

Chaired by **PROF. DR. MICHAEL WINK**



Beware of oysters. Rapid advance of non-native species in tropical Pacific islands

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Abstract:

Coral reefs are usually robust, dynamic and balanced ecosystems; but there are situations in which this balance can be quickly and easily thrown out of whack. Marine biological invasions are one of the main causes of biodiversity losses, and ports are main entry gates of exotic biota, principally through biofouling and ballast water. Since eradication is more difficult in late than in early invasion stages, early detection of first stages of invasion is essential in conservation biology policy. The main problem is that most species are difficult to detect, especially during early developmental stages, and new strategies are needed to effective prevention and early detection of nuisance organisms.

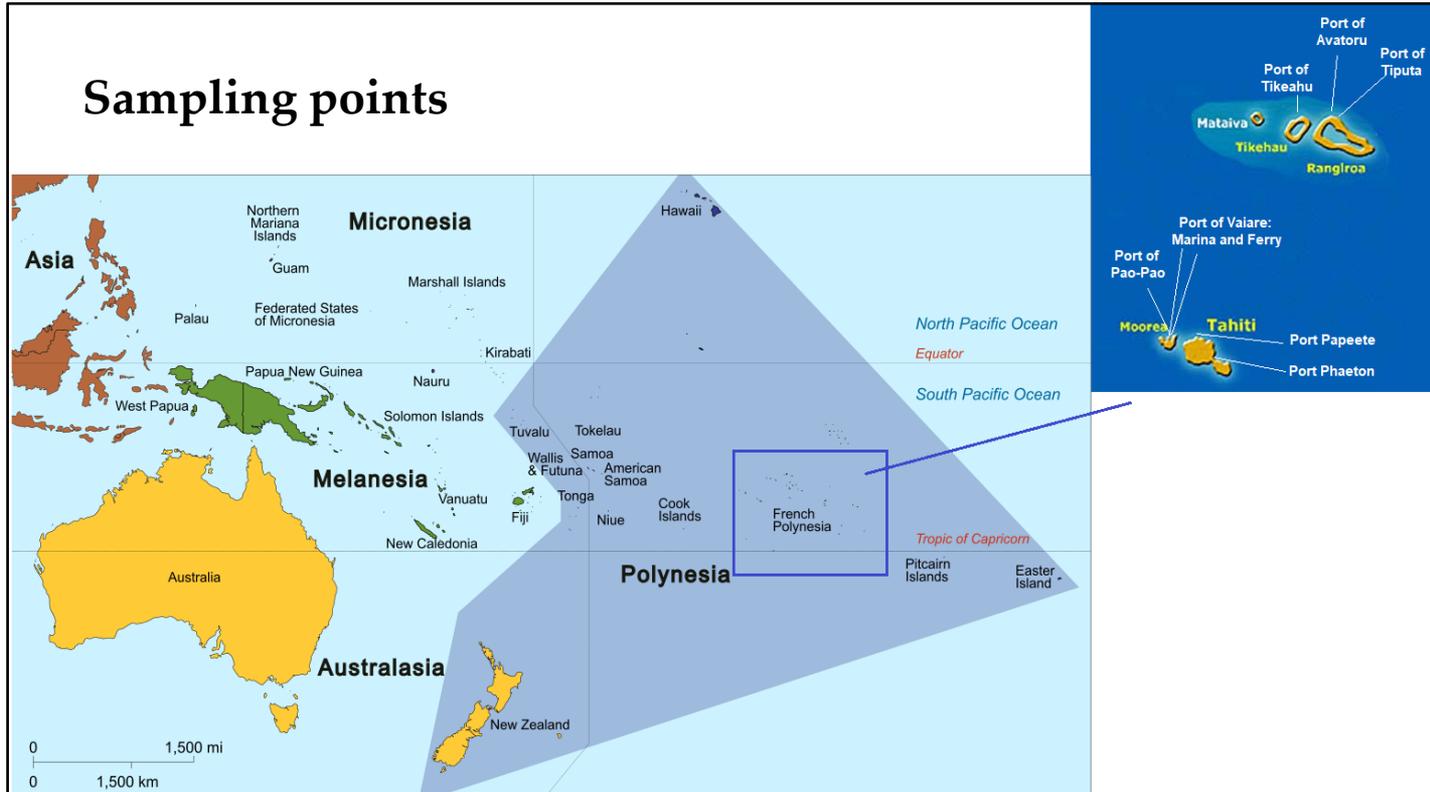
The principal aim of this work is the development of an early detection, monitoring and control protocol for benthonic NIS in Polynesian ports in order to see the evolution of invasive oyster species. Two exotic species were identified in different years: the Natal rock oyster and the Frond oyster. The Frond oyster (*Dendostrea frons*) was detected only in the three ships sampled in Port of Papeete in 2011, however, in 2018 this oyster was present into the port of Papeete and in Vaiare Ferry and Marina. On the other hand, the Natal rock oyster (*Saccostrea cucullata*) was present only in Pao-Pao port in Moorea Island in 2011, and in Pao-Pao, Vai'are Ferry and Port of Papeete in 2018.

Keywords:

Barcoding; NIS; benthonic species; French Polynesia;
monitoring; early detection.

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Material and Methods



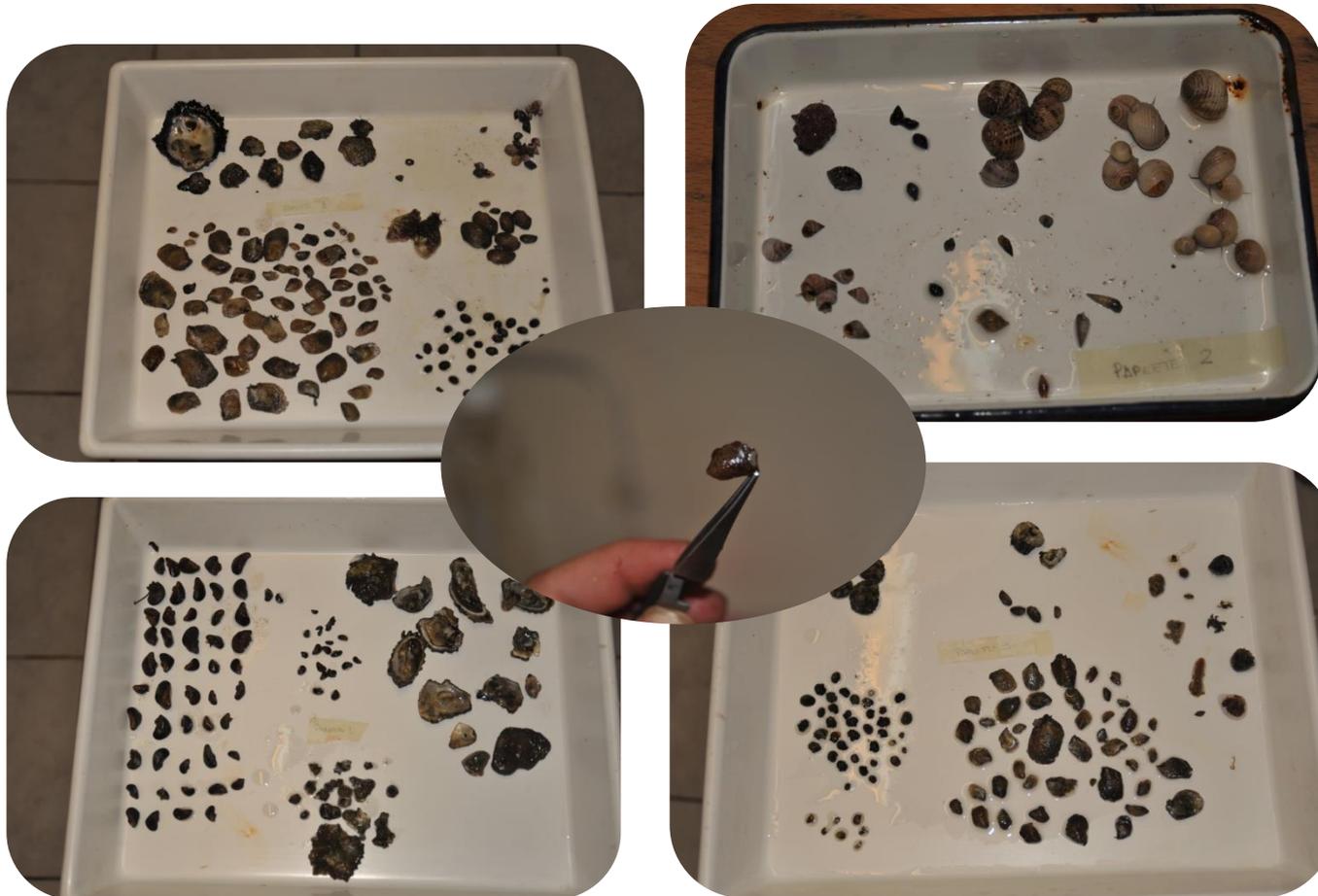
Material and Methods

Sampling was carried out picking (at random within species) oyster specimens.

An effort was made for obtaining representative samples, proportional to the abundance of each species.

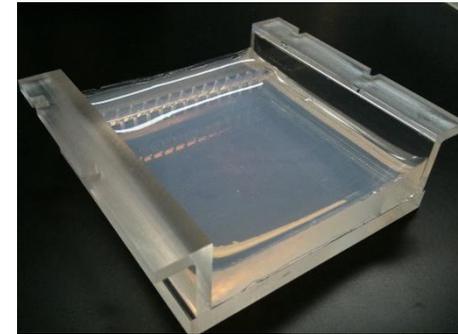
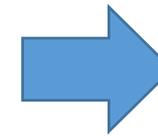
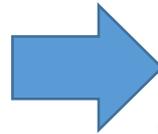


Material and Methods

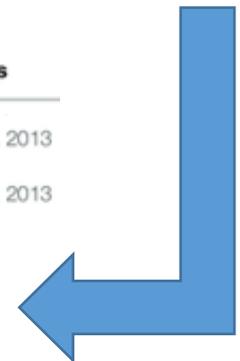
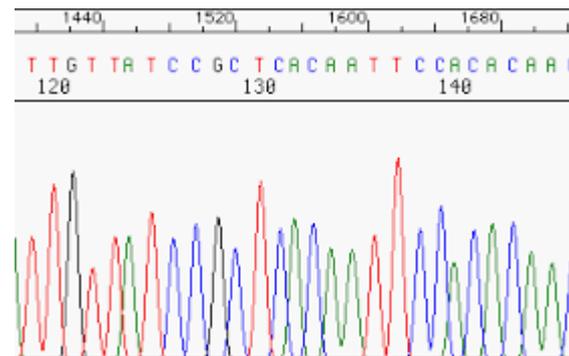
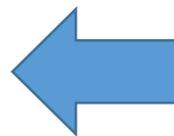


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Material and Methods



PrimerName	Direction	Sequence 5'-3'	References
igLCO1490	Forward	TITCIACIAAYCAYAARGAYATTGG	Geller et al., 2013
igHCO2198	Reverse	TAIACYTCIGGRTGICCRARAAYCA	Geller et al., 2013

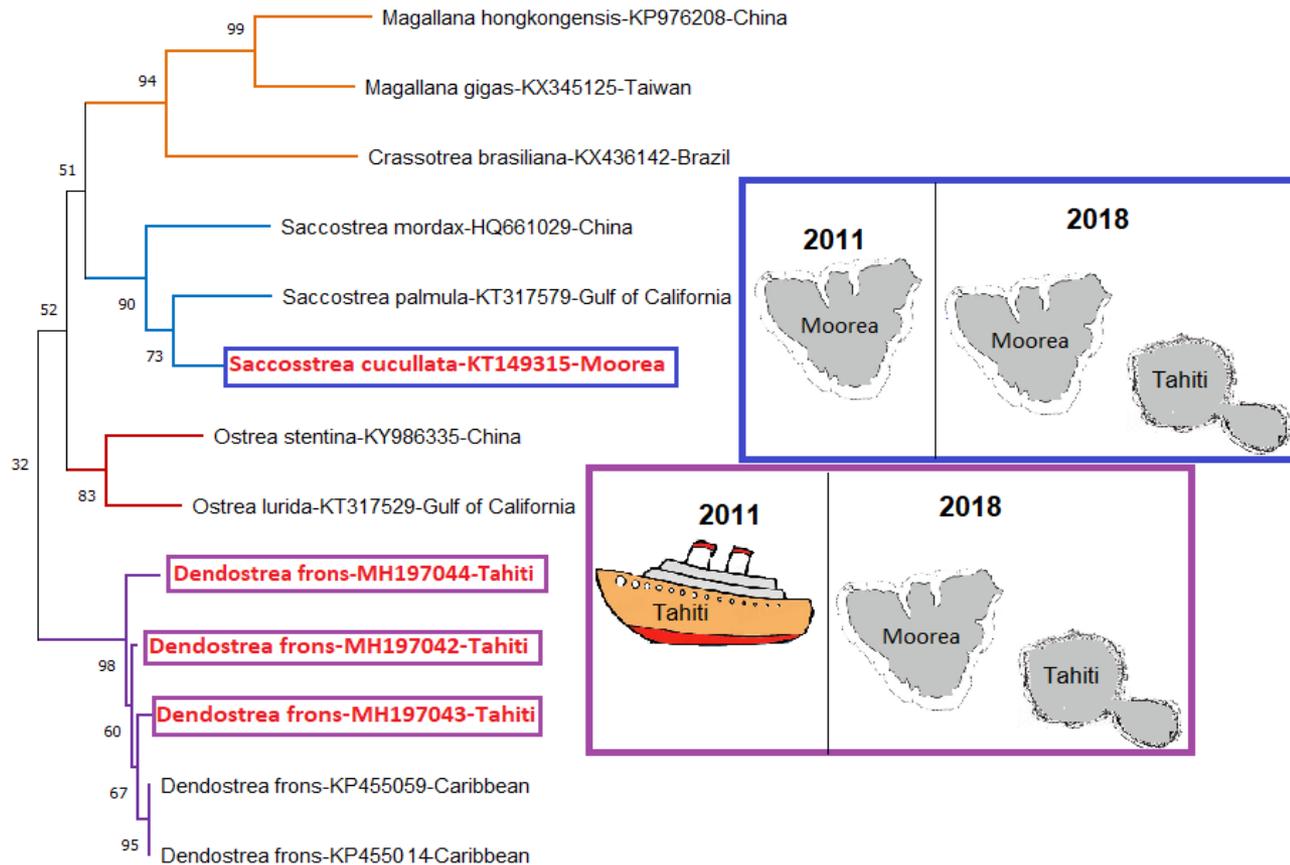


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Results and Discussion

	ORIGIN	MOOREA ISLAND			TAHITI ISLAND		RANGIROA ATOLL		TIKEHAU ATOLL	TOTAL
		VAI'ARE MARINA	VAI'ARÉ FERRY	PAO-PAO	PAPEETE	PHAETON	AVATORU	TIPUTA	TIKEHAU PORT	
<i>Alectryonella plicatula - 2018</i>	Native	0	0	0	0	0	9	0	0	9
<i>Dendostrea sandvichensis - 2018</i>	Native	0	0	0	1	0	0	0	0	1
<i>Dendostrea frons - 2018</i>	Central	10	1	0	3	0	0	0	0	14
<i>Dendostrea frons - 2011</i>	America	0	0	0	3	-	-	-	-	3
<i>Isognomon nucleus - 2018</i>	Native	0	8	1	0	0	0	0	19	28
<i>Isognomon perna - 2018</i>	Native	0	0	0	3	0	0	0	16	19
<i>Pinctada maculata - 2011</i>	Native	0	0	0	26	-	-	-	-	26
<i>Saccostrea cucullata - 2018</i>	SE Africa	0	3	15	8	18	0	0	0	44
<i>Saccostrea cucullata - 2011</i>		0	0	9	0	-	-	-	-	9
										153

Results and Discussion



Results and Discussion

- In total, 153 oyster samples were analysed: 38 in 2011 and 115 in 2018, corresponding to seven species.
- Two exotic oyster species were identified in this study:
 - Natal rock oyster *Saccostrea cucullata* – native to the Indian Ocean and the Red Sea-
 - Frond oyster *Dendostrea frons* – native to Caribbean Sea.
- These two species are catalogued as invasive species in the Mediterranean Sea.



Results and Discussion

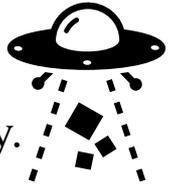
- *D. frons*
 - **2011**: present in **TAHITI** (on three ships docked in Port of Papeete).
 - **2018**: present in **TAHITI** (into the port of Papeete) and in **MOOREA** (in Vai'are ferry station and marina).
- *S. cucullata*
 - **2011**: present in **MOOREA** (port of Pao-Pao).
 - **2018**: present in **MOOREA** (port of Pao-Pao, Vai'are ferry station) and in **TAHITI** (port of Papeete and port of Phaeton).
- Comparing the proportion of the different species of oysters found in French Polynesian samples of 2011 and 2018:

**A clear increase of alien species was found in 2018,
that was significantly different:**

($\chi^2 = 17.411$, $p = 3.01 \cdot 10^{-5}$, d.f. = 1, Monte Carlo $p = 0.0001$).

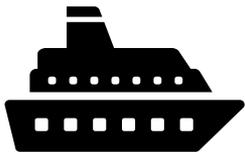
Conclusions

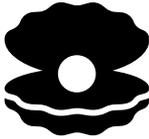
- This study demonstrates that several islands of French Polynesia are experiencing an increase of the proportion of exotic oyster species that are invasive in other regions.
- Species found in 2011 only in Tahiti are now present in Moorea, and reciprocally.
 - *D. frons* was detected and genetically ascertained for the first time in 2011 (Garcia-Vazquez et al., 2020).
 - *S. cucullata* had been cultured in French Polynesia and was described in samples taken from natural rocks in 2009 (Tröndle and Boutet, 2009).
 - None of these species appears in French Polynesia in the geographic distribution described in the World Register of Marine Species in 2021.
 - The relatively high variability of *D. frons*, with three haplotypes detected, would suggest multiple introduction hits.



Conclusions

- It is also important to highlight the presence of *A. plicatula* in the Rangiroa atoll. It had not been recorded in previous inventories in French Polynesia (Tröndle and Boutet, 2009) and it is not described in the World Register of Marine Species and the IUCN Red List for this area.
- The proportion of non-indigenous individuals increasing significantly in only seven years to the detriment of native species.
- Significant differences were found in the composition of foreigners versus natives between 2011 and 2018.
- The importance of maritime transport in the dispersal of exotic species and the impact that these species have on native communities is strongly suggested from our data.



The presence of new oysters 
in remote ecosystems supports this hypothesis,
since it is the only possible gateway for them.

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