"Tetiaroa Atoll Restoration Program", UCB Gump station, Moorea, 30 March 2023

Forest dynamics in the atoll of Tetiaroa after rat eradication

5 years (2018-2022) monitoring of plant recruitment on Motu Reiono

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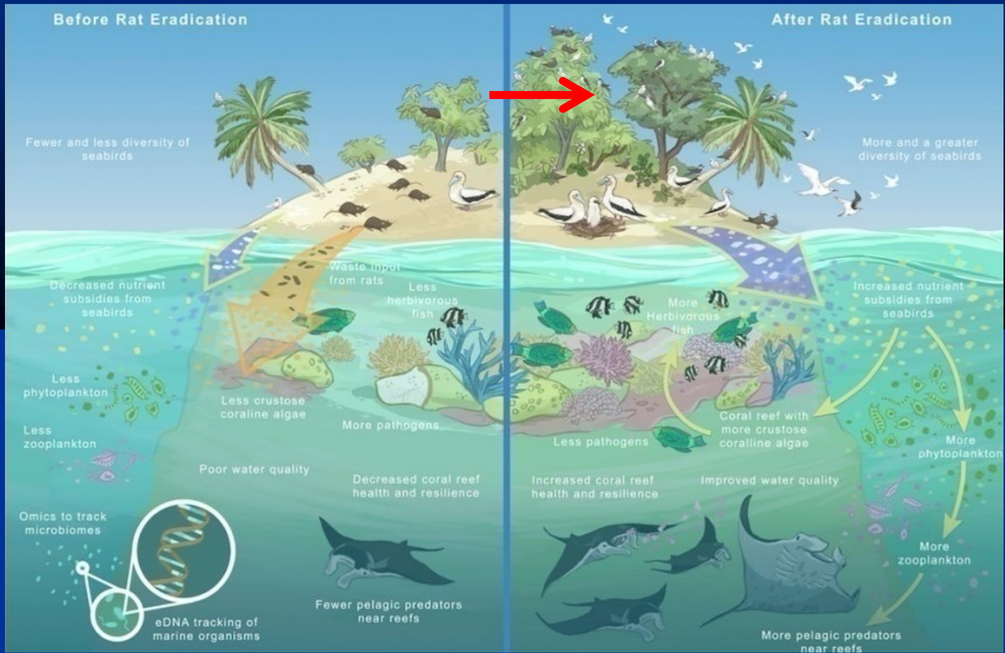
Forest ecosystem trajectories: *where do we go ?*



(VEGA-THURBER *et al.*, unpubl ished)

Pisonia grandis forest (Reiono)

?

Rat-free motu (‘A’ie)

?

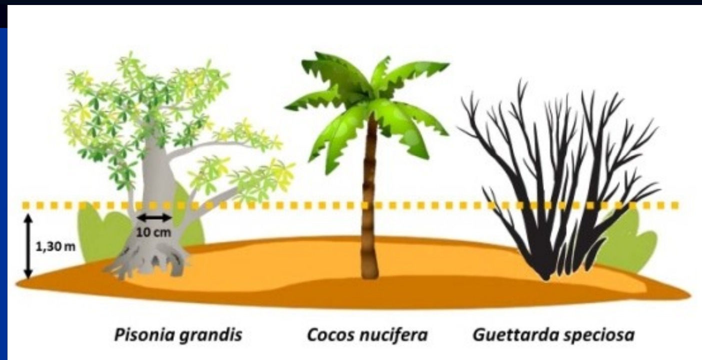
Rat-free atoll of Morane (Tuamotu-Gambier)

Protocol

- **Motu Reiono (22 ha)**
- **10 permanent plots (490m² each)**

In Palmyra atoll, only three types of forests were recognized according to the coconut tree cover based on basal area (BA) : « *High Cocos* » (>75% of the total BA), « *Low Cocos* » (<25%) et « *Intermediate Cocos* » (between 25-75%) (YOUNG *et al.* 2010, WOLF *et al.* 2018).

Satellite image of Motu Reiono (Pleiades 2014, © IDEA-ETH Zurich) with the location of the 10 study plots (courtesy of Benoît STOLL, Université de la Polynésie française - UPF)



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➢Forest description and classification

Table 1. Forest composition and woody species cover in the circular plots (CP) according to the number of trees and stems (DBH > 10 cm) and Basal Area (cm²/m² or m²/ha). Piso.= *Pisonia grandis*; Coco. = *Cocos nucifera* ; Pand. = *Pandanus tectorius* ; Guet. = *Guettarda speciosa* ; Helio. = *Heliotropium arboreum* (syn. *H. foertherianum*)

Circular plot	Number of trees	Number of stems	Total Basal Area	BA Piso.	BA Coco.	BA Pand.	BA Guet.	BA Helio.
CP1	23	38	70,65	68,96	1,69	0	0	0
CP2	28	38	94,50	80,44	14,06	0	0	0
CP3	30	40	59,64	57,23	2,42	0	0	0
CP4	31	32	64,72	19,35	45,36	0	0	0
CP5	40	50	41,04	23,74	3,66	3,78	3,45	6,42
CP6	43	50	100,50	91,72	8,78	0	0	0
CP7	33	45	73,90	62,16	9,14	0	2,60	0
CP8	31	43	32,83	18,70	4,63	5,43	4,08	0
CP9	31	40	47,73	39,32	6,21	0	2,20	0
CP10	33	41	76,67	42,74	33,93	0	0	0
Total	**323**	**417**	**662,18**	**504,36**	**129,88**	**9,21**	**12,33**	**6,42**
Density/ha	**659**	**851**	-	-	-	-	-	-

Pandanus tectorius forest

Guettarda speciosa forest

Table 2. Forest classication according to the % basal area of each taxa

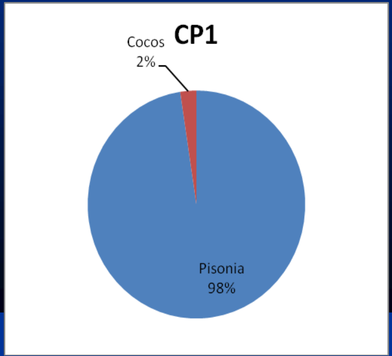
Forest type	%BA of taxa
Forest dominated by X (« *X dense forest* »)	X>75%
Forest codominated by X and Y (« *X-Y dense forest* »)	30%<X<75% and 30%<Y<75% and X-Y<10%
Mixed forest dominated by X (« *Mixed X forest* »)	30%<X<75% and X> all other taxa
Mixed forest dominated by X with Y (« *Mixed X forest with Y* »)	Y>25% and X-Y>10%
With Z uncommon	10%<Z<25%
With V rare	5%<V<10%
With W very rare	W < 5%

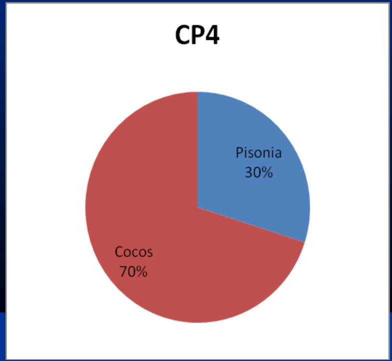
Table 3. Description of the different habitat types based on forest classification

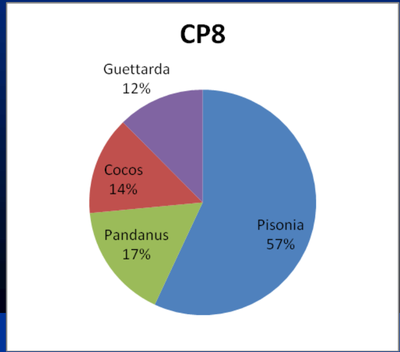
Plot/Transect	Habitat/forest type
CP1/TR1	*Pisonia* dense forest with *Cocos* very rare
CP2/TR2	*Pisonia* dense forest with *Cocos* uncommon
CP3/TR3	*Pisonia* dense forest with *Cocos* very rare
CP4/TR4	Mixed *Cocos* with *Pisonia*
CP5/TR5	Mixed *Pisonia* forest with *Heliotropium* uncommon and *Pandanus, Cocos, Guettarda* rare
CP6/TR6	*Pisonia* dense forest with *Cocos* rare
CP7/TR7	*Pisonia* dense forest with *Cocos* uncommon
CP8/TR8	Mixed *Pisonia* forest with *Pandanus, Cocos, Guettarda* uncommon
CP9/TR9	*Pisonia* forest with *Cocos* uncommon and *Guettarda* rare
CP10/TR10	*Pisonia-Cocos* dense forest

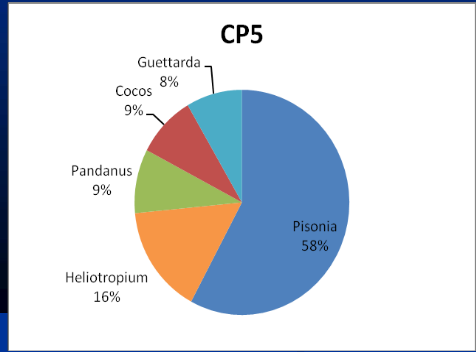
TR8: *Pisonia-Pandanus-Cocos-Guettarda* mixed forest

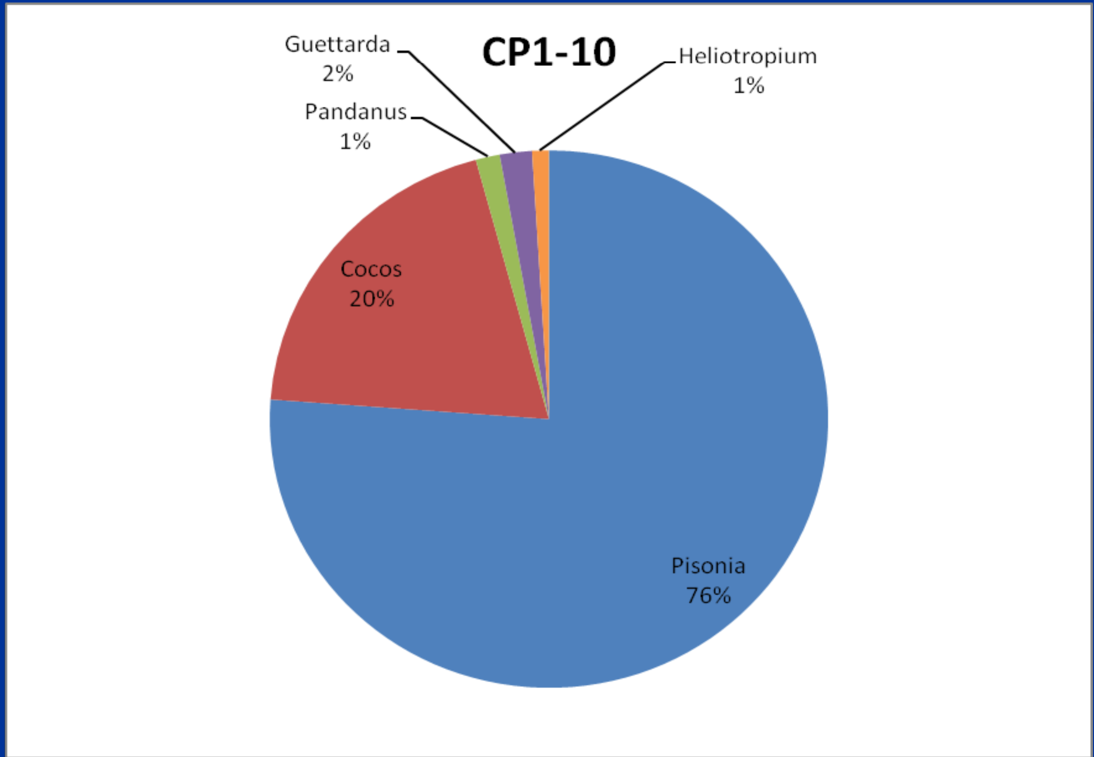
Figures. Examples of woody species abundance (%BA) in different circular plots (CP)





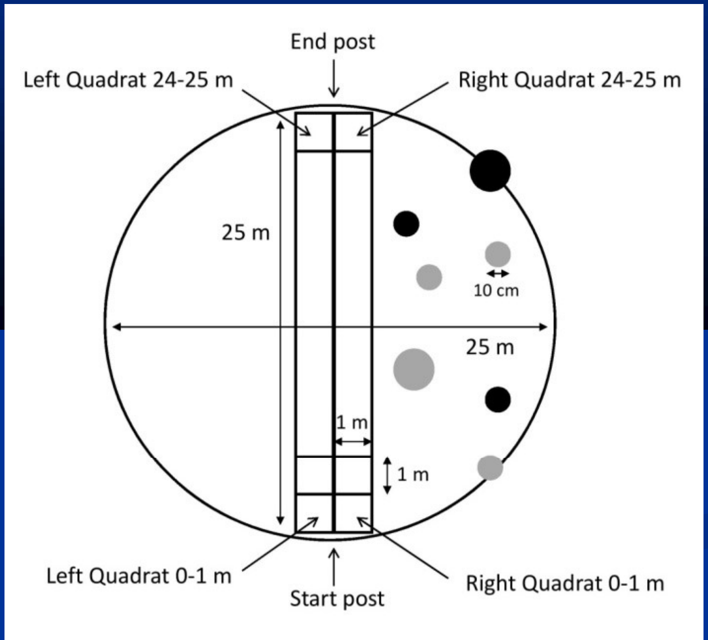






Protocol

- 10 permanent transects (25 m long)
- 50 quadrats/transects (1 m²)
- Coconut and woody species seedlings (< 30 cm tall)




2019

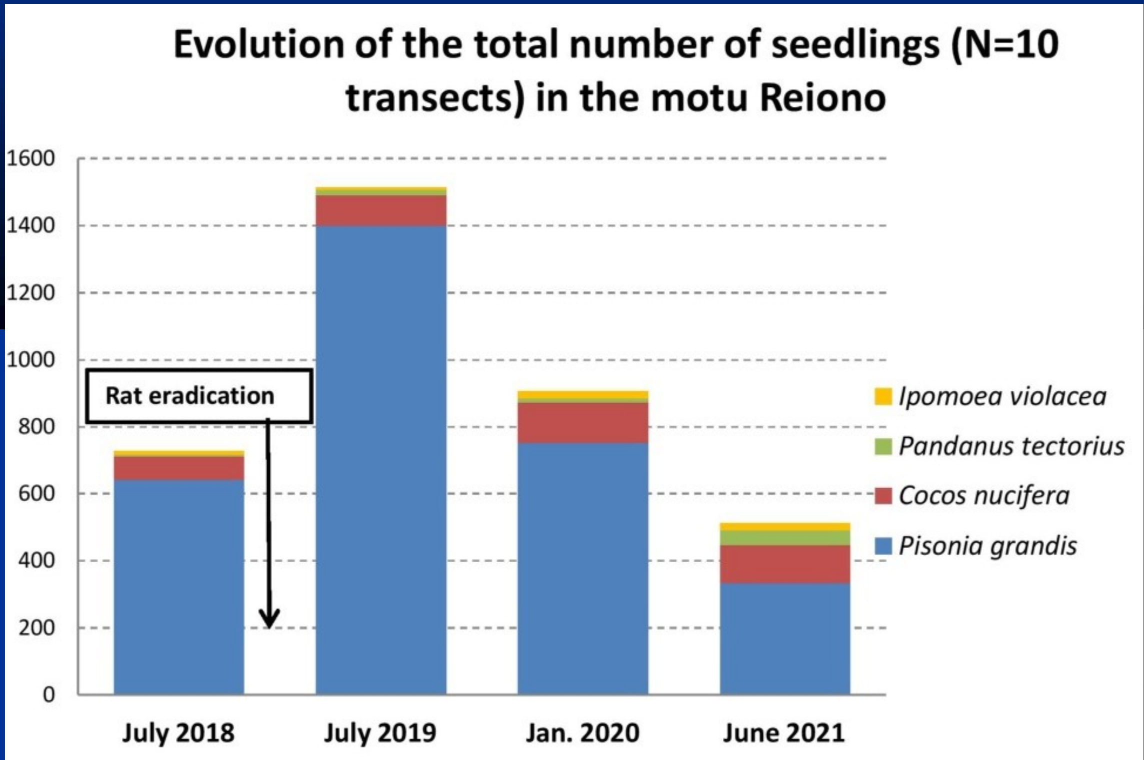

2020


2021


2022 ('A'ie)


2023 (Auroa)

Results



Pisonia grandis

Pandanus tectorius

Ipomoea violacea

Guettarda speciosa

Cocos nucifera

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TR3: *Pisonia* dense forest


2019

→


2021

→


2022

TR9: *Pisonia-Cocos-Guettarda* mixed forest


2018

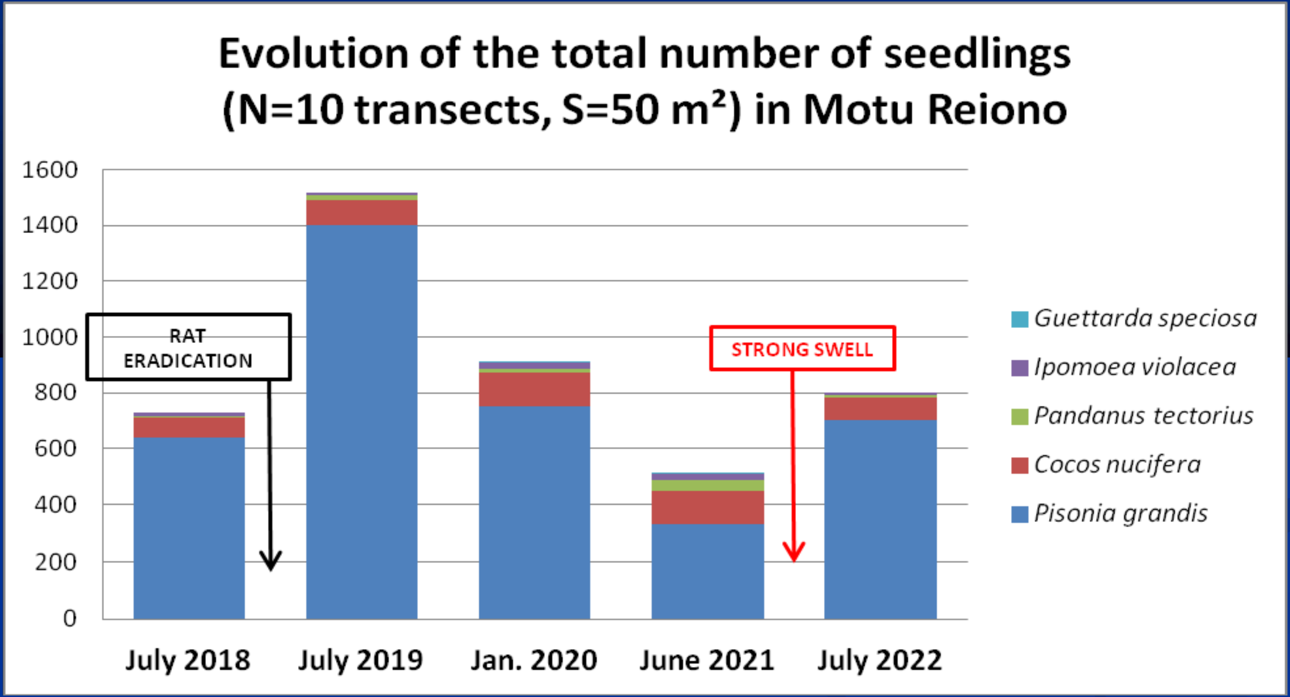
→


2019

→

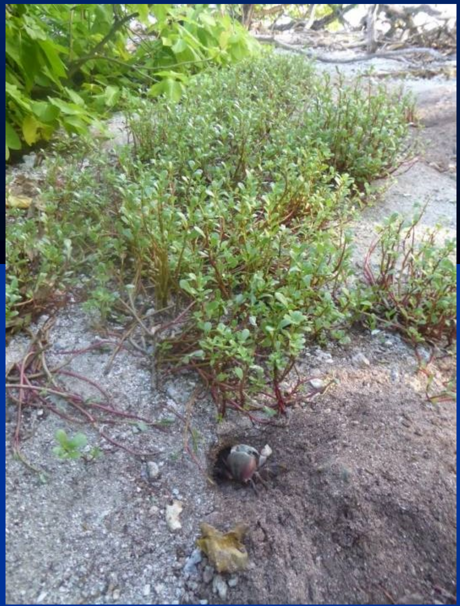

2022

Effects of natural disturbances ?



Effects of land crabs & hermit crabs ?

TR10: *Pisonia* –*Cocos* dense forest



Cardisoma carnifex

Birgus latro

Coenobita spp.

Conclusion

- The number of *Pisonia* seedlings in Motu Reiono (Tetiaroa) has dramatically changed during 5 years of monitoring with a strong decrease 3 years after rat eradication, and a recent increase in 2022. This unexpected successional pattern might be explained by **both abiotic and biotic factors** (*e.g.* fruit, seed and seedling predation by rats and possibly crabs?). Natural disturbances such as tree falls and canopy openings caused by strong winds may favoured the seedling recruitment of light-demanding pioneer species (e.g. *Pisonia grandis*) whereas periodic flooding by sea-water may favor *Pandanus tectorius*.

- Results in Palmyra have demonstrated a strong increase of *Cocos nucifera* seedlings and biomass 5 years after rat eradication (WOLF *et al.* 2018, MILLER-TER KUILE *et al.* 2021). The same trend is observed in Motu Reiono with numerous fallen young coconuts in the transects which are no more eaten by rats. The removal of coconut trees, considered as an invasive species with detrimental impacts on atoll native forest ecosystem (YOUNG *et al.* 2010) should be considered as it is currently done in Palmyra (WEISS 2020).

- In July 2021, 10 new transects were set up in Motu Ahuroa before rat eradication conducted in May-June 2022. We have added to our seedling recruitment protocol a visual assessment of herbaceous plant cover (using six classes: 0-1%, >1-5%, >5-25%, >25-50%, >50-75%, and >75%) in order to monitor the potential changes in abundance of the creeping herb *Boerhavia tetrandra*, the succulent herb *Portulaca oleracea*, and the terrestrial fern *Microsorum grossum*.