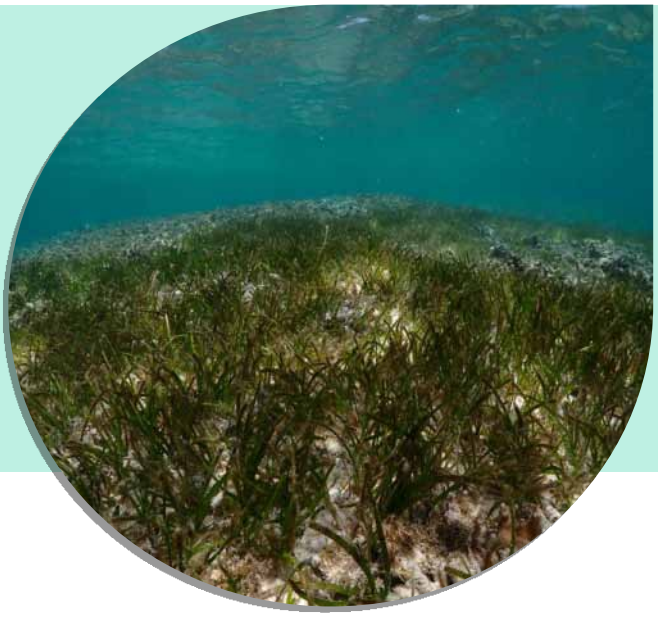
Final report

SCIENCE EN HERBE



Raising awareness about the importance of dugongs and their habitat in New Caledonia.

Brisset, M., Derville, S., Andréfouët, S., Cleguer, C., Buttin, J., Garrigue, C.

2022

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Context and objectives

The project *Science en herbe* was funded by the MoU Dugong through a Small-Scale Funding Agreement, and developped to improve knowledge of seagrass meadow distribution and dugong foraging ecology in the southwest lagoon of New Caledonia, while promoting citizen science and raising awareness about the conservation status of these emblematic animals and their habitat.

New Caledonia, a French overseas territory located in the south-western Pacific Ocean, ~1500 km east of Australia, is home to one of the largest population of dugongs in the world. Extensive aerial surveys provided a general overview of its distribution, with the highest densities being observed on the west coast. The population of dugongs in New Caledonia was estimated between 426 ± 134 and 717 ± 171 individuals between 2008 and 2012 (Cleguer *et al*., 2017, Hagihara *et al*., 2018). Moreover, satellite tracking has revealed a great heterogeneity of movements across individuals and identified multiple core areas of use (Cleguer *et al*., 2020). Dugongs were found to use diverse habitats, from intertidal coastal seagrass meadows in lagoons, to the oceanic deeper waters outside the barrier reef.

Seagrass meadows have been extensively studied around New Caledonia in the past 50 years, but considering the extent of the lagoon, many gaps in knowledge remain. In the southwest lagoon, deep seagrass meadows were first sampled using dredge and scuba diving (Garrigue 1987, Garrigue 1995). For instance, around the capital, *Nouméa*, seagrass and algal beds were partially mapped and sampled in 2005-2006 using satellite imagery and in situ records (Andréfouët *et al*., 2021). However, most of the seagrass data around the region is restricted to shallow waters < 5 m and some could now be considered as obsolete in several areas. Indeed, these shallow seagrass meadows are located in lagoonal nearshore waters and islets reef flats where they are influenced by intense anthropogenic activity compared to the rest of the archipelago.

Satellites tracking of dugongs around *Nouméa* have revealed potential feeding behaviour in deeper parts of the lagoon where seagrass occurrence is unknown (Derville, *et al*., 2022). Yet, in this region, multi-specific meadows (*Cymodocea serrulata, Halodule uninervis, Syringodium isoetifolium*) and mono-specific meadows (*Halophila decipiens*) are known to occur in soft bottom at a mean depth of 11 m and > 20 m respectively (Garrigue 1995), in addition to extensive *Sargassum* spp. algal beds (Mattio *et al*., 2008) that rather settle and develop on hard-bottom. These deep meadows could represent important feeding resources for dugongs but remain understudied (Cleguer *et al*., 2020).

The *Science en Herbe* project was led by the French National Research Institute for Sustainable Development (IRD), which is implanted in New Caledonia since 1946 to conduct applied research on the interactions between humans and their environment. IRD actions are deeply rooted in the local

scientific and societal environment and promote sustainable development. Due to time and budget constraints, the project focused on the southwestern part of the main island, and the capital *Nouméa*.

Based on a citizen science approach, this project aimed to 1) enhance the evidence base for local conservation of seagrass and dugongs in the southwest lagoon of New Caledonia, and 2) help raise awareness on the ecosystemic value of seagrass meadows and currents threats to dugongs in New Caledonia, by specifically targeting the younger members of urban communities in *Nouméa*. The project included five phases that took place from January to May 2022 : outreach and launch of the participatory research activities ; participatory seagrass meadows photo collection ; scientific seagrass meadows mapping and dugong diet analyses; raising awarness among youth community, and a finale photo exhibition.

1. Outreach to the general public via press and social medias

1.1. Project launch

Communication in the social media about the project was scheduled as soon as it started (03/01/2022) and has been maintained throughout, the purpose being to post educational content about dugongs and seagrass, as well as frequently inform the community about the achievements and progress of the *Science en herbe* project. In order to reach a wide range of people in a limited time frame, it was decided to focus on social media platforms for communication. A Facebook page was first created followed with Instagram and Tweeter accounts (Table 1).

Table 1. Social medias accounts created within the project and subscribers associated.

Social media	ID	Subscribers
Facebook	@ScienceEnHerbe.nc	431
Instagram	Science_en_herbe	113
Tweeter	@ScEnHerbe_nc	29

Timely information, events planning, and overviews of the project progress, were frequently updating theses accounts. Around 50 publications were posted on our social networks over the duration of the project (see Annex 1 for more detailed statistics). The photo contest was the first information published online and promoted, with a post explaining how to participate and guidelines to share submarine photographs via a dedicated email. Three displays; respectively compiling indications about: the project, the contest and seagrass phanerogams meadow in New Caledonia; and a short video footage (available online at: https://www.youtube.com/watch?v=Y40LMcbxsi4), were created and edited for this purpose. The displays and the video helped to inform the community on the project goals, and transfer essential information to participate in the project (Annex 2). A poster (Annex 3) was also printed, systematically exposed whenever possible for educative and informative purpose. It summarizes the five main actions carried out during the project.

A media release was also transmitted to all local Medias and provided an opportunity for our team to communicate on the project and especially the photo contest (Table 2**Erreur ! Source du renvoi introuvable.**). We were broadcasted on three local radios, and interviewed by local TV channel NC1ere. This also led to a press article written by LNC newspaper (Annex 4.A) and an online article wrote by NC1ere (Annex 4.B). Part of *Science en herbe* budget was dedicated to a radio commercial which was broadcasted by NC1ere during six days in the morning, noon and/or evening, from 01/03/2022 to 06/03/2022. Audience reached on the period was about 134 706 auditors.

Table 2. List of the full media broadcasts during the project.

Media	Diffusion type	Diffusion date
RRB	Radio Interview	08 & 09/01/2022
LNC	Press Article	08/01/2022
Djido	Radio Interview	12/01/2022
NC 1ere	Television	13/01/2022
LNC	Paper press Article	15/01/2022
NC 1ere	Radio Interview	21/01/2022
NC 1ere	Radio Interview	04/02/2022
NC 1ere	Radio commercial	01/03/2022 to 06/03/2022
NC 1ere	Radio Interview	16/03/2022
NC 1ere	Online article	16/03/2022
LNC	Online and Paper press article	11/05/2022
NC 1ere	TV news Guest	14/05/2022

During the whole program, IRD and the NGO *Opération Cétacés* systematically relayed *Science en herbe* posts via their own social media, websides and/or YouTube channel. Local institutions and contributors (*e.g.*, province sud, CEN[1], CIE[2], MDB[3], Cresica, Hô-üt association and diving clubs such as Blue Caledonia Diving, Abyss, Odyssey diving, Pop club) also collaborated to the project promotion, frequently relaying our post, and sharing our displays through their social medias and community (see Annex 5 for a detailed list).

Figure 1. **Biodiversity House (photo credit: *Ville de Nouméa*).**

[1] Conservatoire des Espaces Naturels (Conservatory of Natural Spaces)
[2] Centre d'Initiation à l'Environnement (Environmental Initiation Center)
[3] Maison de la biodiversité (Biodiversity house)

We also had frequent contact with *Maison de la Biodiversité* (*i.e.*, MDB, Figure 1), a facility run by the city of *Nouméa* which is dedicated to environmental education and outreach. MDB relayed and shared major information to visitors and the local community centers with whom they work. This venue is very popular among various *Nouméa* communities and neighbourhoods and it is visited daily by the general public and families.

1.2. Public restitution and acknowledgement of the project

The communication actions contributed to a wide transmission of the key information related to *Science en herbe*. Several noteworthy events and web publications occurred within the time frame of the project (see Table 3 for detailed listing and Figure 2).These events included notably a full day spent at the Phare Amédée islet and organized with Blue Caledonia Diving club, where our team promoted the photo contest and animated a round table about dugong and seagrass conservation with divers. An article promoting awareness of seagrass meadow in New Caledonia was also posted by Instagram account Word.inprogress, which is collaborating with IRD.fr and intend to promote sciences for youth (full article available online at: https://www.instagram.com/p/CaXkflmoRaS/?utm_source=ig_web_copy_link, Figure 2.C). The digital platform Issuu also published an article written by *Outre mer grandeur Nature*, (full article available online at: https://issuu.com/oceindia/docs/omgn_9, Figure 2.D).

Table 3. Events and mentions that occurred during the Science en herbe project.

Structure	Type	Date
Instagram account World.inprogress	Article about seagrass meadows in New Caledonia	25/02/2022
E-mag *Outre-mer grandeur Nature*	Article about dugongs and their protection in New Caledonia	11/03/2022
Blue Caledonia Diving club	Meeting and presentation of the project to the club's divers	13/02/2022
province Sud	Seagrass Workshop with partners working on the same thematic field	25/04/2022
UNC University	Workshop about participatory approaches in sciences	03/05/2022
Maison de la biodiversité	Photo exhibition, special afternoon dedicated to the *Science en herbe* project, and interactive youth activities	May 2022
province Sud	Conference about the project and achievements	31/05/2022

Our team was also invited to a workshop (Figure 2.E) that took place at University of New Caledonia to discuss citizen science and public awareness of environmental issues. This meeting was the occasion to present our project, especially the photo contest and our approach to interact with the general public and communities. We also had the opportunity to communicate about the impact of the schools and MDB events as we were invited as guest to NC 1er TV news the 14th of May 2022. Finally, in partnership with the *province Sud* structure, a one hour public conference (C'Nature) was organised

to present the entire work carried out during *Science en herbe* on the 31rst of May 2022. The conference was attended by about 60 people.

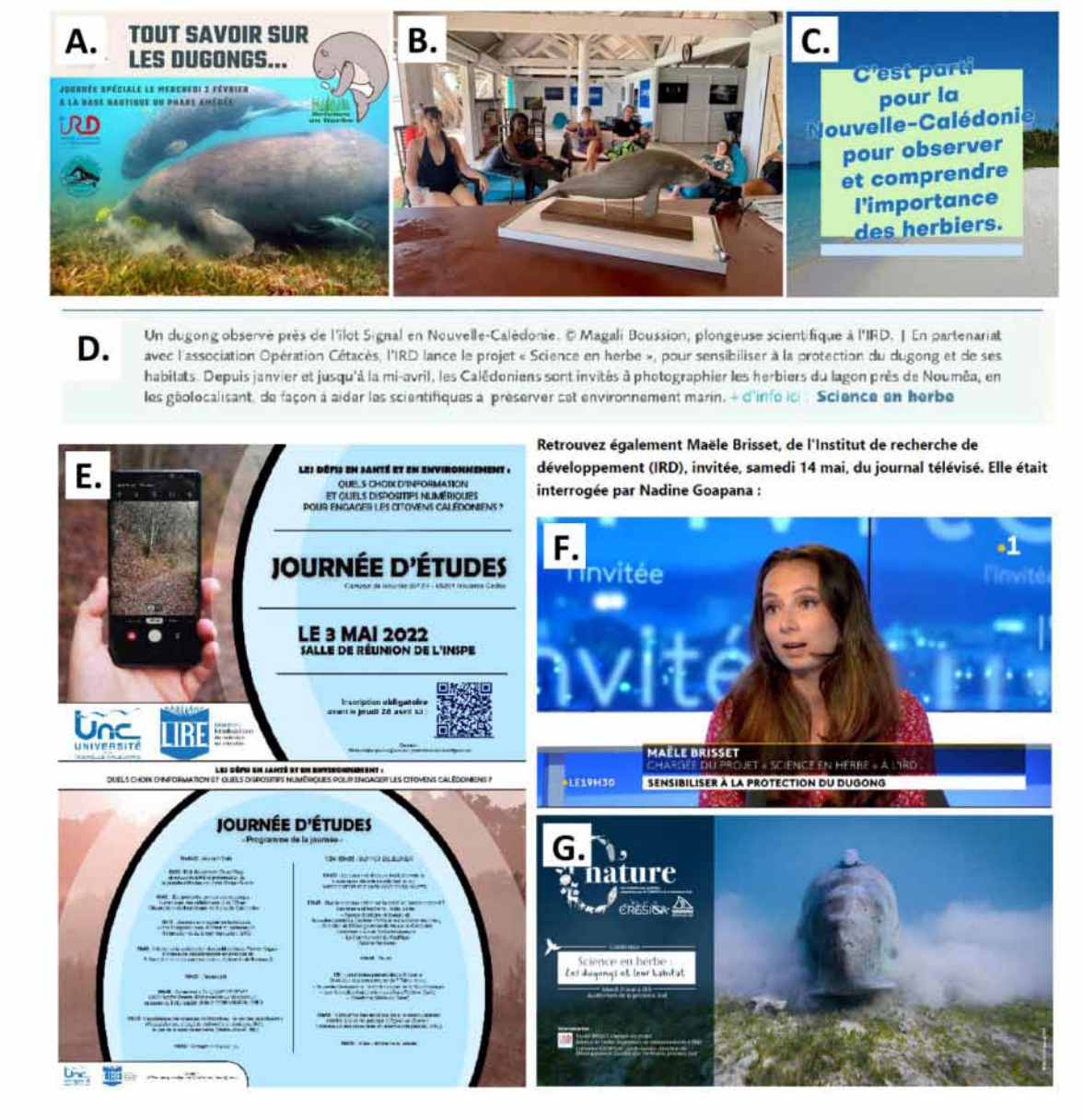

Figure 2. Events and web publications that took place during the *Science en herbe* project : A. **and** B. **Meeting hold the 13/02/2022 with Blue Caledonia Diving club divers with a focus on dugongs and habitat protection in New Caledonia (Phare Amédée islet);** C. **Article wrote by World.inprogress Instagram account the 25/02/2022 about seagrass meadows in New Caledonia and thus mentioning *Science en herbe;*** D. **Mention of *Science en herbe* in the E-mag *Outre-mer grandeur Nature* published the 11/03/2022;** E. **Display of the Workshop that took place in University of New Caledonia the 03/05/2022, on participatory approaches in sciences,** F. **Illustration of the guest footage that occurred during the NC 1ere TV News the 14/05/2022;** G. **Conference hold in partnership with the *province Sud* structure for the project closure the 31/05/2022.**

2. Participatory seagrass meadows photo collection and contest

13 contributors posted 200 seagrass meadows photographs to compete in the participatory photo challenge (see section 1). Photos were taken in 15 different locations in New Caledonia, with specific GPS coordinates given for photographs taken in Touho region and sent by the local NGO Hô-üt association (Figure 3). The 16 best shots were selected by a jury of five IRD staff (*i.e.*, C. Garrigue, C. Payri, M. Brisset, S. Andrefouet and S. Derville), and were shown in an exhibit from the 3rd to the end of June 2022 at the MDB (Figure 4). The contributors of the best photographs received a prize, on the occasion of a special afternoon dedicated to the *Science en herbe* project conducted also at the MDB (see section 4.2). The photographs that illustrated solely seagrass meadow (*i.e.*, without any organisms) where uploaded on SeagrassSpotter database, using an account created for the project (@ScienceEnHerbeNC). 60 photographs were thus included and may now contribute to an improved knowledge of seagrass distribution in the New Caledonian lagoons.

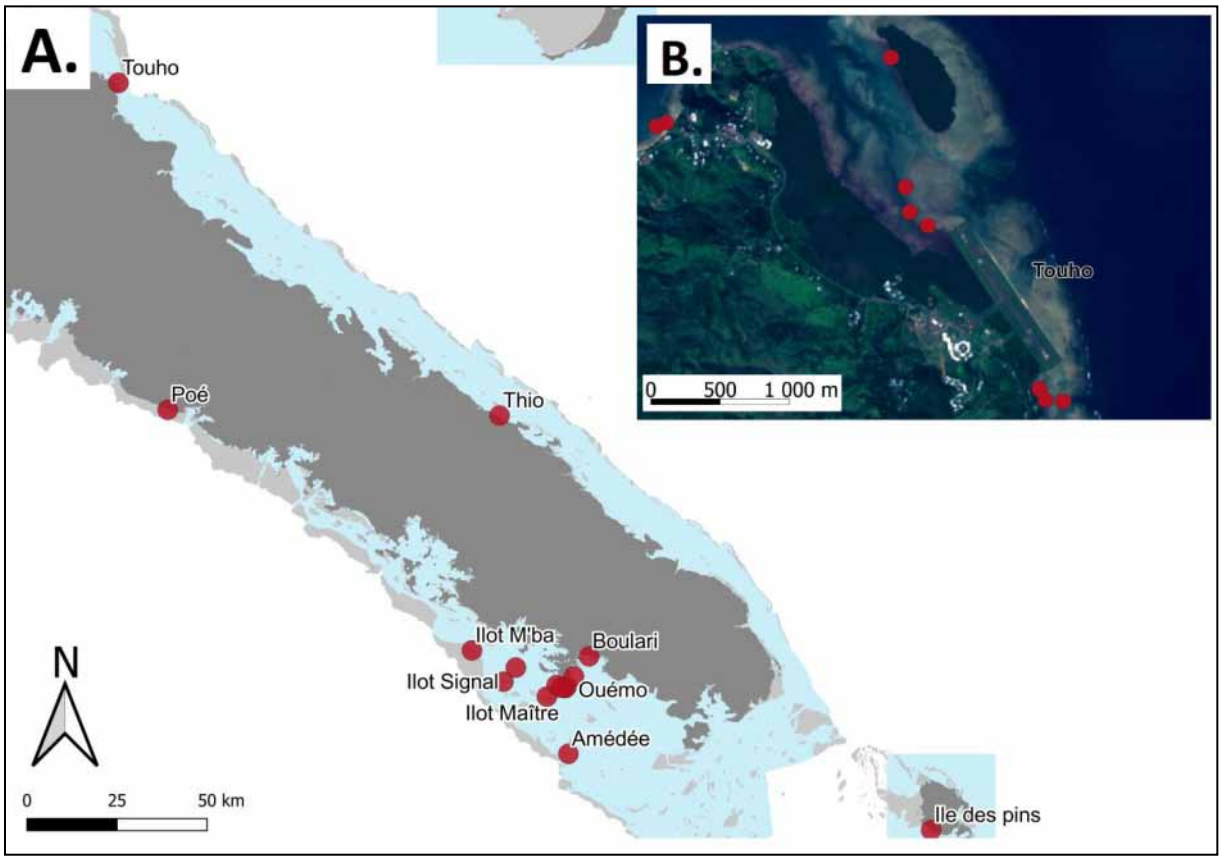

Figure 3. Map of the New Caledonian locations where contributors took photographs for the purpose of participating in the photo contest. A**. 15 areas with only mention of the approximate location.** B**. Sites with specific GPS coordinates located in the Touho region.**

Figure 4. Photo exhibition hosted at the MDB (photo credit: Karla Bussone).

3. Scientific data collection and analysis

3.1. Scientific seagrass meadow mapping

Between 2012 and 2019, 16 dugongs were fitted with GPS-Argos beacons in order to track their movement and identify important habitats for the species (Cleguer *et al*., 2020, Derville *et al*., 2022). Seven localities (*i.e*., *Crouy, Larégnère, Ilot Maître, Amédée* East and West, and *Atire*) where tagged dugongs showed movements indicative of potential foraging were selected for the purpose of this study (Figure 5). Three days of field work where organised in 2021 to carry out scuba diving sampling and visit the six study sites, in order to take photographs, and identify the seagrass species present and their density. The *Mouea* site initially identified as a potential site of interest could not be surveyed and was then replaced by *Larégnère*.

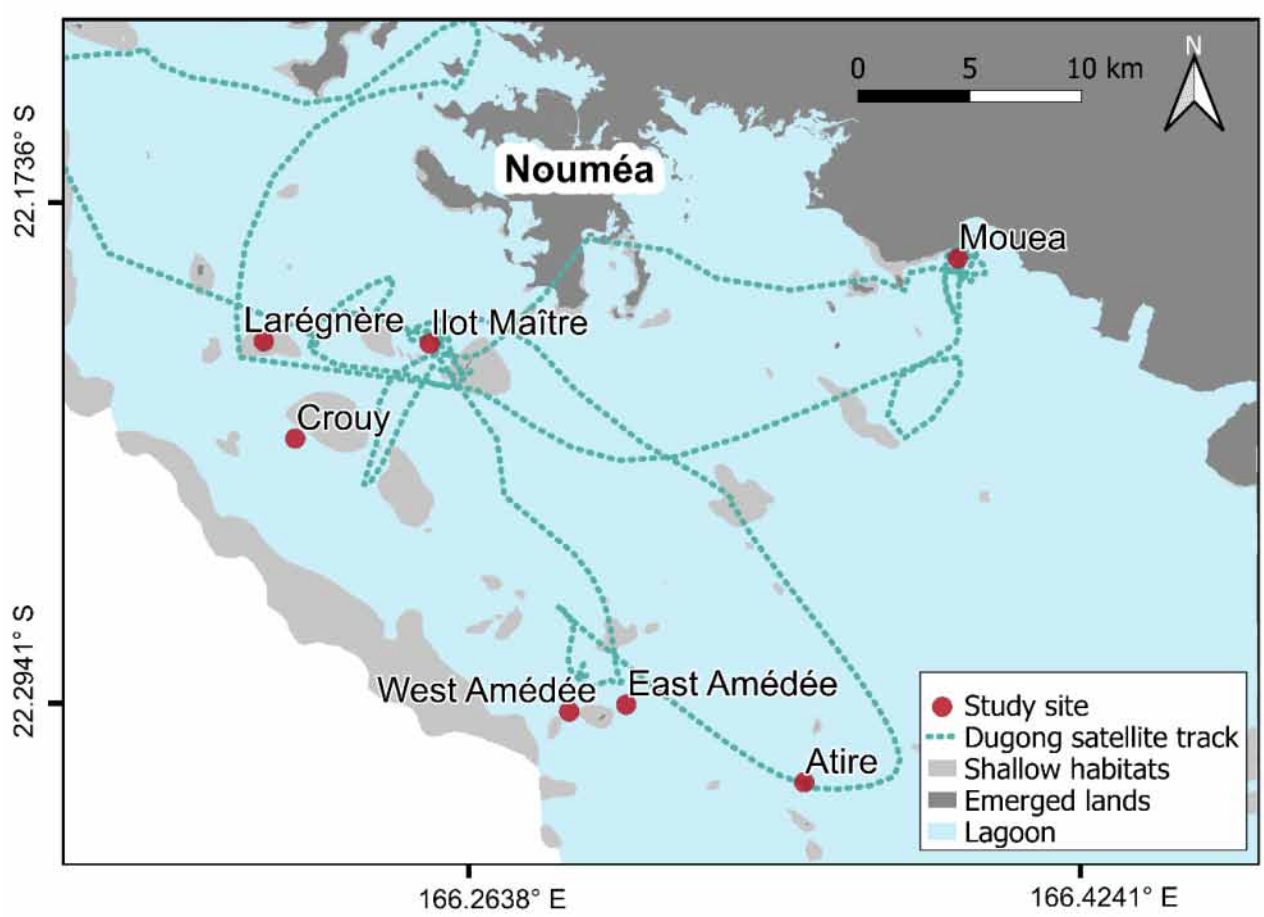

Figure 5. Map of the southwestern New Caledonian lagoon and seagrass study sites associated with dugong feeding behaviour. Location of the seven initially identified sampling sites located around *Nouméa* and dugong satellites tracking (Cleguer *et al*., 2020). The shallow habitat layer includes reef flats (~0-3m).

Habitat information was recorded along the scuba-divers track using a fast, visual, semi-quantitative protocol to characterize cover and dominant organisms. The track of the scuba-divers was recorded by a GPS towed by one of the divers. Presence distinct seagrass species were assessed during several stops along the diving transect, when the physiography of the seagrass beds was changing. Specimens were collected in zip lock bags if necessary. Numerous photographs were taken regularly along the track to document habitats, sediments, and biodiversity. Maximum and minimum depth of study sites ranged between 20 and 5 meters deep. Most sites had seagrass, although at very low density for several of them (*e.g.*, *Crouy*, the two *Amédée* sites, *Atire* and part of the *Larégnère* track). A mosaic of low density seagrass, algae, and some coral patches were often observed (Table 4), as described below.

Table 4. **Occurrence of seagrass species collected on sites.**

	West Amédée	**East Amédée**	**Ilot Maître**	**Crouy**	**Atire**	**Larégnère**
Cymodocea serrulata	x	x	x			x
Halophila decipiens	x	x	x	x	x	x
Halophila ovalis	x	x	x	x	x	x
Halophila ovata			x		X	
Halodule universis			x	x		x

Amédée

The two *Amédée* sites were dominated with very sparse to sparse (<10%) *Halophila* seagrass bed, nevertheless quite wide, notably at West *Amédée*. Species such as *Caulerpa* spp and *Halimeda* spp were found within the meadows (Figure 6). East *Amédée* site was characterized with frequent and dense Sargassum algae patches, sometimes up to 70 cm high. Coral reefs were also found at both West and East *Amédée* sites. Sediments characterizing the seagrass areas were thin to very thin and spread in a thick layer.

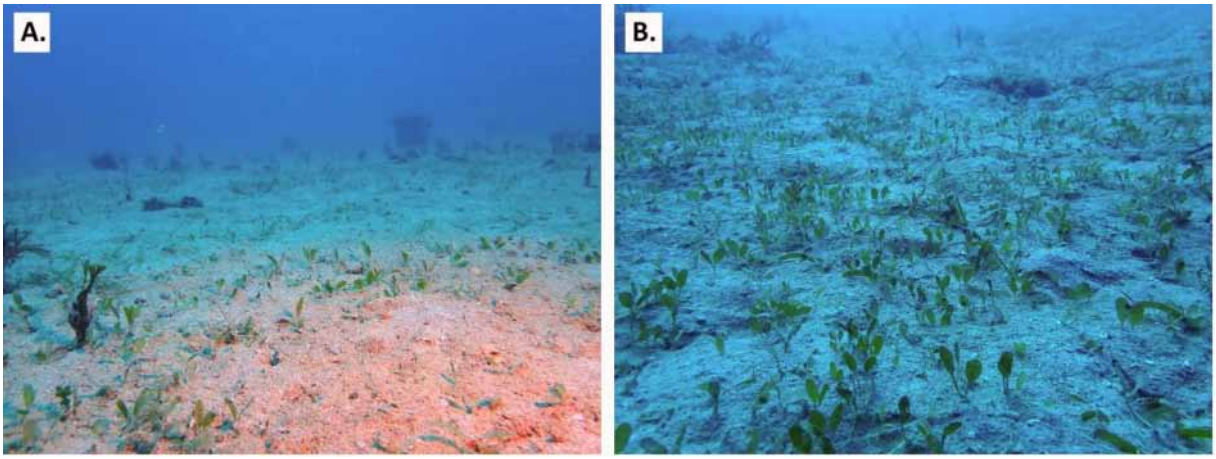

Figure 6. **Habitat found in *Amédée* site.** A. **East *Amédée*;** B. **West *Amédée* (photo credit: Serge Andréfouët).**

Atire

The *Atire* site was heterogeneous and mostly dominated with Sargassum algae, in which sit a few patches of *Halophila* (Figure 7). Carbonated sediments were mostly thin and covered a hard bottom, visible a few centimeters deeper in the substrate.

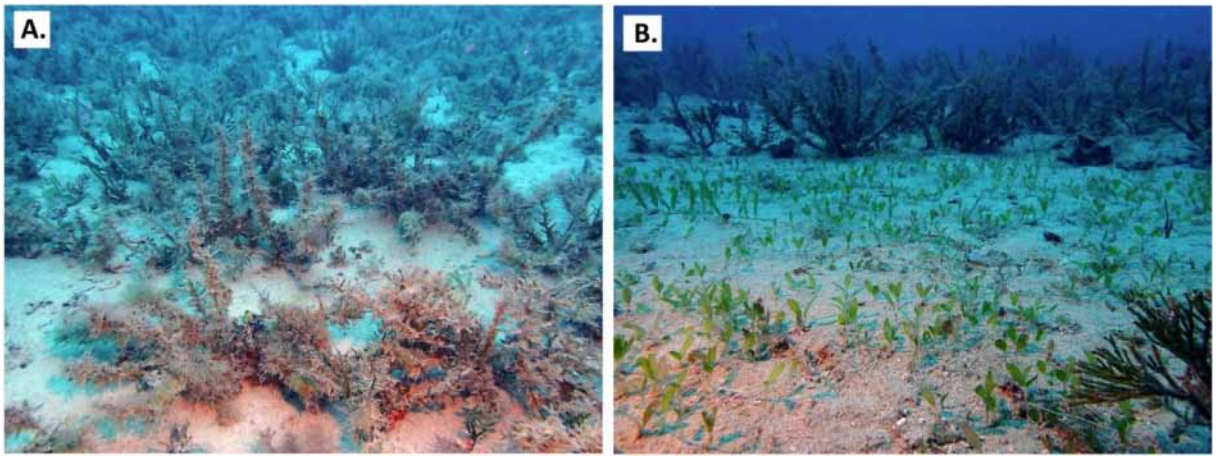

Figure 7. **Habitat found at *Atire* site.** A. **Sargasses algae;** B. ***Halophila*** **(photo credit: Serge Andréfouët).**

Crouy

Crouy site was also heterogeneous and organisms were fixed to a rocky layer, covered with a thin layer (1-2 cm) of sediments, which obstructed the establishment of seagrass rhizomes. The area was a patchwork of macroalgae, sponges and coral (including *Millepora*), with few phanerogams found in areas where the sediments accumulated (Figure 8). This area seems to remain stable over time as shown in satellites imagery (Andréfouët pers. obs.).

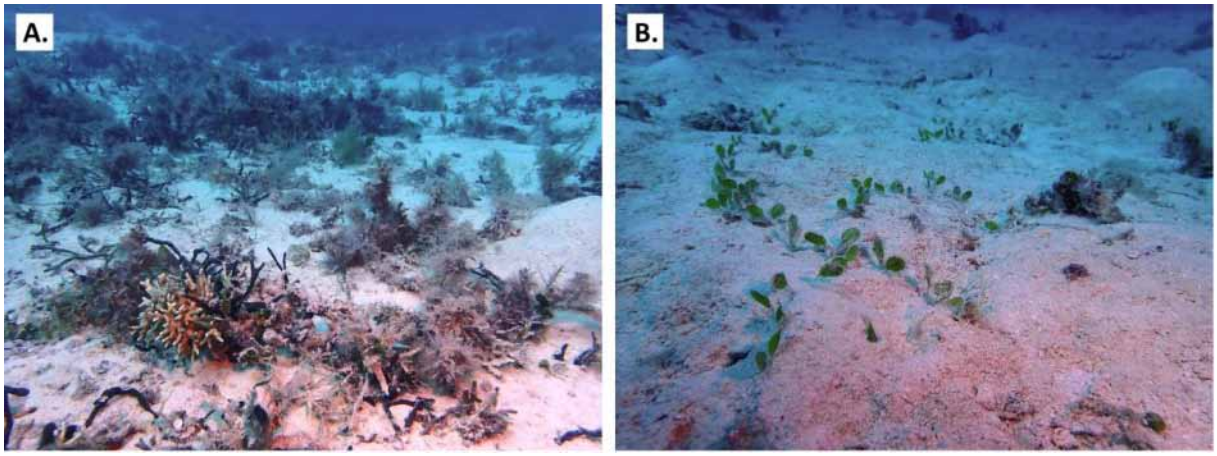

Figure 8. **Habitat found in *Crouy* site.** A. **Hétérogenous patchwork;** B. ***Halophila*** **(photo credit: Serge Andréfouët).**

Larégnère

Cymodocea, *Halodule* and *Halophila* seagrass meadow homogeneously covered almost the entire site, although with low density (< 5%). Microalgae was also characterizing the habitat, notably with *Halimeda* spp and *Caulerpa* spp, and few Sargassum (Figure 9). Some of the seagrass patches were denser (15-20 %). The thick layer of thin carbonated sediments suggested that the seagrass meadow may have been denser at other times. This area seems to be dynamic over time, as shown in satellites imagery (Andréfouët pers. obs.).

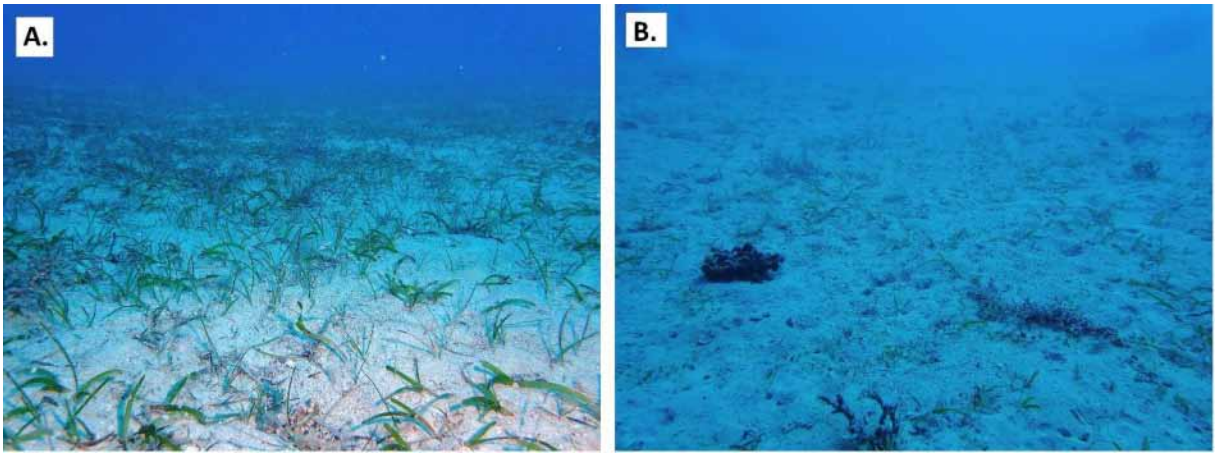

Figure 9. **Habitat found in *Larégnère* site.** A. **Cymodocea and Halodule almost continuous seagrass meadow;** B. **Halophila seagrass meadow (photo credit: Serge Andréfouët).**

Ilot Maître

The *Ilot Maître* was the most homogeneous site, covered with dense and multispecific seagrass beds, notably composed of *Cymodocea* and *Halodule, with* very few *Halophila* (Figure 10). Less dense areas were structured in small seagrass patches or green algae. A peculiar cover of cyanobacteria was also observed. Seagrass meadow seemed denser in the past, as shown in satellites imagery (Andréfouët pers. obs.).

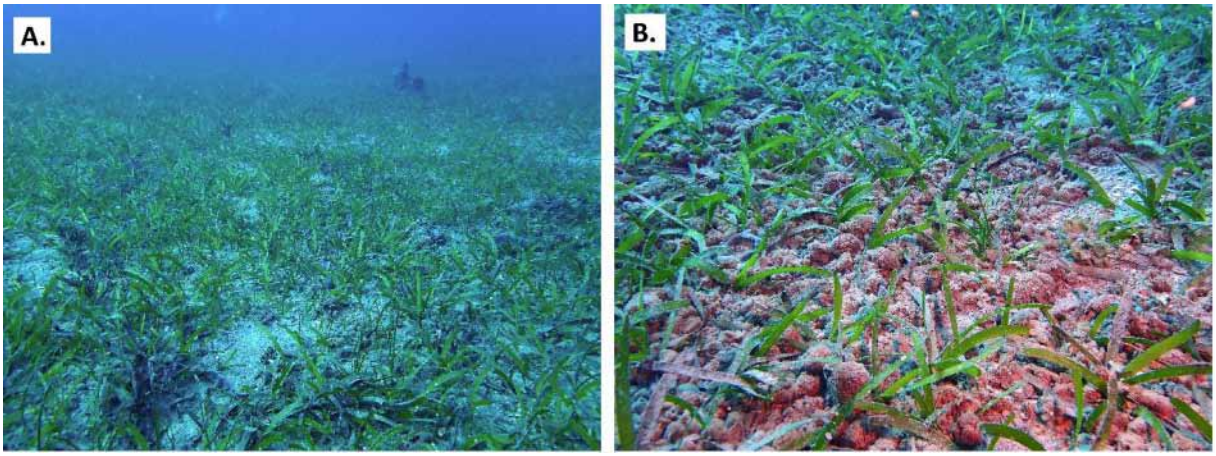

Figure 10. **Habitat found in *Ilot Maître* site: dense and multispecific seagrass beds (photo credit: Serge Andréfouët).**

3.2. Laboratory analysis of dugong stomach content

Strandings of marine mammals have been recorded since the 1990s in New Caledonia (see www.rescue.ird.nc). The dugong is the most frequently stranded species in New Caledonia (n = 65 to date). Whenever possible, samples are collected on carcasses (skin, stomach contents, teeth, etc.). Four stomach contents were available for analysis. They were analysed to identify the species of phanerogams contributing to the dugong's diet (Figure 11 and Table 5). Phanerogam species were difficult to identify due to the leaf degradation caused by digestion. We found that each individual stomach contained a different dominant seagrass species.

Table 5. Species of phanerogams and algae found and identified in stomach content of four dugongs, along with their length and sex.

Samples	Dugong		Species of phanerogams		Seaweeds
	Length (m)	sex	dominants	others	
EC2006-01-01	1.82	Male	*Halophila ovalis*	*Cymodocea serrulata*, *Halodule sp*	/
EC2022-02-01	3.01	Female	*Halodule sp*	*Halodule sp*, *Halophila ovalis*, *Cymodocea serrulata*, *Syringodium isoetifolium*	Sargassum spp., brown Algae
EC2021-03-01	2.70	Male	*Halodule sp*	*Cymodocea serrulata*	Caulerpa (*taxifolia*, and *cupressoides*)
EC2006-13-01	2.54	Male	*Cymodocea spp*	*Halophila ovalis*	

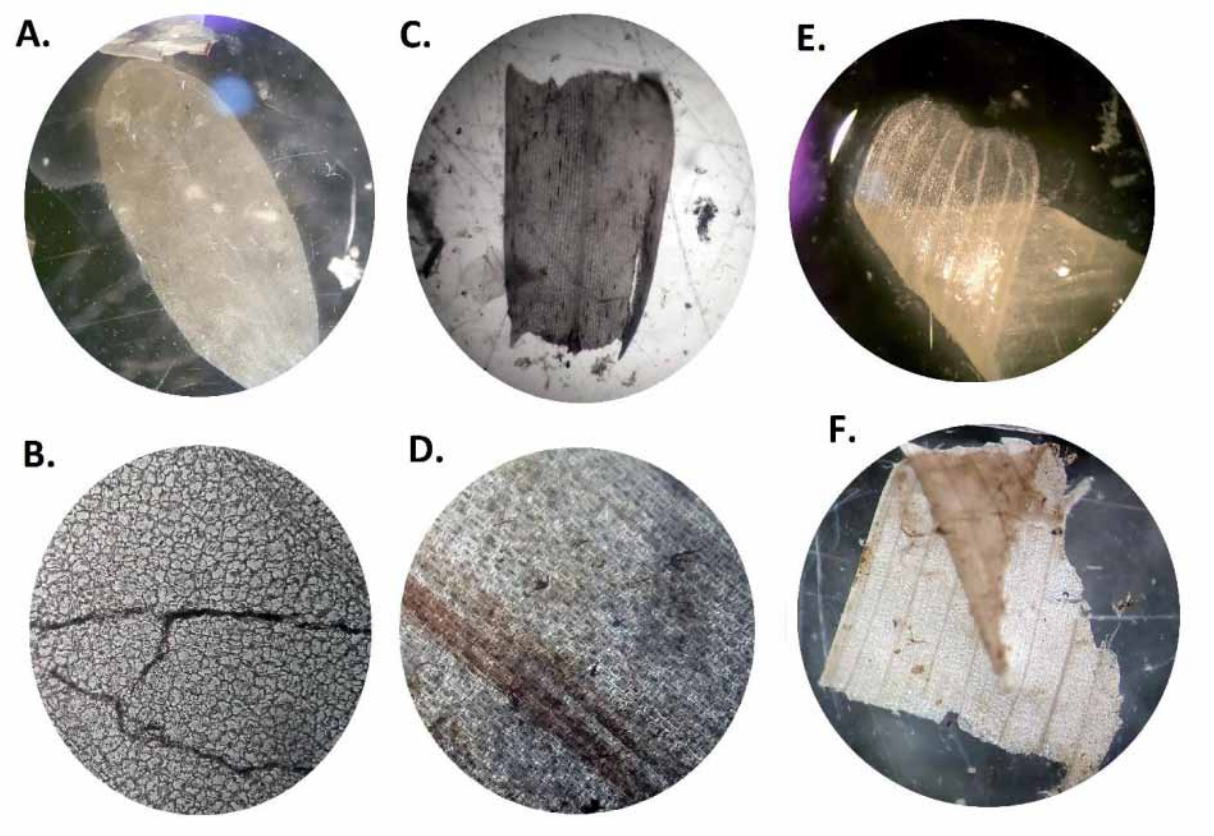

Figure 11. **Dominant species found in stomach contents of dugongs**. A. ***Halophila ovalis*** **external habit*;*** B. **Alignment of *Halophila ovalis* cells;** C**. *Halodule sp*.external habit**; D**. Alignment of *Halodule sp*. cells;** E. ***Cymodocea spp*** **external habit;** F**. Alignment of *Cymodocea spp* cells.**

4. Youth awareness and education

4.1. Student workshops

Interactive activities with youth were organized in 30 institutions such as public and private high and primary schools, around *Nouméa*, targeting various communities from March to May 2022. About 600 students were involved. The technical complexity and the length of the activities were adapted to the age of the students (*i.e.*, two hours for high schools and one hour for primary schools).

Each intervention started with a dedicated time devoted to acquiring data on students' prior knowledge and cultural representation of dugongs and their habitat. For the oldest students, this was the occasion to discuss and ask questions about the topic, thus providing an overview of the general knowledge of the class. For the youngest, each pupil was asked to draw and/or write what they had in mind concerning this animal in order to evaluate the way in which the child apprehended the animal and its living environment before providing any explanations. Drawings were thus retrieved and kept for further analysis. The teacher will ask the children for a new drawing after the intervention. The aim is to assess the evolution of children's representations of dugong and its habitat through drawings before and after the intervention (Chabanet *et al.*, 2018).

The first part of the session was a presentation of the *Science en herbe* project and basic concepts concerning dugongs, seagrass meadow, ecology and conservation in New Caledonia, supported with field photographs, videos, and various biological samples (seagrass, dugong teeth and skull). The second part was more hands-on and was adjusted depending on the age of the participants. It was organised as follow: one hour of phanerogams identification workshop for the oldest and 30 min of entertaining workshops for the youngest (*i.e.*, colouring, reading and educational games). At the end of the intervention, each primary school was offered a poster illustrating facts about dugongs and its protection, and an illustrated book about whales in New Caledonia (Garrigue & Greaves, 2002; see Annex 6). Satisfaction surveys were also made among high school teachers (Annex 7.A) and students to complete the intervention (Annex 4). It gave our team feedback about the student's experience and his opinion about the intervention, notably regarding the duration, the workshop and the knowledge received (Figure 12).

A video footage was shot during these scholar activities in different institutions; it summarises, explains and illustrates the activities we conducted (available online at:

https://www.youtube.com/watch?v=1mxS2kJgcqg).

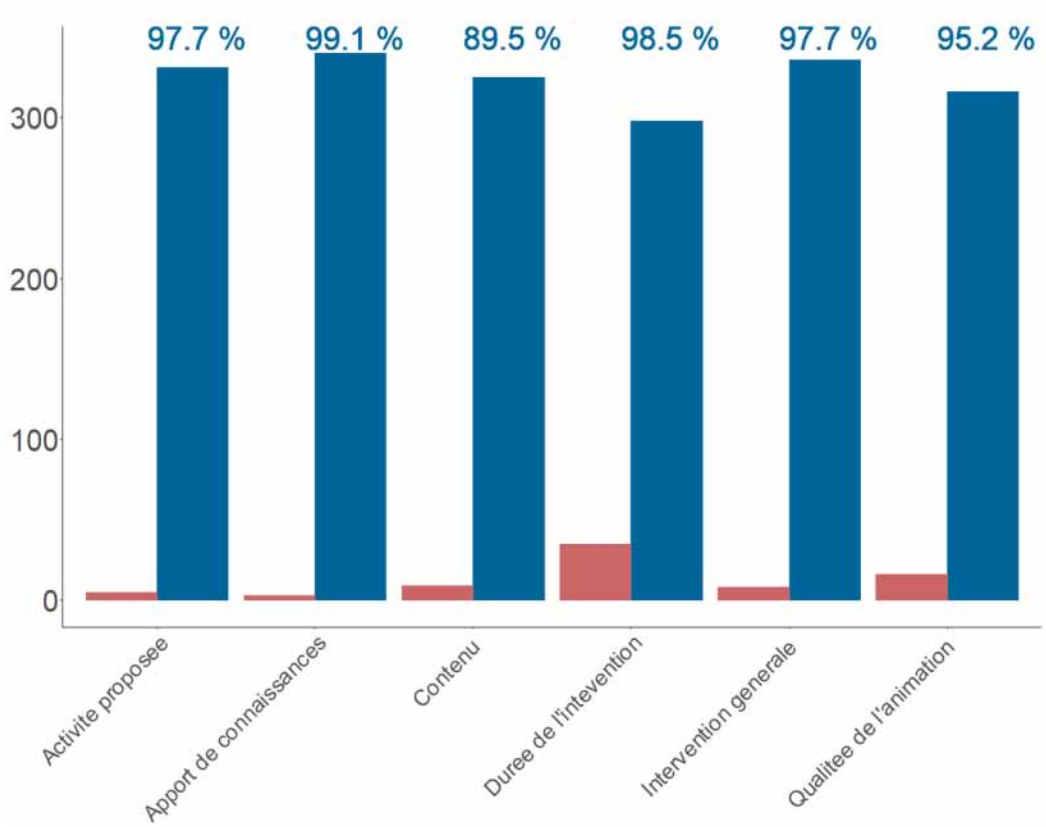

Figure 12. **Feedback provided by approximately 350 students: satisfactory (blue) and unsatisfactory (red)**

Identification activities

This active learning activity offered the opportunity to gain knowledge on seagrass ecology and learn how to identify the 11 different species that can be found in New Caledonia. It also offered the possibility to complete and keep a leaflet observation data. Each participant had at his/her disposal a panel of seagrass samples (photographs, fresh and/or dry samples) and had to make his/her own observations (*i.e.*, measurements, sketching…), complete the leaflet (Annex 4.A), and use a simplified set of identification keys (Annex 8.C) and species identification sheets (Annex 8.B). These documents were created specifically for the purpose of the project and are meant to be reused in the future if needed. When available, a binocular magnifier was provided to ease the identification. We notably used for this workshop the seagrass photographs received during the photo contest (Figure 13).

Colourings activities

This workshop was devoted to creativity, and participants could garnish a colouring template chosen between: a submarine drawing with dugongs, a dugong and seagrass book mark, a dugong magic colouring or a ‘’connect the dots’’ dugong drawing (Figure 14 and Annex 9).

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Figure 13 (A **and** B)**. Identification activities held at *Plum* high school the 31/02/2022 (photo credit: Magali Boussion).**

Figure 14. **Colourings activities settled at the *Maison de la Biodiversité* every Wednesday afternoon during the month of May (See next section, photo credit: Karla Bussone).**

Reading activities

This workshop was an opportunity to discover and learn more about dugongs, threats, and seagrass in New Caledonia. Numerous books and leaflets were provided, such as '*'Les Dugongs*'' edited by the *CIE* (Bourdeau *et al*., 2010, Figure 15 and Annex 10).

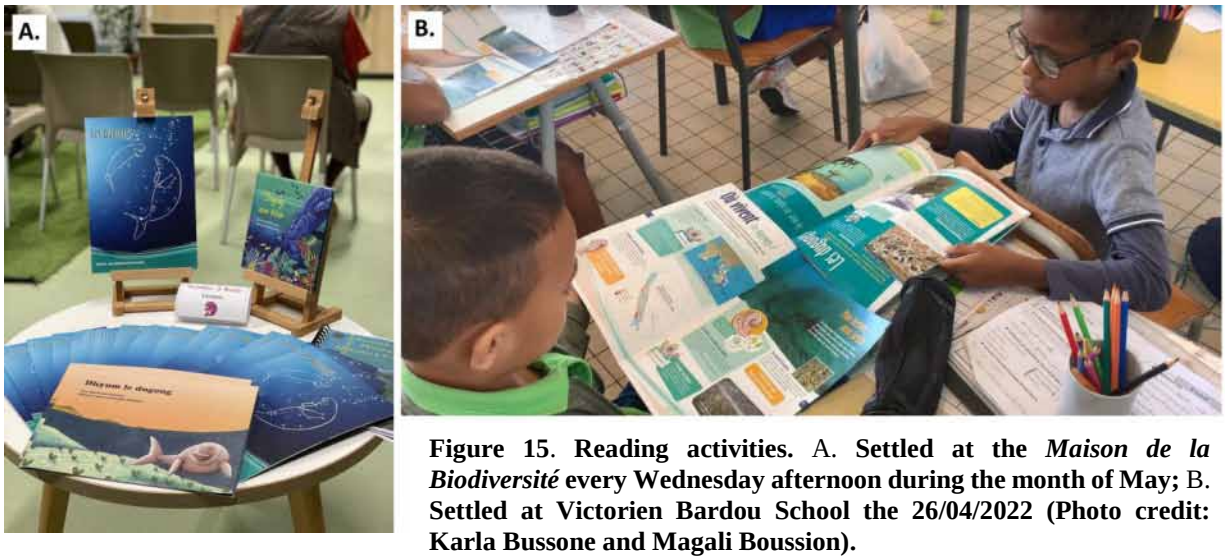


Figure 15. **Reading activities.** A. **Settled at the *Maison de la Biodiversité* every Wednesday afternoon during the month of May;** B. **Settled at Victorien Bardou School the 26/04/2022 (Photo credit: Karla Bussone and Magali Boussion).**

Educational games

During this activity, the participants could choose between multiples educational games (*e.g*., words search, criss-cross or double puzzles, fallen phrases, maze, see Annex 11) and interactive activities (*e.g*., puzzles of dugongs 46 and 65 pieces, poster puzzle game to complete, see Annex 12), to assess the level of knowledge on the subject (Figure 17). If needed activities were supported with a vocabulary sheet.

4.2. *Maison de la Biodiversité* workshop

Similar workshops were also organized in May, every Wednesday afternoon at MDB (Figure 17). The launch of these interventions was conducted with the opening of the photo exhibition, exposing the 16 best seagrass photographs received during the photo contest. A special afternoon dedicated to the *Science en herbe* project was organized on the 12th of May. The first part of this event was allocated to youth activities, while the second part was allocated to a conference and round table about dugongs in New Caledonia (Figure 16). This conference was also an opportunity to thank the photo challenge participants with a small prize: an illustrated book about whales in New Caledonia (Garrigue & Greaves, 2002; see Annex 6.B). The conference was attended by about 50 people.

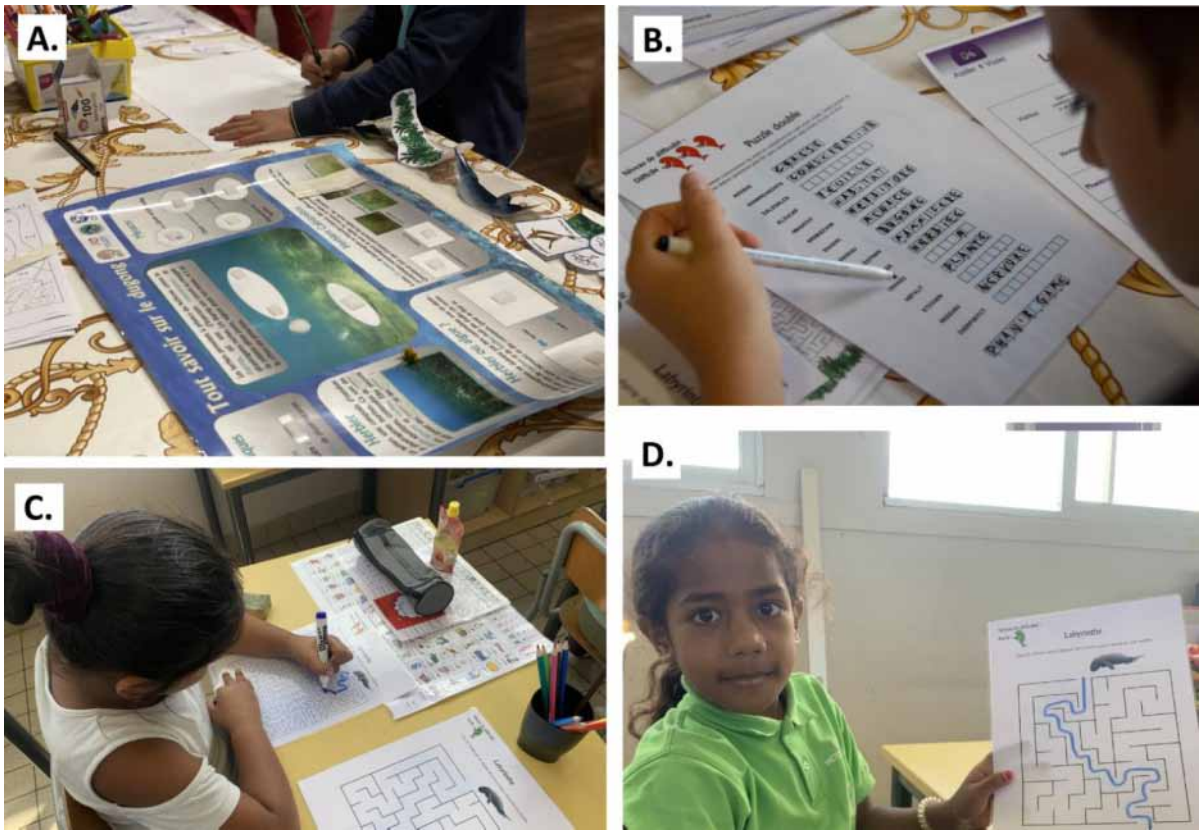


Figure 17. **Educational games.** A. **and** B. **At *the Maison de la Biodiversité*, sessions held every Wednesday afternoon during the month of May;** C. **and** D. **At Victorien Bardou School the 26/04/2022 (Photo credit: Karla Bussone and Magali Boussion).**

Figure 16. **Dugongs and habitat conference conducted the 12th of May at the MDB (Image right: Karla Bussone).**

5. Discussion and concluding remarks

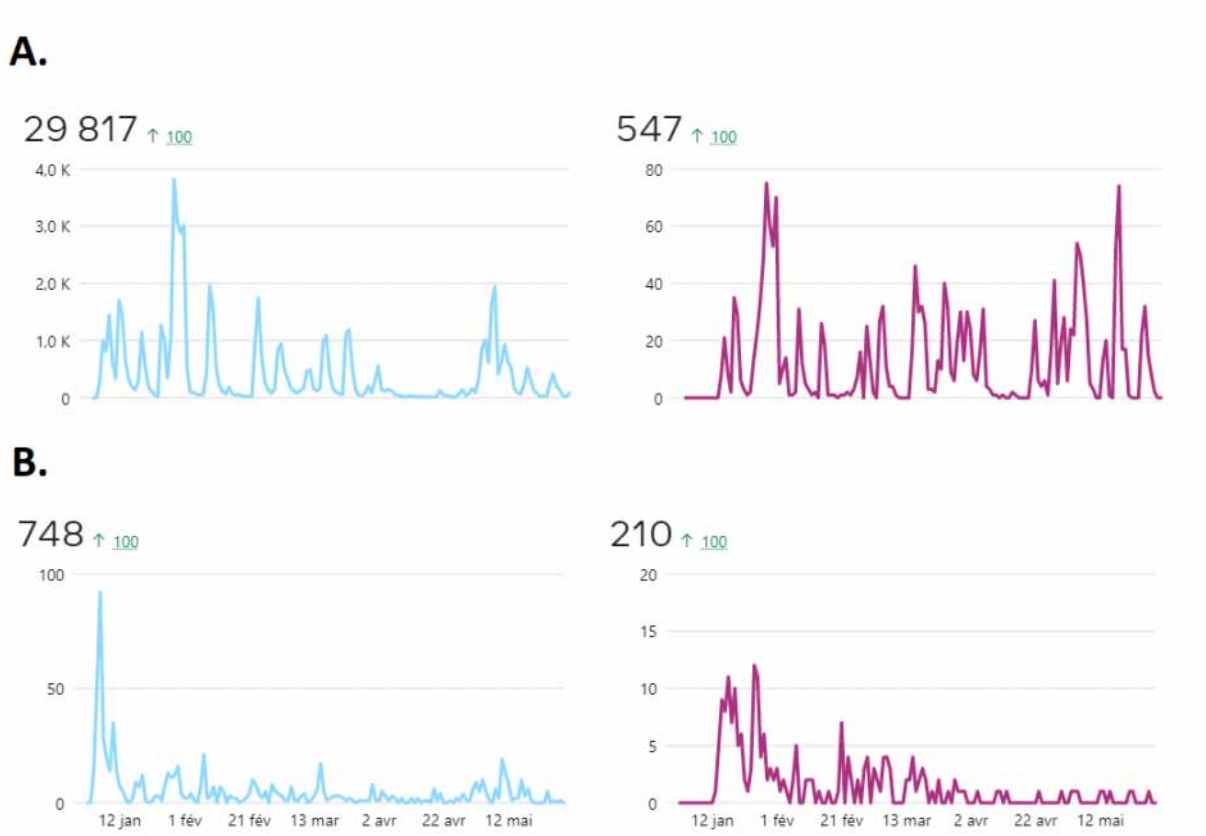
Participation rate in the seagrass photo contest by the general public was lower than expected. This may be explained by the fact that seagrass meadows are probably not as attractive as other lagoon habitats, and are less visited for leisure than coral and sand habitats. Also, while corals and mangroves are the objects of awareness campaigns since at least a decade, this was the first for seagrass and probably the interest will row if the same activity is repeated in the future. Regarding the public most likely to have an interest in seagrass meadows (*i.e*., underwater photographers or diving club divers), they usually seldom visit this type of habitat, or otherwise mostly focus on small macro fauna organisms (*e.g*., crustaceans, nudibranchs, seahorses) and not on seagrass species themselves. Therefore, most underwater photographers did not have any general view of seagrass meadows in their database, but only close up photographs. Should also be taken into account the fact that the participant must own underwater equipment and material to take pictures of seagrass habitat, which is not within everyone's reach. Importantly, due to the Covid crisis, the project had to be delayed and thus was launched shortly before the beginning of the school year, while it was programmed to happen during the summer holidays (*i.e*., mid-december to mid-february) in the first place. However, in spite of these limitations, we managed to collect a satisfactory number of seagrass photographs for a first event.

Concerning interactive youth activities (conducted at the MDB and in scholar institution), we feel that we successfully managed to target various communities and school grades, since we were able to work with about 600 children attending both public and private school, primary to high schools all around *Nouméa,* all neighborhoods confounded. We received numerous additional requests from teachers to visit their classes, but for budgetary and temporal reasons, we had to limit our school visits to *Nouméa*. However, it is of particular importance to note that we had demand from scholar institutions located in the North province of New Caledonia and Loyalty Islands province that we were not able to respond to. The documents created for the purpose of the project were judged appropriate, useful and fun to interactive with. All teachers (primary and high schools) were very satisfied with the intervention and some of them asked for the documents we used in classes, but also articles and references about dugongs and seagrass after our visit. Some of them wrote articles about the intervention and published it on their school website. A few of them mentioned in the satisfaction survey that they would be glad to deepen the knowledge of their students/ pupils with another intervention of this type. Most of the feedbacks provided by students were also very positive and valuable for our team, showing that this thematic, even if little known, may be of interest to the youngest, if well delivered. In most cases, unsatisfactory feedbacks were given by students who already had worked on this thematic before.

From a general point of view, we estimated that communications, broadcasts and advertisements on the project and its related events were efficient so that we were able to reach a large public and various communities in a limited time. Numerous institutions got involved and contributed to promote our work, which tended to raise the interest of local medias during the project.

Annex 1

A. Post reach and **B.** Visitors for Facebook account (blue) and Instagram account (purple) along the project period (January to May 2022).



Annex 2

Displays respectively compiling information about: **A.** The project; **B.** The photo contest and **C.** Seagrass meadows in New Caledonia**.**

A.

B.

C.

Annex 3

Poster presenting the project and its five main actions.

Projet Science en herbe

Le projet « **Science en herbe** » est porté par l'IRD en partenariat avec Opération Cétacés, et financé par la CMS (Convention de Bonn sur la conservation des espèces migratrices). Il valorise les **sciences participatives** en sensibilisant le grand public autour des **dugongs** et de leur habitat : les **herbiers** de phanérogames marines. Le programme se déroulera de janvier à mai 2022.

Concours photos

L'une des actions les plus importantes du programme est une contribution citoyenne visant à récolter des données via l'organisation d'un concours photos. L'opportunité est ainsi offerte au grand public de participer à la science en photographiant des herbiers marins et en envoyant les clichés à l'adresse e-mail : sc.enherbe.nc@gmail.com

La Nouvelle-Calédonie est le seul territoire français qui abrite une population viable de dugongs, mais leur survie est menacée.

Analyse participative

Afin d'aider et de se former à l'identification des espèces présentes sur les photographies reçues, des ateliers participatifs sont organisés avec des scolaires. L'aboutissement de ce travail permet ainsi de sensibiliser les plus jeunes et de les former à distinguer les espèces entres elles grâce à une clé de détermination et des fiches espèces.

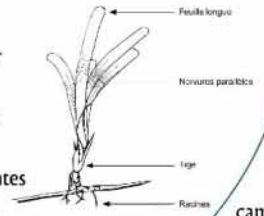
Communication

La campagne de communication est principalement focalisée sur les médias (presse, radio, télévision) et les réseaux sociaux, avec la création de profils Facebook, Instagram et Tweeter.

ScEnHerbe_nc
@ScienceEnHerbe.nc
Science-en-herbe

Tous les efforts doivent être entrepris pour sauvegarder les dugongs, notamment développer les actions de recensement des herbiers marins dont ils se nourrissent.

Les herbiers sont des prairies de plantes marines appelées phanérogames.



Elles possèdent des racines, des tiges, et des feuilles avec nervures, et peuvent avoir des fleurs.

Campagnes

Des relevés scientifiques sont organisés sur différents sites d'études autour de Nouméa. Le but de ces campagnes est de répertorier les espèces et les communautés d'herbiers qui y sont établies, et de faire des estimations de densité.

Restitution

La dernière action du programme permet de reprendre les différentes missions effectuées et d'en discuter via des conférences publiques ou des communiqués médiatiques. Elle permet également de sensibiliser à la conservation du dugong et son habitat grâce à une exposition des dix plus belles photographies reçues du grand public avec, à la clé, un prix à gagner pour le meilleur cliché.

M. Brisset, S. Andréfouët, J. Buttin, S. Derville, C. Garrigue, C. Payri.

Crédit photographies : @ird

IRD · ACTION DUGONG · DUGONG MOU · CMS

Annex 4

Media published at the launch of the project: **A.** Press articles written by LNC newspaper and **B.** Online article written by NC 1er.

A.

lnc.nc les Nouvelles Calédoniennes

175 746

CINÉMA
First cow, un western atypique

SÉRIE ÉTÉ
Vallée-du-Tir, une balade au cœur de la diversité calédonienne

Le DUGONG cherche à éviter l'homme

Selon une vaste étude, le mammifère développe des stratégies pour se protéger des activités humaines, en cause dans le déclin de l'espèce. P2-3

AMERICAN BBQ 2095

JUSTICE
Cinq ans de prison pour avoir défiguré un homme

ANTIVAX
L'un des leaders convoqué par la justice

SÉCURITÉ ROUTIÈRE
Radars nouvelle génération pour la police

INONDATIONS
Ras-le-bol à Ondemia

MESCAL ARRIVAGE IMPORTANT
AU PRIX EXCEPTIONNEL
3 300 FTTC
612 FTTC

B.

Mer

Un nouveau programme de science participative lancé cette année

Le projet de science participative Science en herbe vient d'être lancé. Porté par l'IRD en partenariat avec l'association Opération cétacés, il vise à sensibiliser les Calédoniens autour des dugongs et de leurs habitats. Le public est invité, durant six mois, à photographier les herbiers du lagon autour de Nouméa, en précisant la localisation. Ces contributions citoyennes permettront également de constituer des données précieuses pour les équipes scientifiques. Plus d'informations sur la page Facebook, ScienceEnHerbe.nc.

Annex 5

Local institutions and contributors that collaborated for the project promotion**.**

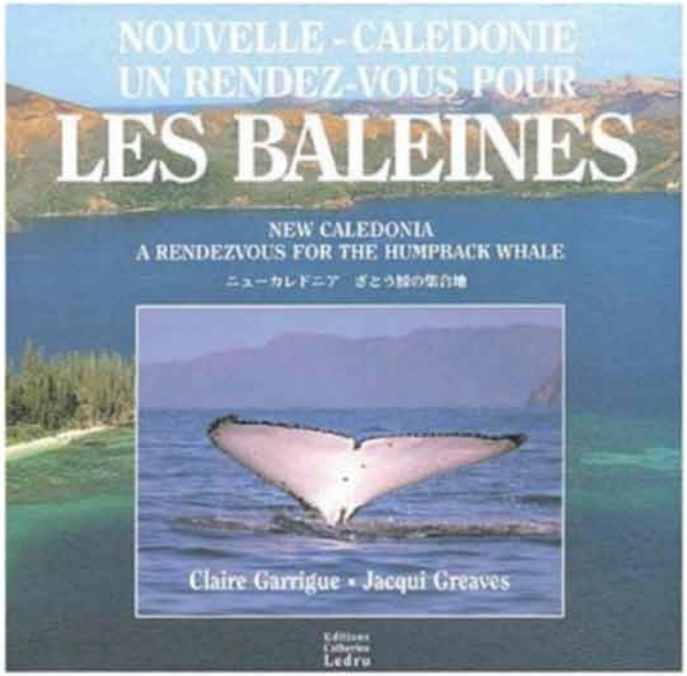
Name	Structure	Method of diffusion
Abysse	Diving centre	Paper display
Odyssey diving	Diving centre	Paper display
Amede diving club	Diving centre	Paper display
Hô-üt	Association	Facebook post
province sud	Public structure	Website and Facebook post
Maison de la biodiversité	Awarness structure	Paper display and videos
Cresica	Scientific public structure	Facebook post
Les plongeurs de Nouvelle Calédonie - SCUBA DIVE	Facebook group	Facebook post
PMT Nouvelle-Calédonie	Facebook group	Facebook post
Pop club	Associative Diving centre	Facebook post
Groupe de soutien aux Tortues Marines de la Roche Percée	Facebook group	Facebook post
Spearfishing NC - Le groupe	Facebook group	Facebook post
Conservatoire d'Espaces Naturels (CEN)	Environmental public structure	Facebook post
Centre d'initiation à l'environnement (CIE)	Environmental public structure	Paper display

Annex 6

Classroom gifts: **A.** Poster illustrating fact about dugongs and its protection in New Caledonia and **B.** An illustrated book about whales in New Caledonia.

A.

B.



Annex 7

A.

Questionnaire d'enquête auprès des enseignants : bilan de l'intervention Science en herbe

Quel niveau enseignez-vous, et combien d'élèves avez-vous dans votre classe ?

De manière générale, êtes-vous satisfait(e) de l'intervention ?

- ☐ Très satisfaisant
- ☐ Satisfaisant
- ☐ Peu satisfaisant
- ☐ Insatisfaisant

Sur une échelle de 1 à 5, trouvez-vous l'atelier réalisé en accord avec vos attentes ?

- ☐ Oui tout à fait
- ☐ Partiellement
- ☐ Pas vraiment

Les objectifs de l'atelier ont été atteints ?

- ☐ Oui tout à fait
- ☐ Partiellement
- ☐ Pas vraiment

Avez-vous trouvé l'intervention adaptée au niveau de la classe ?

- ☐ Oui tout à fait
- ☐ Partiellement
- ☐ Pas vraiment

Pensez-vous que vos élèves ont aimé cette intervention ?

- ☐ Oui tout à fait
- ☐ Partiellement
- ☐ Pas vraiment

Avez-vous des remarques dont vous souhaiteriez nous faire part ?

Quelle(s) suggestion(s) avez-vous à apporter pour améliorer ce type d'intervention ?

B.

Classe Date d'intervention

Questionnaire de satisfaction

1) L'intervention t'a paru … (entoure la ou les réponses correspondante(s)) :

Intéressante Ennuyeuse Inutile Instructive

2) Penses-tu avoir appris de nouvelles choses, coche la réponse qui te convient :

3) Coche les réponses qui te correspondent le mieux :

	Satisfaisant	Insatisfaisant
Durée de l'atelier		
Activités proposées (atelier pratique, discussion…)		
Apports d'information / Contenu de l'intervention		
Qualité de l'animation (écoute des intervenants…)		

Satisfaction surveys given after the intervention, designed for: **A.** Teachers and **B.** Students.

Annex 8

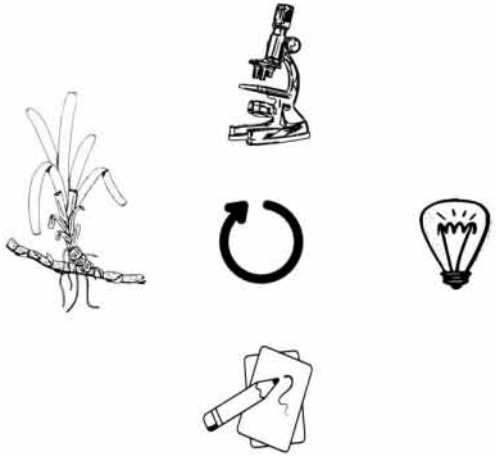
Documents used for the identification workshop: **A.** Personal leaflet to complete; **B.** Simplified identification key and **C.** Species identification sheets.

A.

Nom : .....
Prénom : .....
Classe : .....

Date : .....

Mon feuillet d'observations naturalistes :
les herbiers marins de Nouvelle-Calédonie



Complète :

Genre : .....
Longueur de la feuille (cm) : .....
Largeur de la feuille (cm) : .....

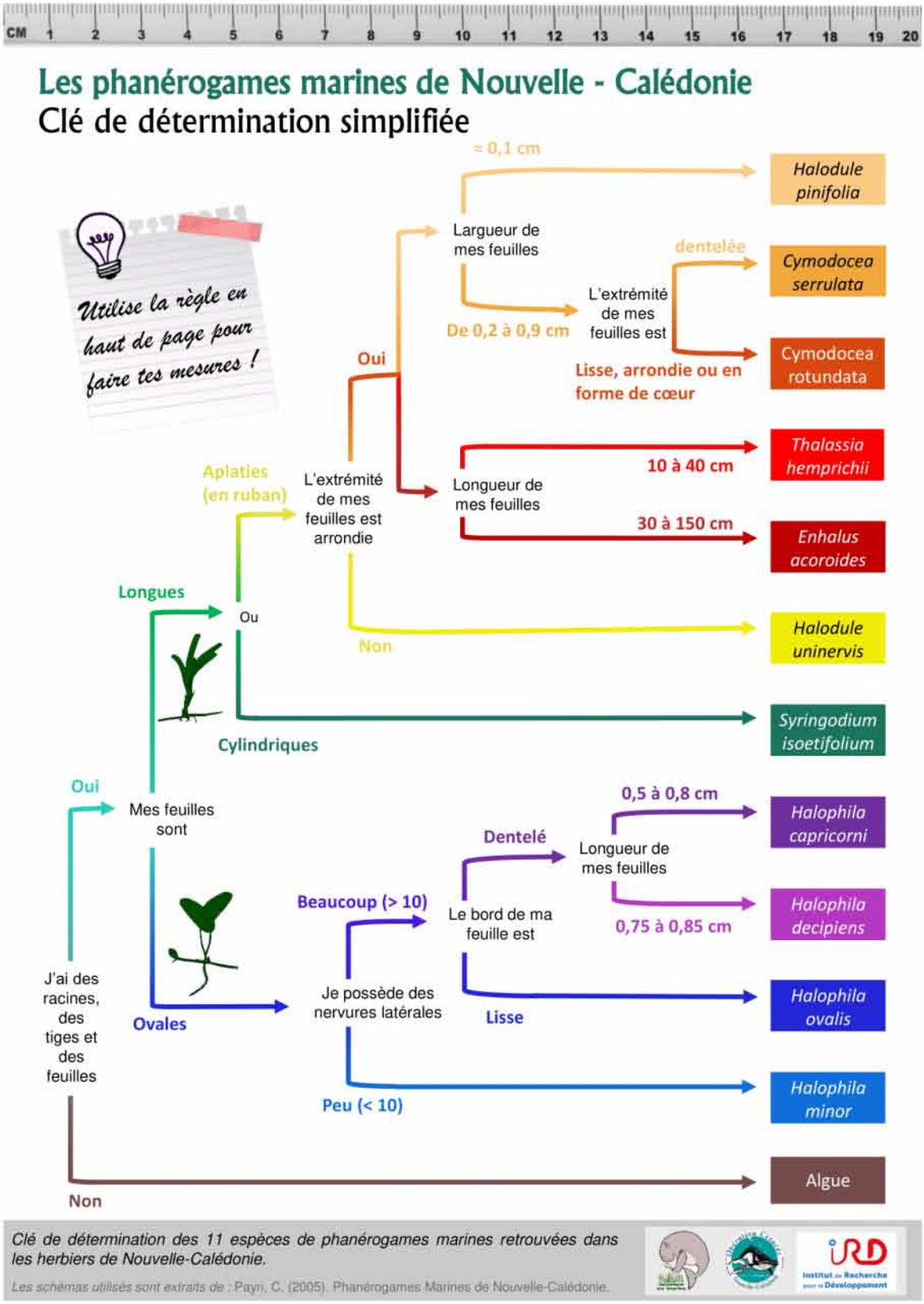
Coche la bonne option en fonction de l'échantillon que tu as choisi d'identifier :

Mon dessin a été réalisé sur la base de :
- ☐ Une photo
- ☐ Un échantillon frais
- ☐ Un échantillon sec

Dessine l'échantillon que tu as choisi. Sur ton dessin doivent figurer les mots légendés suivants : feuille, racine, tige, nervure (longitudinale, centrale, périphérique ou latérale).

Nom de l'espèce : .....

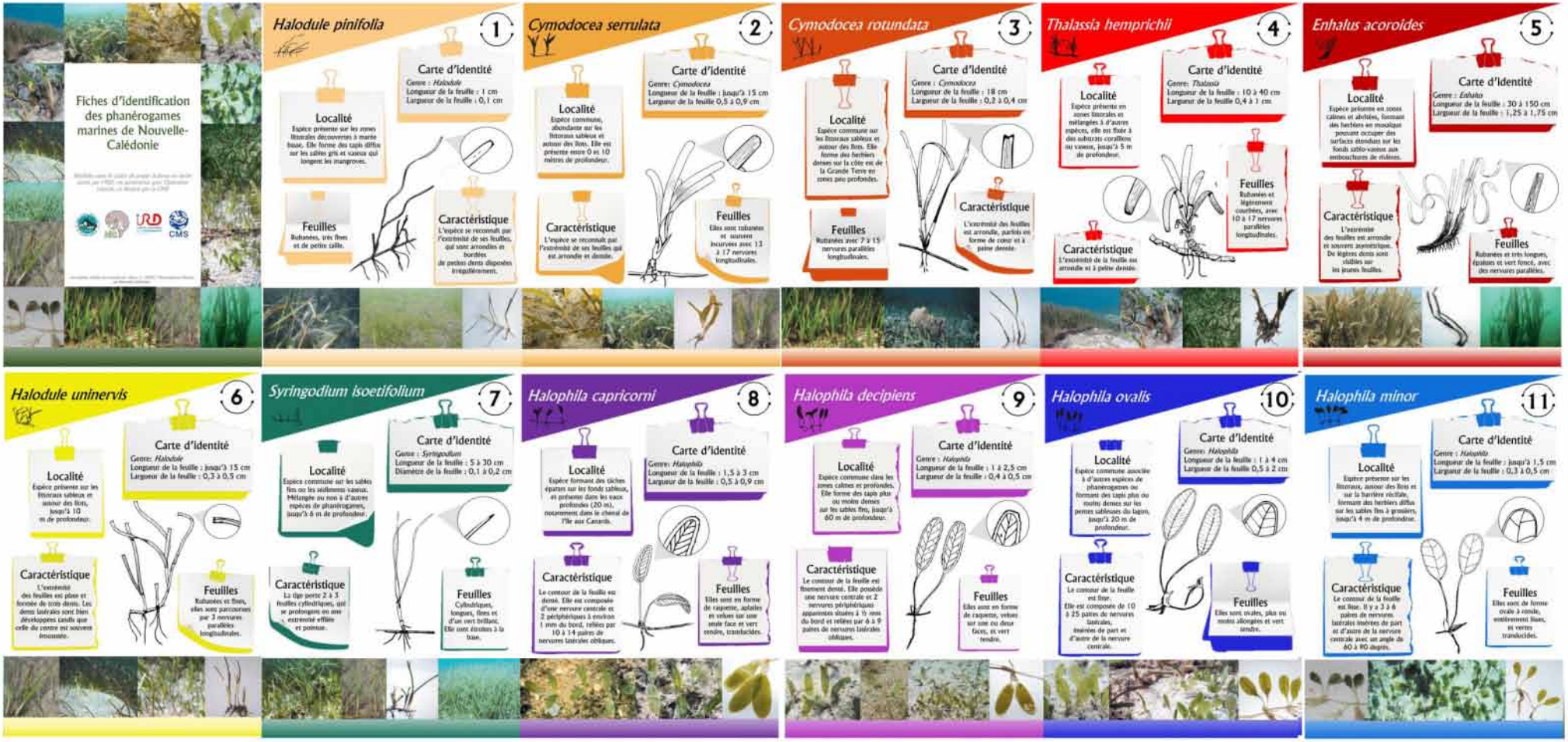
B.



Clé de détermination des 11 espèces de phanérogames marines retrouvées dans les herbiers de Nouvelle-Calédonie.

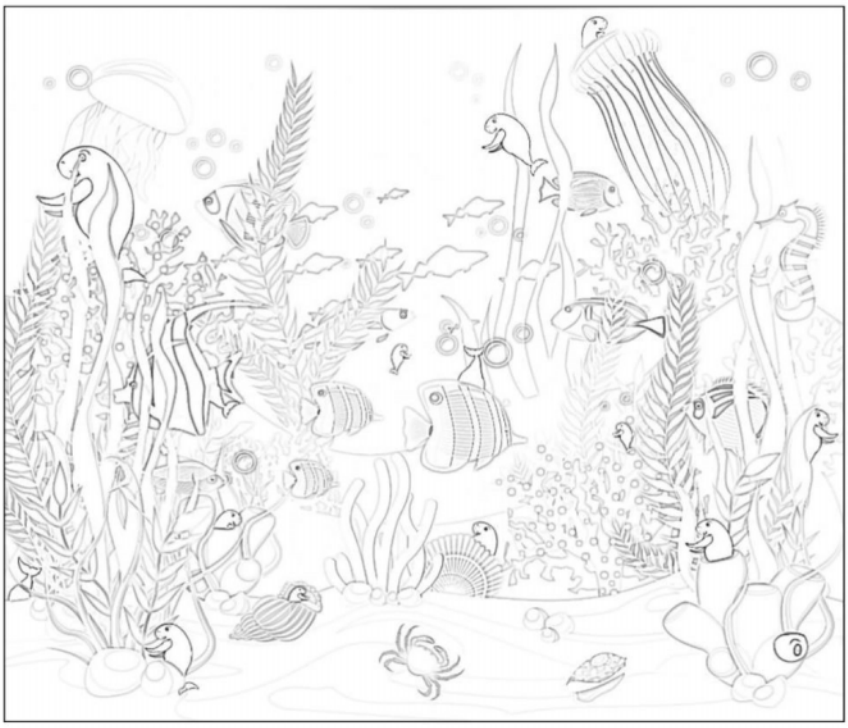
Les schémas utilisés sont extraits de : Payri, C. (2005). Phanérogames Marines de Nouvelle-Calédonie.

C.


Fiches d'identification des phanérogames marines de Nouvelle-Calédonie
IRD
CMS
Halodule pinifolia
1
Carte d'identité
Genre : Halodule
Longueur de la feuille : 1 cm
Largeur de la feuille : 0,1 cm
Localité
Espèce présente sur les zones littorales découvertes à marée basse. Elle forme des tapis diffus sur les sables gris et vaseux qui longent les mangroves.
Feuilles
Rubanées, très fines et de petite taille.
Caractéristique
L'espèce se reconnaît par l'extrémité de ses feuilles, qui sont arrondies et bordées de petites dents disposées irrégulièrement.
Cymodocea serrulata
2
Carte d'identité
Genre: Cymodocea
Longueur de la feuille : jusqu'à 15 cm
Largeur de la feuille 0,5 à 0,9 cm
Localité
Espèce commune, abondante sur les littoraux sableux et autour des îlots. Elle est présente entre 0 et 10 mètres de profondeur.
Caractéristique
L'espèce se reconnaît par l'extrémité de ses feuilles qui est arrondie et dentée.
Feuilles
Elles sont rubanées et souvent incurvées avec 13 à 17 nervures longitudinales.
Cymodocea rotundata
3
Carte d'identité
Genre : Cymodocea
Longueur de la feuille : 18 cm
Largeur de la feuille : 0,2 à 0,4 cm
Localité
Espèce commune sur les littoraux sableux et autour des îlots. Elle forme des herbiers denses sur la côte est de la Grande Terre en zones peu profondes.
Feuilles
Rubanées avec 7 à 15 nervures parallèles longitudinales.
Caractéristique
L'extrémité des feuilles est arrondie, parfois en forme de coeur et à peine dentée.
Thalassia hemprichii
4
Carte d'identité
Genre: Thalassia
Longueur de la feuille : 10 à 40 cm
Largeur de la feuille 0,4 à 1 cm
Localité
Espèce présente en zones littorales et mélangées à d'autres espèces, elle est fixée à des substrats coralliens ou vaseux, jusqu'à 5 m de profondeur.
Feuilles
Rubanées et légèrement courbées, avec 10 à 17 nervures parallèles longitudinales.
Caractéristique
L'extrémité de la feuille est arrondie et à peine dentée.
Enhalus acoroides
5
Carte d'identité
Genre : Enhalus
Longueur de la feuille : 30 à 150 cm
Largeur de la feuille : 1,25 à 1,75 cm
Localité
Espèce présente en zones calmes et abritées, formant des herbiers en mosaïque pouvant occuper des surfaces étendues sur les fonds sablo-vaseux aux embouchures de rivières.
Caractéristique
L'extrémité des feuilles est arrondie et souvent asymétrique. De légères dents sont visibles sur les jeunes feuilles.
Feuilles
Rubanées et très longues, épaisses et vert foncé, avec des nervures parallèles.
Halodule uninervis
6
Carte d'identité
Genre: Halodule
Longueur de la feuille : jusqu'à 15 cm
Largeur de la feuille : 0,3 à 0,5 cm
Localité
Espèce présente sur les littoraux sableux et autour des îlots, jusqu'à 10 m de profondeur.
Caractéristique
L'extrémité des feuilles est plate et formée de trois dents. Les dents latérales sont bien développées tandis que celle du centre est souvent émoussée.
Feuilles
Rubanées et fines, elles sont parcourues par 3 nervures parallèles longitudinales.
Syringodium isoetifolium
7
Carte d'identité
Genre : Syringodium
Longueur de la feuille : 5 à 30 cm
Diamètre de la feuille : 0,1 à 0,2 cm
Localité
Espèce commune sur les sables fins ou les sédiments vaseux. Mélangée ou non à d'autres espèces de phanérogames, jusqu'à 6 m de profondeur.
Caractéristique
La tige porte 2 à 3 feuilles cylindriques, qui se prolongent en une extrémité effilée et pointue.
Feuilles
Cylindriques, longues, fines et d'un vert brillant. Elle sont étroites à la base.
Halophila capricorni
8
Carte d'identité
Genre: Halophila
Longueur de la feuille : 1,5 à 3 cm
Largeur de la feuille : 0,5 à 0,9 cm
Localité
Espèce formant des tâches éparses sur les fonds sableux, et présente dans les eaux profondes (20 m), notamment dans le chenal de l'île aux Canards.
Caractéristique
Le contour de la feuille est denté. Elle est composée d'une nervure centrale et 2 périphériques à environ 1 mm du bord, reliées par 10 à 14 paires de nervures latérales obliques.
Feuilles
Elles sont en forme de raquette, aplaties et veinées sur une seule face et vert tendre, translucides.
Halophila decipiens
9
Carte d'identité
Genre : Halophila
Longueur de la feuille : 1 à 2,5 cm
Largeur de la feuille : 0,4 à 0,5 cm
Localité
Espèce commune dans les zones calmes et profondes. Elle forme des tapis plus ou moins denses sur les sables fins, jusqu'à 60 m de profondeur.
Caractéristique
Le contour de la feuille est finement denté. Elle possède une nervure centrale et 2 nervures périphériques apparentes situées à ½ mm du bord et reliées par 6 à 9 paires de nervures latérales obliques.
Feuilles
Elles sont en forme de raquette, veinées sur une ou deux faces, et vert tendre.
Halophila ovalis
10
Carte d'identité
Genre: Halophila
Longueur de la feuille : 1 à 4 cm
Largeur de la feuille 0,5 à 2 cm
Localité
Espèce commune associée à d'autres espèces de phanérogames ou formant des tapis plus ou moins denses sur les pentes sableuses du lagon, jusqu'à 20 m de profondeur.
Caractéristique
Le contour de la feuille est lisse. Elle est composée de 10 à 25 paires de nervures latérales, insérées de part et d'autre de la nervure centrale.
Feuilles
Elles sont ovales, plus ou moins allongées et vert tendre.
Halophila minor
11
Carte d'identité
Genre : Halophila
Longueur de la feuille : jusqu'à 1,5 cm
Largeur de la feuille : 0,3 à 0,5 cm
Localité
Espèce présente sur les littoraux, autour des îlots et sur la barrière récifale, formant des herbiers diffus sur les sables fins à grossiers, jusqu'à 4 m de profondeur.
Caractéristique
Le contour de la feuille est lisse. Il y a 3 à 6 paires de nervures latérales insérées de part et d'autre de la nervure centrale avec un angle de 80 à 90 degrés.
Feuilles
Elles sont de forme ovale à ronde, entièrement lisses, et vertes translucides.

Annex 9

Colourings templates.

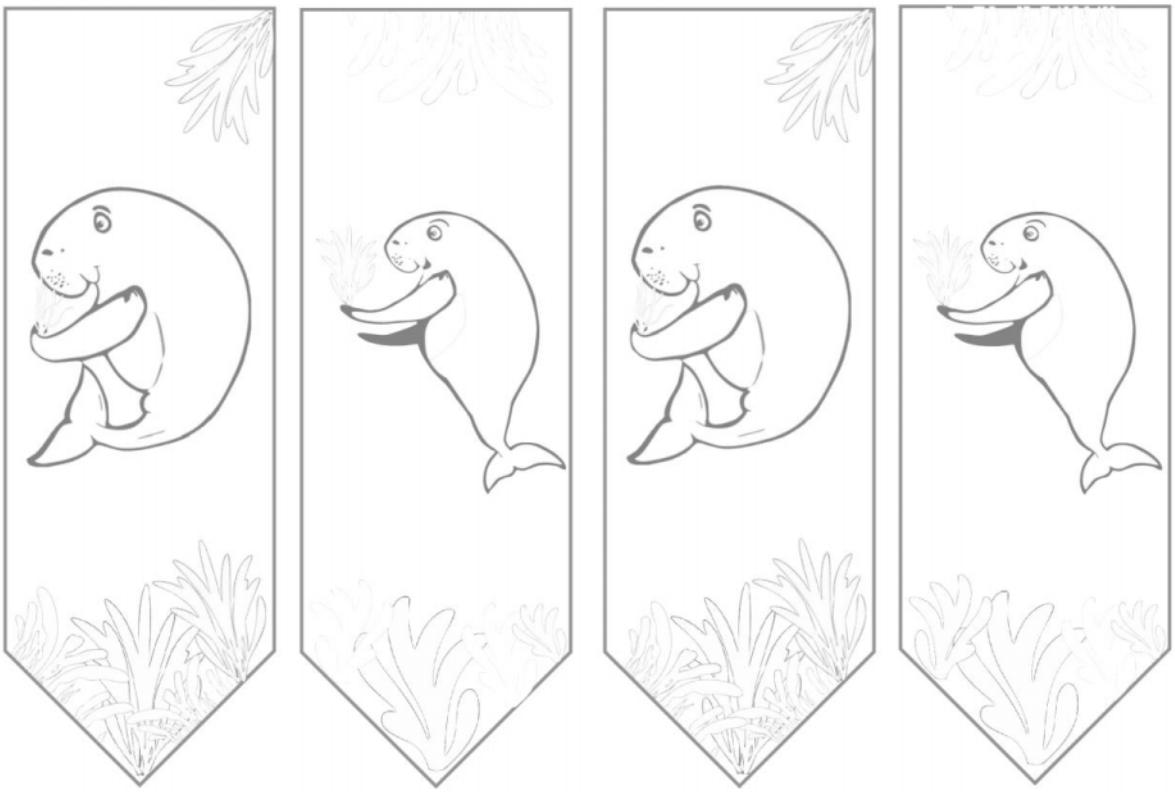


Colorie ce dessin de fond sous-marin. Attention, des dugongs s'y sont dissimulés, pourras-tu tous les retrouver ? Si oui, complète la phrase suivante :

''J'ai retrouvé les

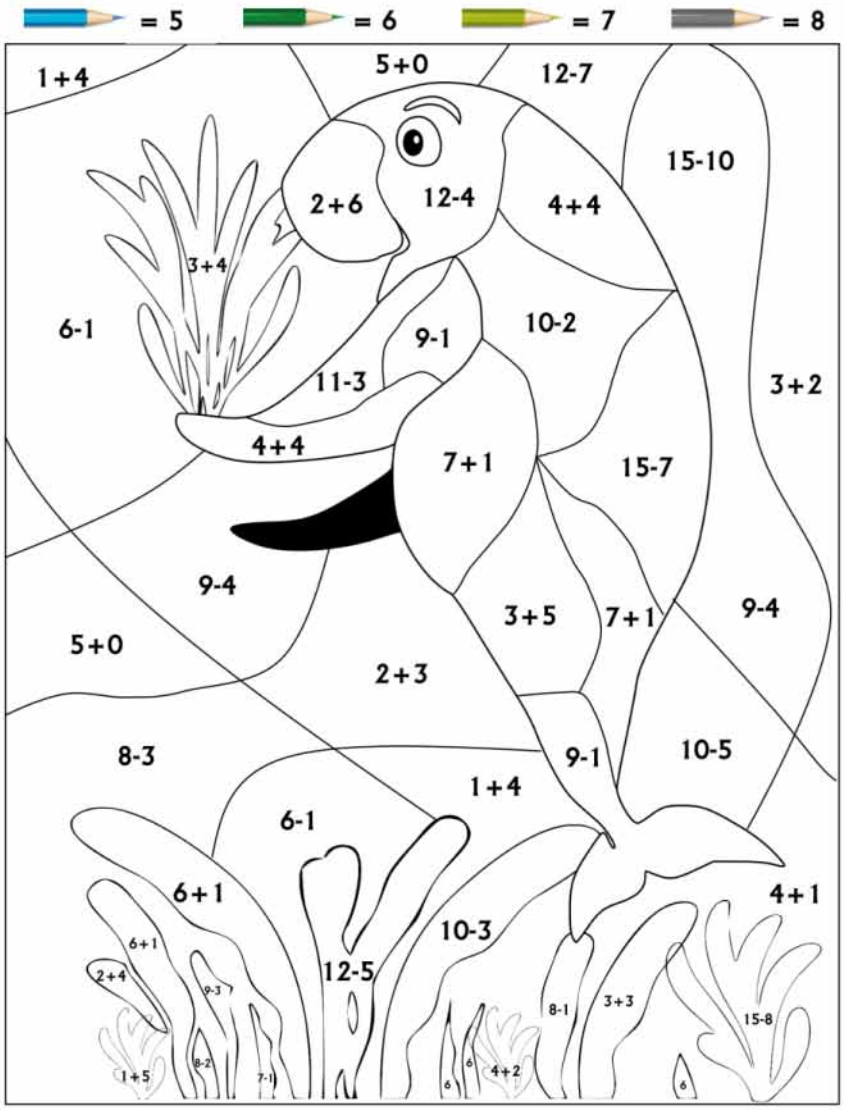
---

dugongs présents sur mon dessin''



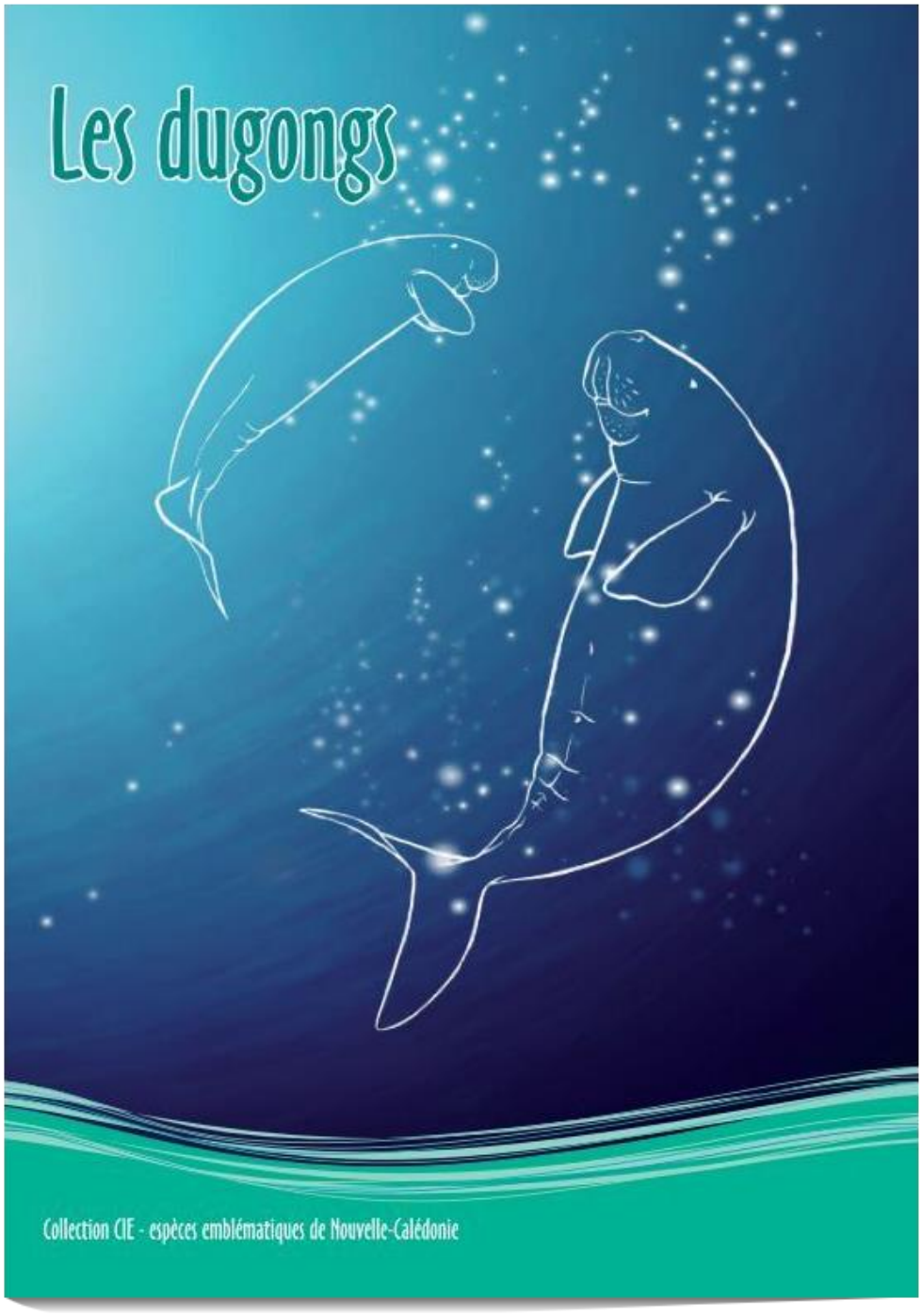
L..... D..... G..... ..... G

Coloriage magique



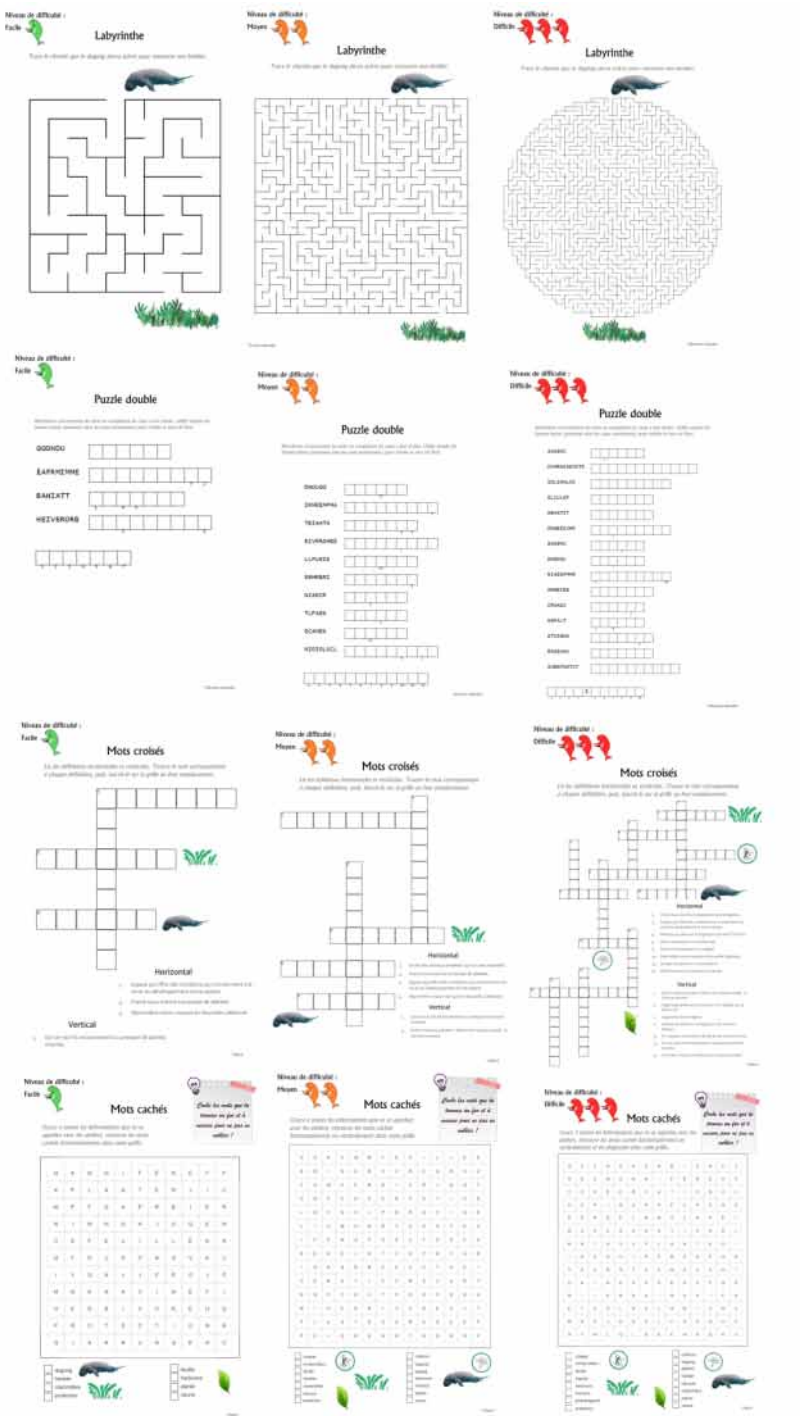
Annex 10

Reading workshop book.



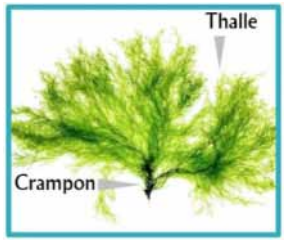
Annex 11

Educational games created in the purpose of the project: level of difficulty indicated by the colour of the dugong located up left. Red: difficult, orange: medium and green: easy.



Annex 12

Poster puzzle game to complete (interactive activities).



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