with each player playing one last turn before tallying up and comparing their VP, after which a winner can be determined.

Components

A complete game of Blue Expanse comes with this document to allow for its printing and distribution. To set the game up, you will require:

- One game board
- 6 decks of cards
    - Currency cards
    - Resource cards
    - Biomass cards
    - Humanitarian cards
    - Bonus cards
    - Malus cards
- Player tokens
- Six-sided dice
- Optional tokens representing research, pollution, and rising temperatures.
- Optional calculator
- A system for taking notes

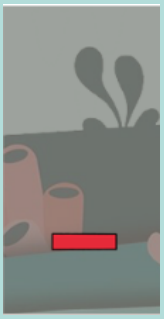
The board

The player moves around the board to acquire cards for building their own reef. Movement is facillitated by rolling a dice, then moving the token by the indicated number of tiles from the current position. The board is divided into tiles, which form a ring parallel to the board's border; and slots in the middle of the board, which contains cards which players obtain. There are six tile types which players can move their player tokens onto.

The start tile is where all players start. Passing by or landing on this tile after the game starts marks one complete loop or circumnavigation of the board. As a reward, after completing each circumnavigation, a player will be able to draw an extra 2 cards on their turn, and their hand size limit increases by 2.

When players land on this tile, they are able to acquire cards from the Resource deck or Biomass-associated slots in the middle of the board. These slots all share the same cyan colour as the background/border and occupy the top row of the purchase slots. Cards in these slots are acquired by playing Biomass currency cards from the player's hand.

When players land on this tile, they are able to acquire cards from the Resource deck or the Humanitarian-associated slots in the middle of the board. Excluding the Resource deck, these slots share the same dark violet colour and occupy the bottom row of the purchase slots. Cards in the dark violet slots are acquired by playing Capital currency cards from the player's hand.



When players land on this tile, marked by a red minus sign on a tan overlay, they must choose a card from the tan slots associated with the Malus deck. Malus is derived from the Latin for "bad" and is the antithesis to the "good" Bonus, and the cards will have generally temporary negative effects for the player's reef. Players may still choose to buy cards from the Resource deck.

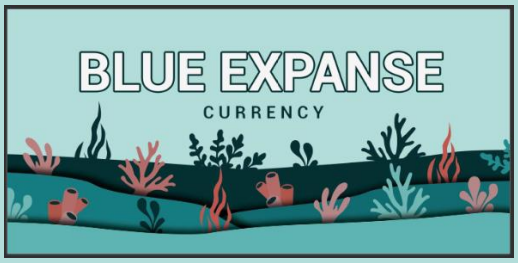

OR


When players land on this tile, marked by a green plus sign on a light green overlay, they must choose a card from the light green slots associated with the Bonus deck. Bonus cards will have generally temporary positive effects for the player's reef. Players may still choose to buy cards from the Resource deck.

Located on the corner opposite to the Start tile, is the Government Grant tile. Taxed Capital is stored here as a pool. When a player token lands here, they gain Capital and Biomass equivalent to the amount pooled for 1 turn. They can acquire cards from the Resource deck, Biomass-associated slots, and Humanitarian-associated slots.

The cards

Cards have five primary classifications: Currency, Biomass, Humanitarian, Bonus, and Malus. These have further sub-classifications. Biomass cards are sub-divided by the trophic level occupied by the organism, or put simply, the role they play in the food web. Humanitarian, Bonus, and Malus cards are divided by the stage the game is in, with new stages introducing associated cards.



The back of the cards show identical designs, with differentiation corresponding to the primary classification of a card – the above is the back of a Currency card.

Currency

The Currency cards are the simplest. The card 'Capital' is shown below as an example:

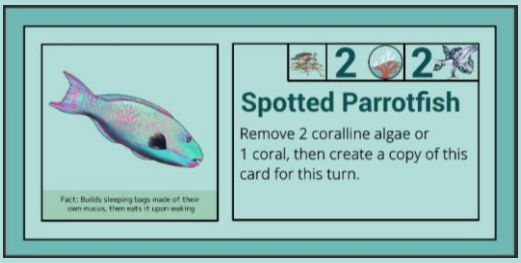
All currency cards have a white border on the front.

Resources

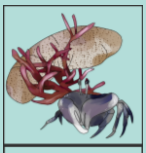
All Resource cards have a black border and represent primary producers in the reef ecosystem. A graphic representing the organism is shown on the left side. The icons in the top right corner show the VP of the organism and its cost. In this case, the VP contributed by the 'Zooxanthellae' card is 0, and it costs 1 biomass to acquire from the Resource deck.

Below that is the name of the organism and its effect. Unless specified otherwise, these effects apply during each of the owning player's turn, after the token is moved and cards are acquired.

Biomass



Biomass cards share many visual elements with Resource cards. However, the border of the card is cyan, and below each graphic is a piece of trivia associated with each organism. Furthermore, in the top right corner to the left of the VP and cost, is a graphic indicating the secondary classification of the organism.



This indicates the organism is a detritivore. To simplify the game, it also includes corallivores.

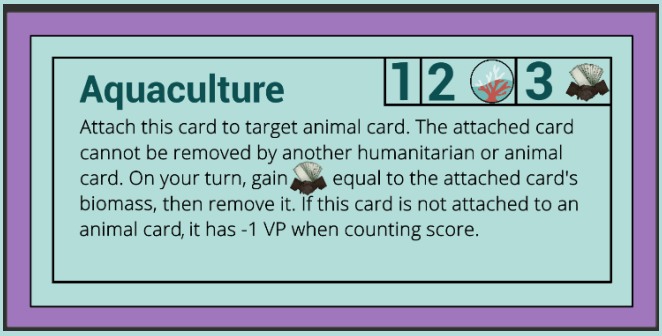
This indicates the organism is an herbivore, whose primary diet is either coralline algae or seagrass.

This indicates the organism is a predator. Not all predators are apex predators, which opens the door for them to be consumed by other predators.

This indicates the organism is a filter feeder. These range from small bivalves to the massive whale shark.

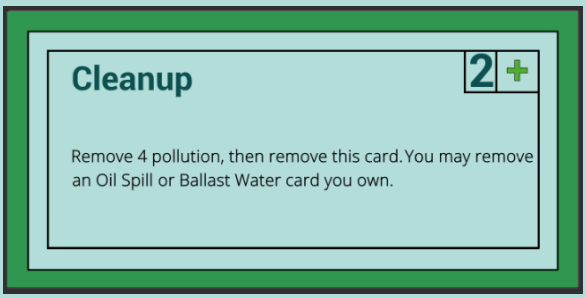
In the example card, 'Spotted Parrotfish' has been classified as a herbivore, contributing 2 VP to the player's total, and costs 2 biomass to acquire.

Humanitarian



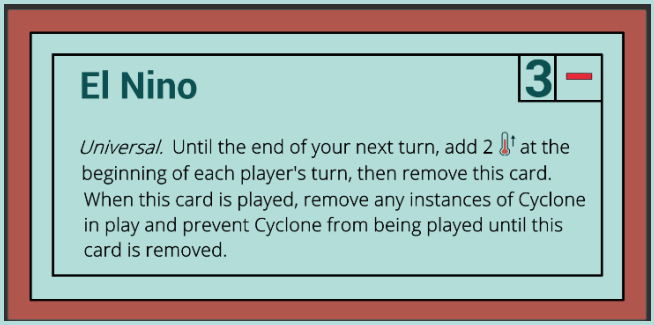
Humanitarian cards tend to lack the large, representational graphics as seen in the Resource, Currency, and Biomass cards. They possess a dark violet border, and a different arrangement for the top right corner. To the left of the VP and capital cost of the card, there is a number signifying the stage from which this card will be present. In the case of this card, 'Aquaculture', it can be acquired from stage 1 (i.e., the beginning of the game) onwards. It has a VP score of 2, which can be modified according to the card's effect, and a cost of 3 capital to acquire. Humanitarian cards can be extremely beneficial in boosting the player's economy – in terms of ability to generate currency – and several have VP which can scale. However, this is often offset by a negative impact on the player's reef ecosystem, which in turn act provide a basis for most Humanitarian cards.

Bonus



Bonus cards are marked by their green border. In the top right corner, there is a number and plus symbol. The number indicates the stage this card is introduced at, whereas the plus symbol is another indicator that this card is a bonus card. Players should note that this card has no VP or cost to acquire. In this case, the 'Cleanup' card is introduced to Bonus deck when the game enters stage 2.

Malus

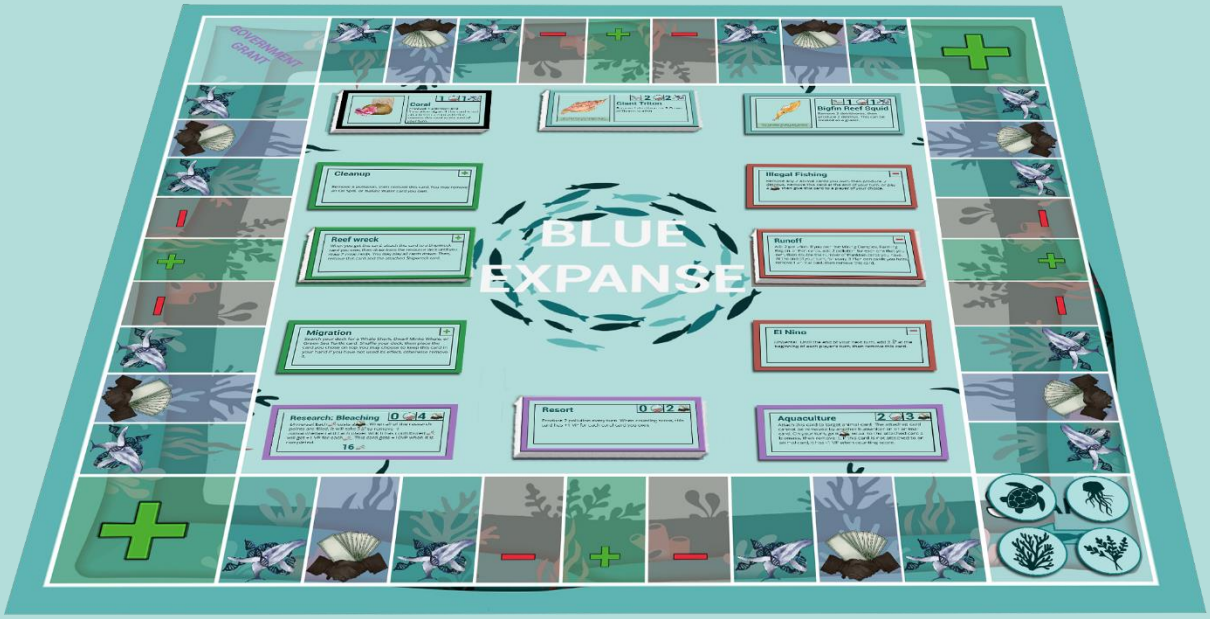


Malus cards have a similar design to Bonus cards, except for the crimson border and minus sign in the top right corner. In this case, the 'El Nino' card is added to the Malus deck when the game enters stage 3.

Game setup

There are two parts that need to be setup prior to the game starting. The first is the board, and the next is the player's deck and play area.

The board



Above is an example of the board, setup at the start of a game for 4 players. All player tokens are on the start tile. On the slots are the decks, with cards facing up. The decks sit on top of slots which identify the deck, whilst individual cards are placed in slots without words but sharing a colour corresponding to the border, except for Resources. The purpose of the slots is to provide players with choice in acquiring cards. Once a card in a slot is acquired, a card from the corresponding deck will be placed face up to fill the slot.

For example, if the player with the turtle token moves onto a tile with the symbol for capital, and they choose to purchase the 'Aquaculture' card on the right, the 'Resort' card will be moved to fill the vacant slot, and the card previously beneath it will be revealed.

The player

The player should set aside space for their personal deck, and a space for them to play cards. Each player's initial personal deck will consist of 10 'Biomass' cards and 6 'Capital' cards. This deck will be shuffled and placed face down, after which each player draws five cards from their own decks. These five cards make up the player's initial hand and should not be shown to other players.

As the game develops, other cards may be added to each player's decks, and the hand sizes may also increase. Besides the deck and the hand, the player will also begin to grow their reef, with cards they acquire kept face up for other players to look at for reference. Attached cards are stacked on each other. To keep track of numbers, it is advisable that players take notes of temporary cards, temporary currency, pollution, and rising temperatures.

Gameplay

Turn structure

A player's turn can be divided into 4 phases: the movement phase, the acquisition phase, the management phase, and the end of turn phase.

The movement phase involves the player rolling a six-sided die and moving their token the number of tiles shown on the top of the die.

The acquisition phase involves the player acquiring cards in exchange for currency cards. During this phase, other players may play currency corresponding to the card to increase the cost of the current player in acquiring said card. For example, it is currently player A's turn, and they wish to acquire a 'Great Triton' card for 2 biomass. However, player B plays 2 biomass as well, increasing the acquisition cost for player A by 2 biomass. Thus, player A must decide whether to spend 4 biomass or spend their biomass on a different card. Other players may only do this once each turn, targeting up to two cards. This does not apply for Bonus and Malus cards.

The management phase involves the player resolving the effects on their cards. These effects often involve removing creatures, or resource production. Unless otherwise stated, the effect of each card should be understood to be triggered on each turn the player has that card and must be triggered unless otherwise stated.

For order of resolution, unless stated otherwise, producing copies of cards take priority, then "remove" effects, such as "remove 1 detritivore". These are followed by other "production" effects, such as "produce 2 pollution", after which other effects are resolved. Note that removed cards no longer trigger effects, except if the effects are explicitly tied to their removal.

The end of turn phase resolves end of turn effects. If card effects are unable to be resolved, they are removed at this phase. Unless otherwise stated, produced items are removed at the beginning of this phase, except for persistent items. This phase also involves replacing cards; the player's exchanged currency cards are shuffled and placed at the bottom of their deck, and removed cards are shuffled, then replaced at the bottom of the corresponding decks on the board. After the end of turn phase, the next player begins their turn.

Stages & Circumnavigation

As the stages progress, the game accrues challenges for the players to face. The main threat posed in stage 1 is overfishing, but this can be managed with careful decision making. This stage primarily exists to allow players to establish their reefs. Stage 2 adds the problem of pollution into the mix. Many of the humanitarian cards introduced in this stage can significantly increase a player's VP and ability to gain temporary resources, at the cost of damaging the reef ecosystem. Stage 3 further raises the stakes by introducing the 'rising temperature' mechanic, indicated by a thermometer adjacent to an arrow, which affects all players. Stage 4 is meant to represent a mass bleaching event, and so it will automatically result in the playing of an 'El Nino' and 'Warming Seas' card.

When players complete a circumnavigation, they add 2 'Capital' cards to their deck and increase their hand size limit by 2.

Extra Notes

- Persistent items are not automatically removed or reduced at the end of turn, except as a result of an effect. These include:
    - Resource cards
    - Pollution
    - Rising sea temperatures
    - Research points
    - Animal cards
    - Humanitarian cards
- Temporary items:
    - Most copied cards
    - Coralline algae
- *Universal* effects affect every player, so long as the card is in play and the effect is triggered
- Animal refers to non-resource cards acquired from the Biomass deck and slot
- As a part of a card's effect text:
    - Research is represented by a conical flask adjacent to a microscope.
    - Capital is represented by a downsized version of the larger graphic
    - For every 4 pollution a player has, the player removes a non-resource biomass card they control. This does not repeat each turn. (*For example, player A gains 4 pollution on one turn and gains 8 pollution on the next. On the first turn they remove 1 card, and on the latter they remove 2, despite a personal total of 12 pollution.)*
    - Rising temperatures is represented by a thermometer adjacent to an arrow. When the total number of rising temperature tokens increases by 3, separate or un-attach a 'Zooxanthellae' card from a 'Coral' card. It follows a similar principle to the pollution mechanic, however the effect is universal. This means that all players contribute to rising temperatures and all players experience the consequences of it.
    - References to "your deck" indicate the player's own personal deck.