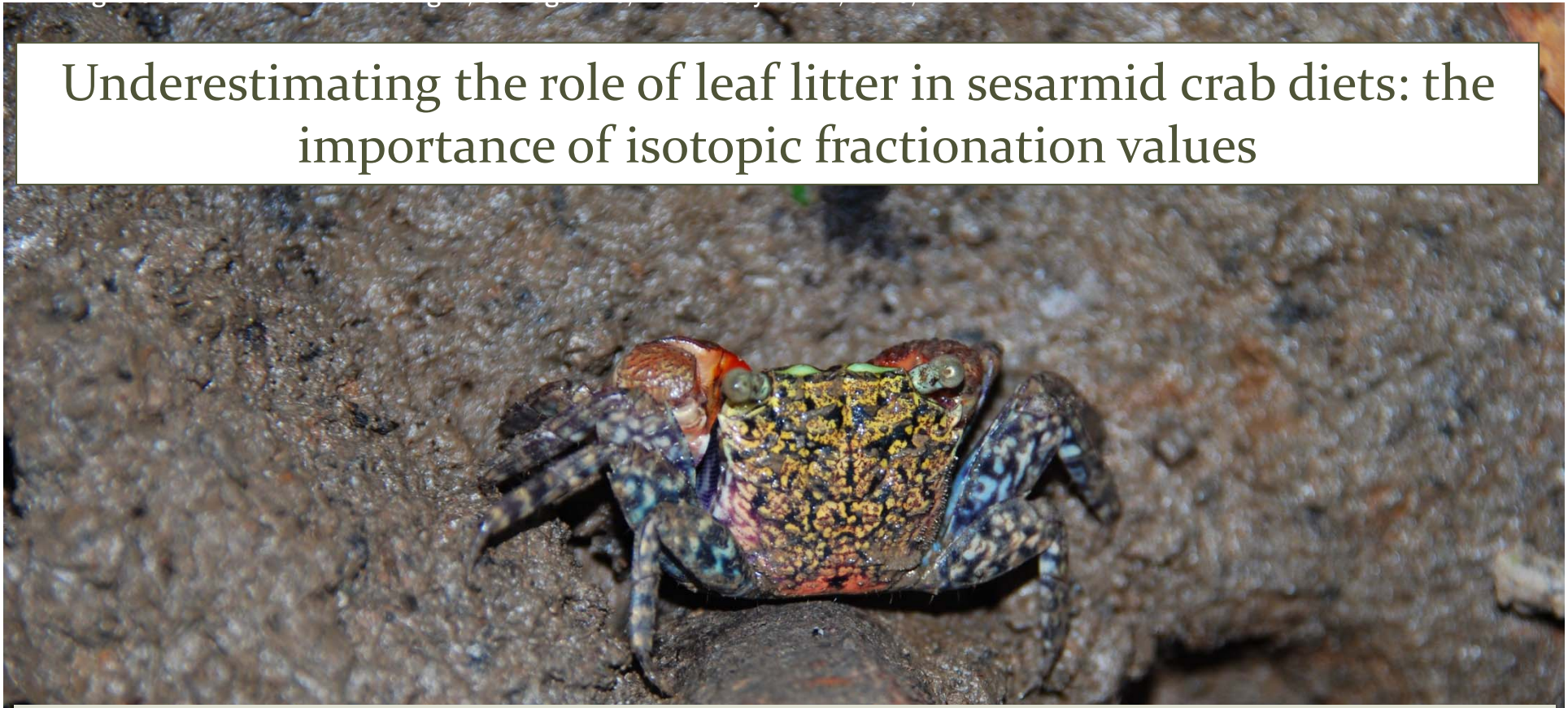
Underestimating the role of leaf litter in sesarmid crab diets: the importance of isotopic fractionation values



Richard A. MacKenzie[1], Nicole Cormier[1,2], Amanda Demopoulos[2], Carmen Pipet[3], Lilah Xavier[3]

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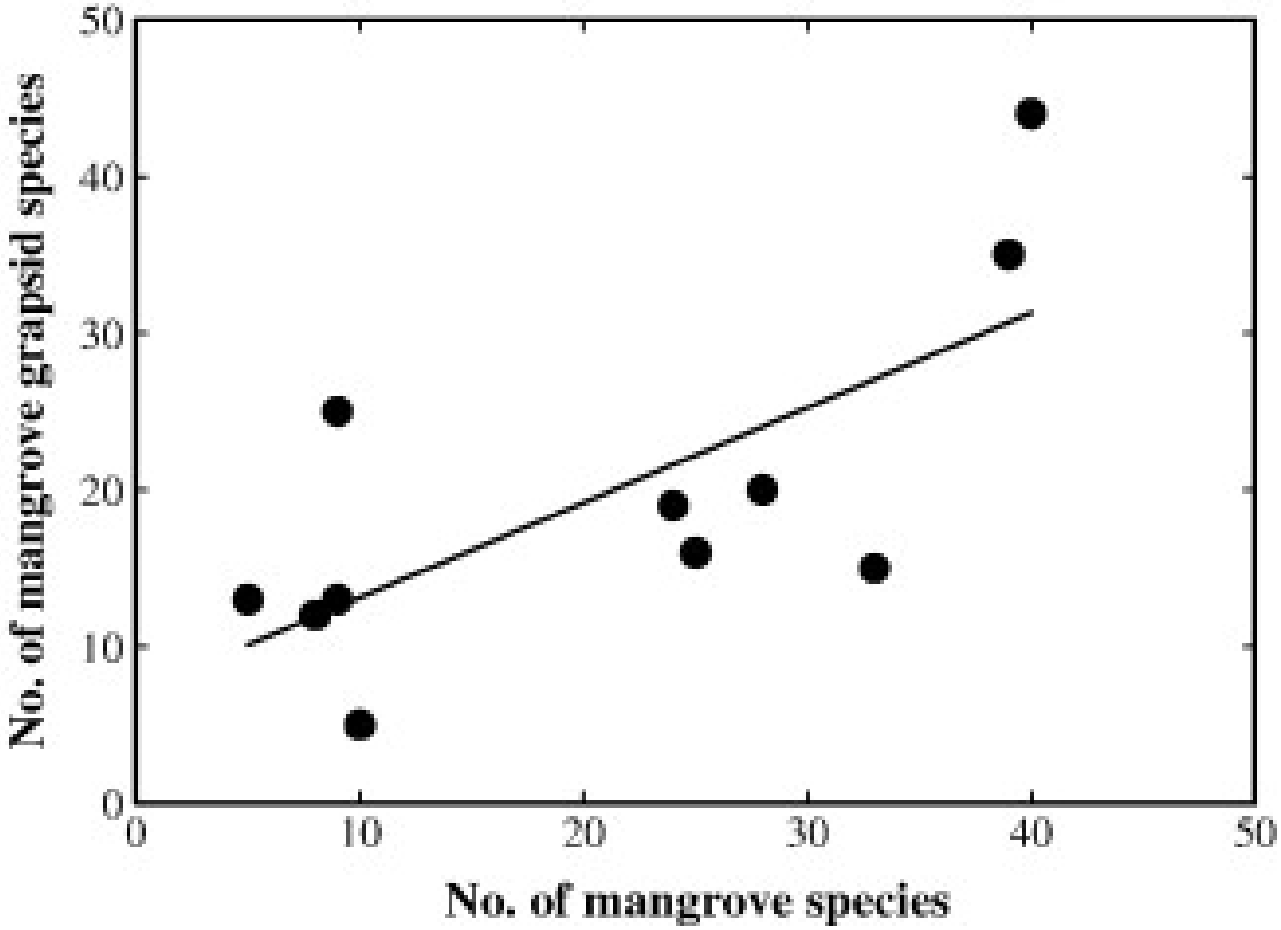
Pacific Southwest Research Station

[2]US Geological Survey, [3]Palau Community College

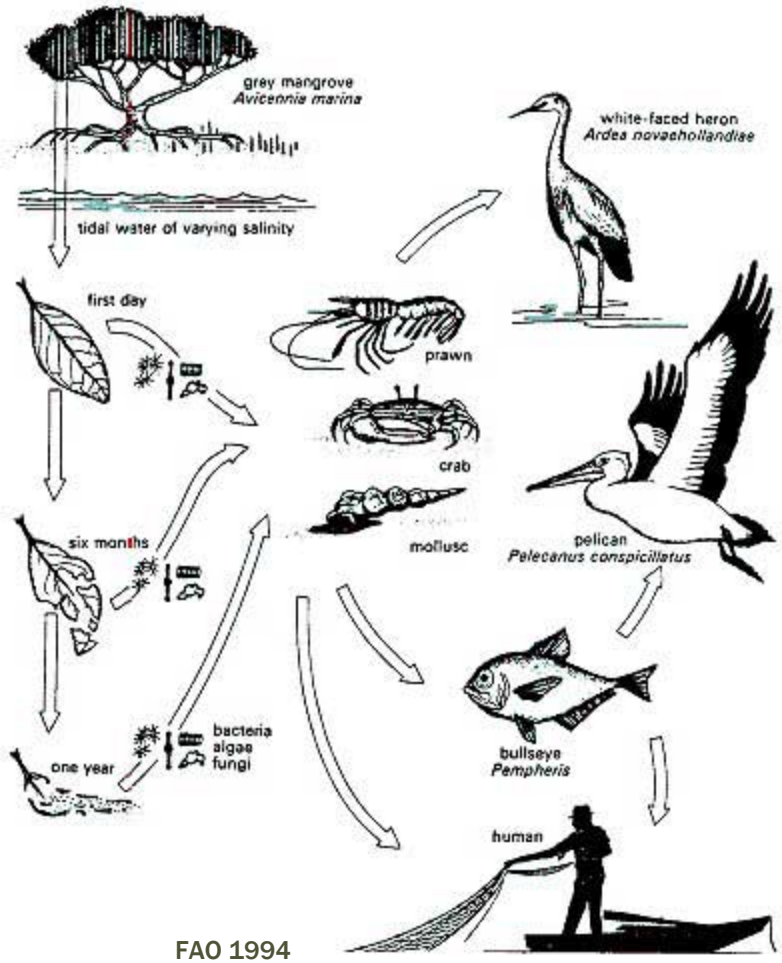
Ecosystem services



Sesarmid crabs support biodiversity in mangroves (Lee 2008)

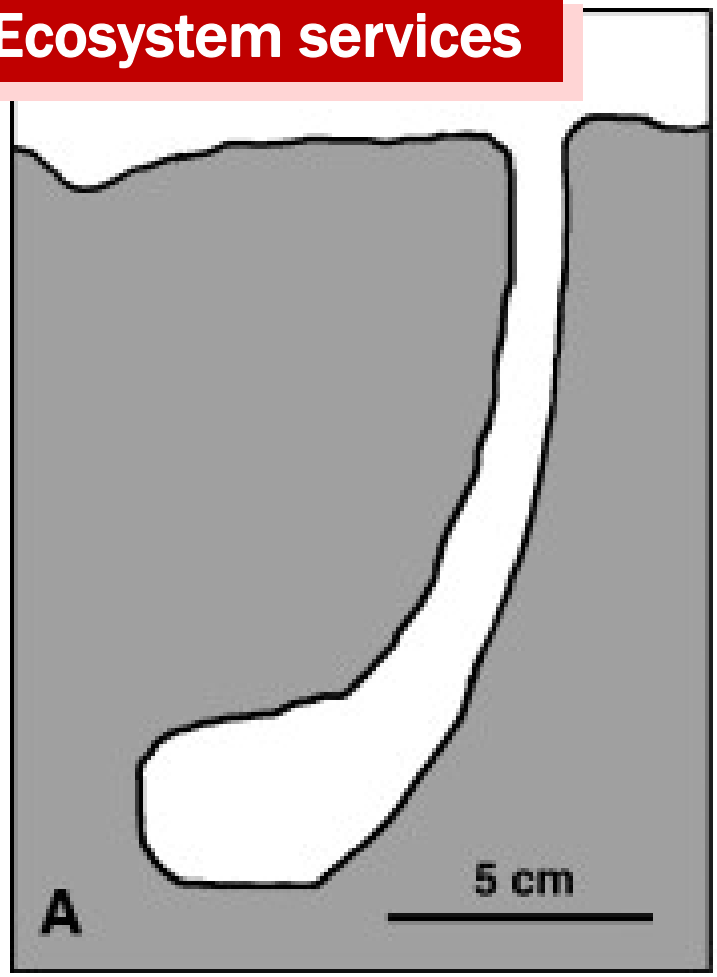
Ecosystem services

Crabs are an important food for many species of birds and other animals (FAO 1994, Nagelkerken & van der Velde 2004)

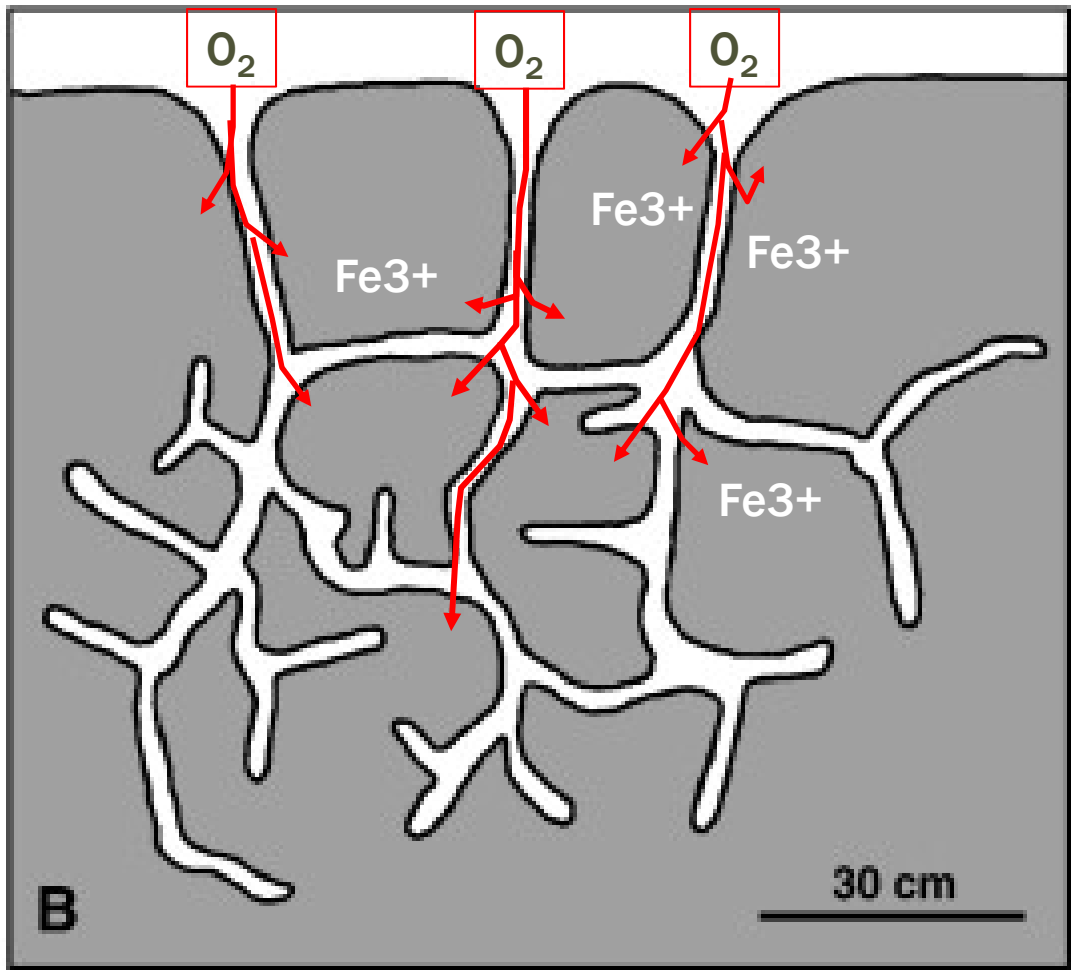


FAO 1994

Ecosystem services



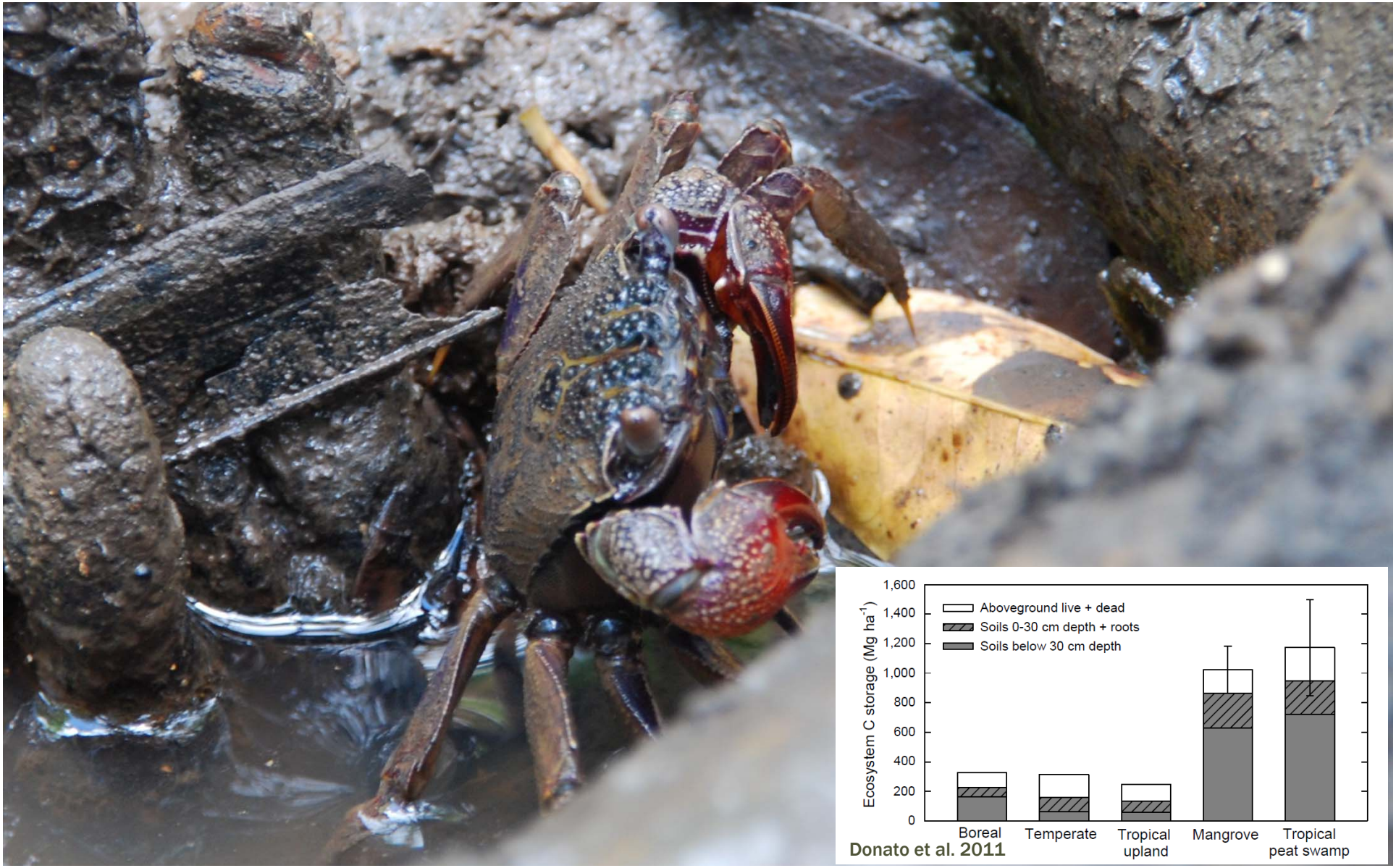
Fiddler crab burrow



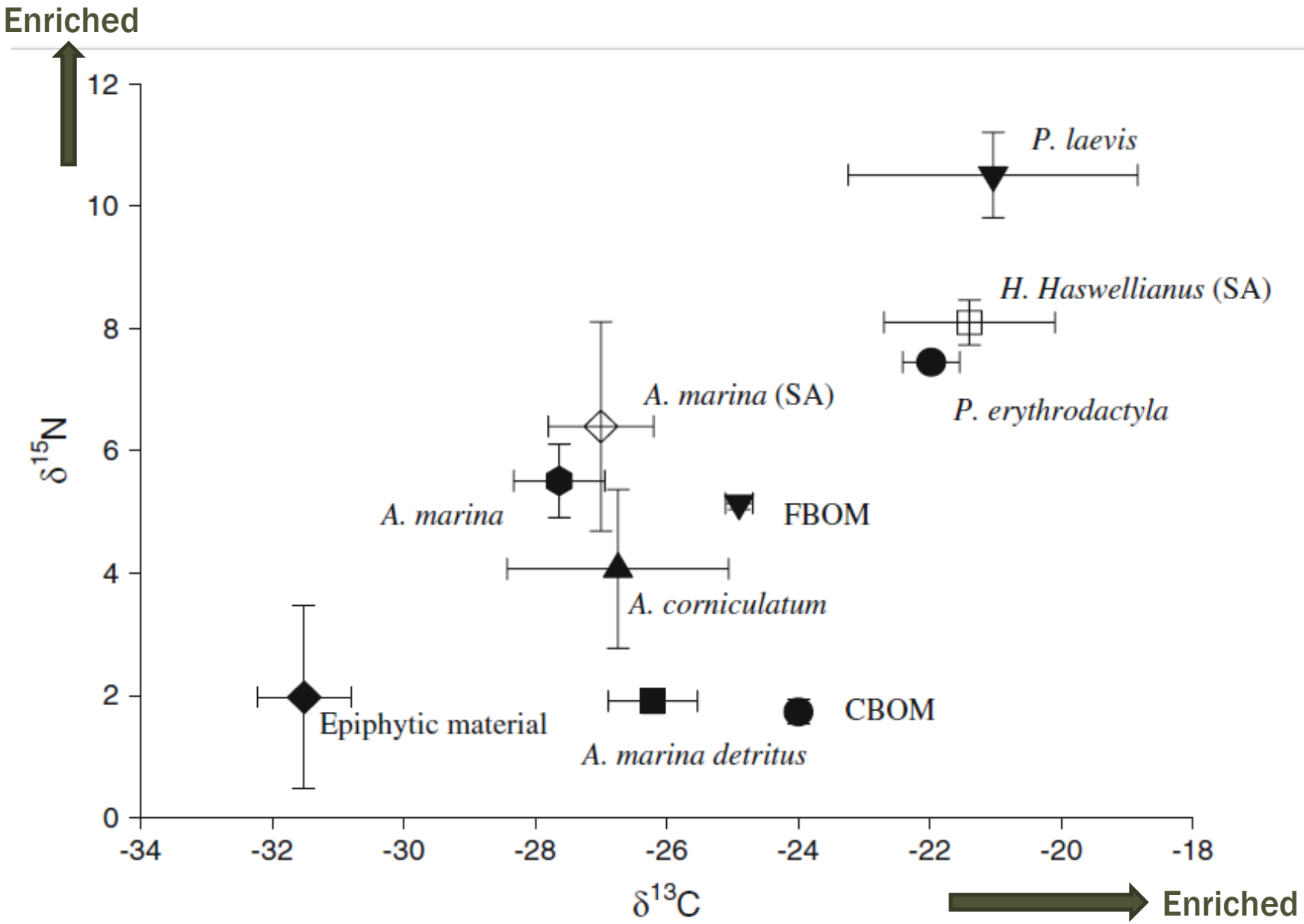
Sesarmid crab burrow

Modified from Kristensen 2008

Burrows increase surface area for O_2 to diffuse across, which increases decomposition of organic matter, oxidation of toxic substances (Kristensen and Holmer 2001, Kostka et al. 2002), and production/reproduction of mangrove forests (Smith III et al. 1991)

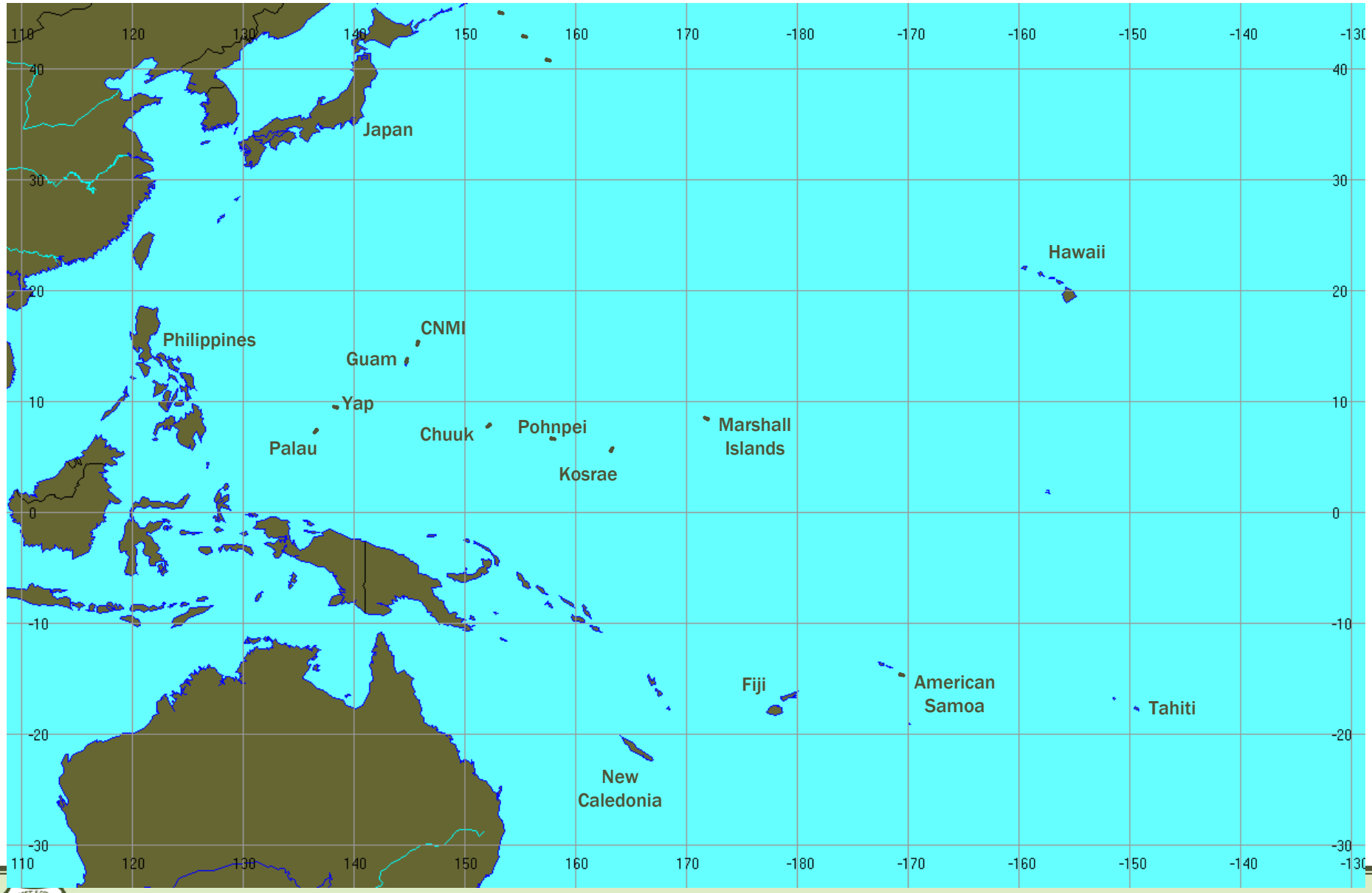


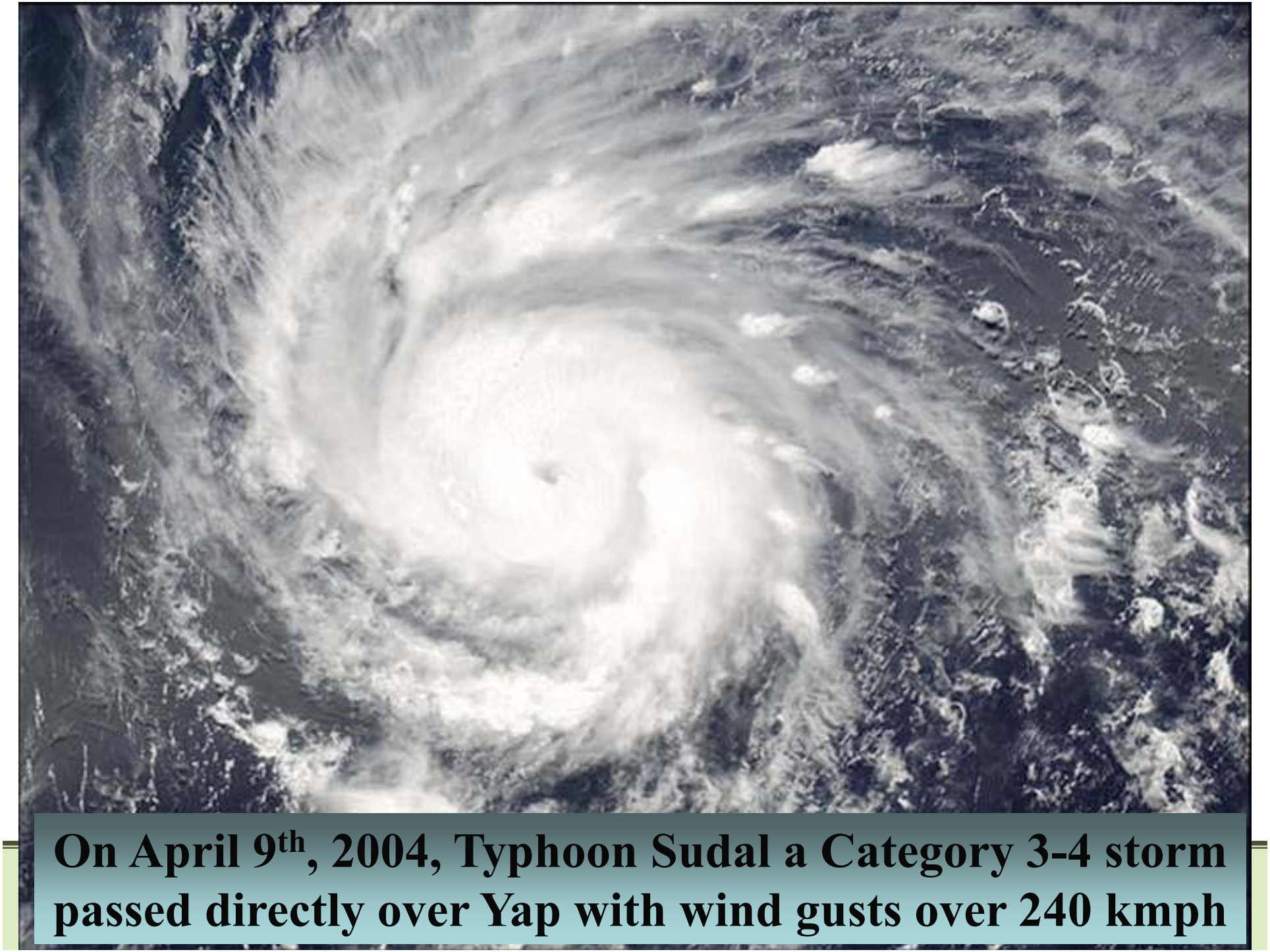
Modify particle size distribution (Mouton & Felder, 1996; Botto & Iribarne, 2000; Werry & Lee 2005) and increase leaf litter decomposition/microbial detrital processing (Lee 1997, Lee 2005)



Mazumder & Saintilan 2010

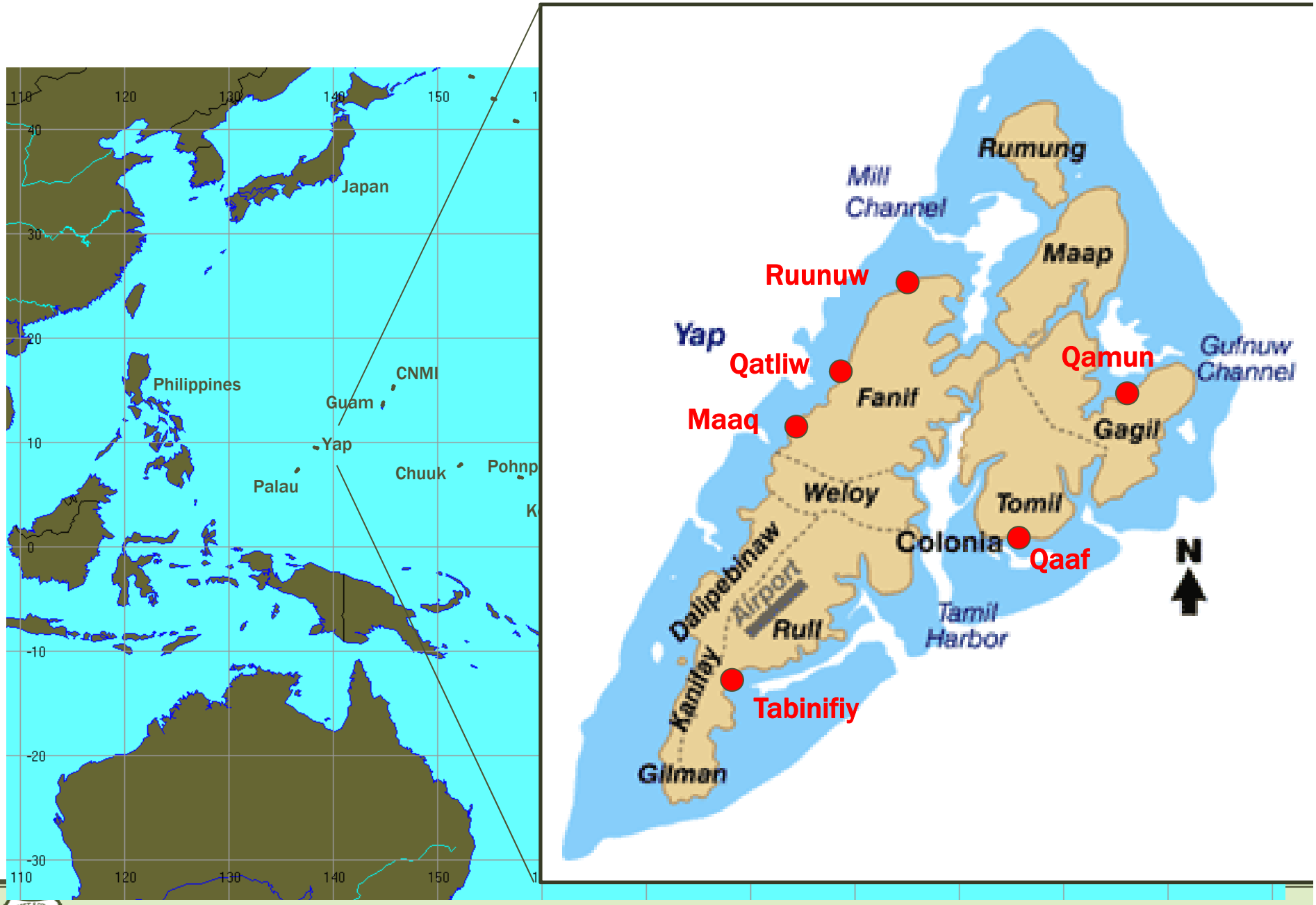
Study	‰	Taxon
Mazumder & Saintilan 2010	4.8-6.6	*Parasesarma erythrodactyla, Paragrapsus laevis, Helograpsus haswellianus*
Bouillon et al. 2004	0.9-11.3	*Perisesarma guttatum, Metopograpsus thukuhar, Neosarmatium smithi*
Bouillon et al. 2002	4.5-8.2	*Episesarma tetragonum, Metopograpsus messor, Parasesarma asperum*
Guest and Connolly 2004	8.7	*Parasesarma erythrodactyla*
Bouillon et al. 2008	8.6	*???*
Kristensen et al. 2010	4.2-5.1	*Neoepisesarma versicolor*
Rodelli et al. 1984	1-8	*Clistocoeloma merguiensis, Metaplax crenulata, M. elegans, Metapograpsus latifrons, Sesarma kraussi, S. mederi, S.onchophorum, S. singaporensis, S. versicolor, Sesarma* spp.

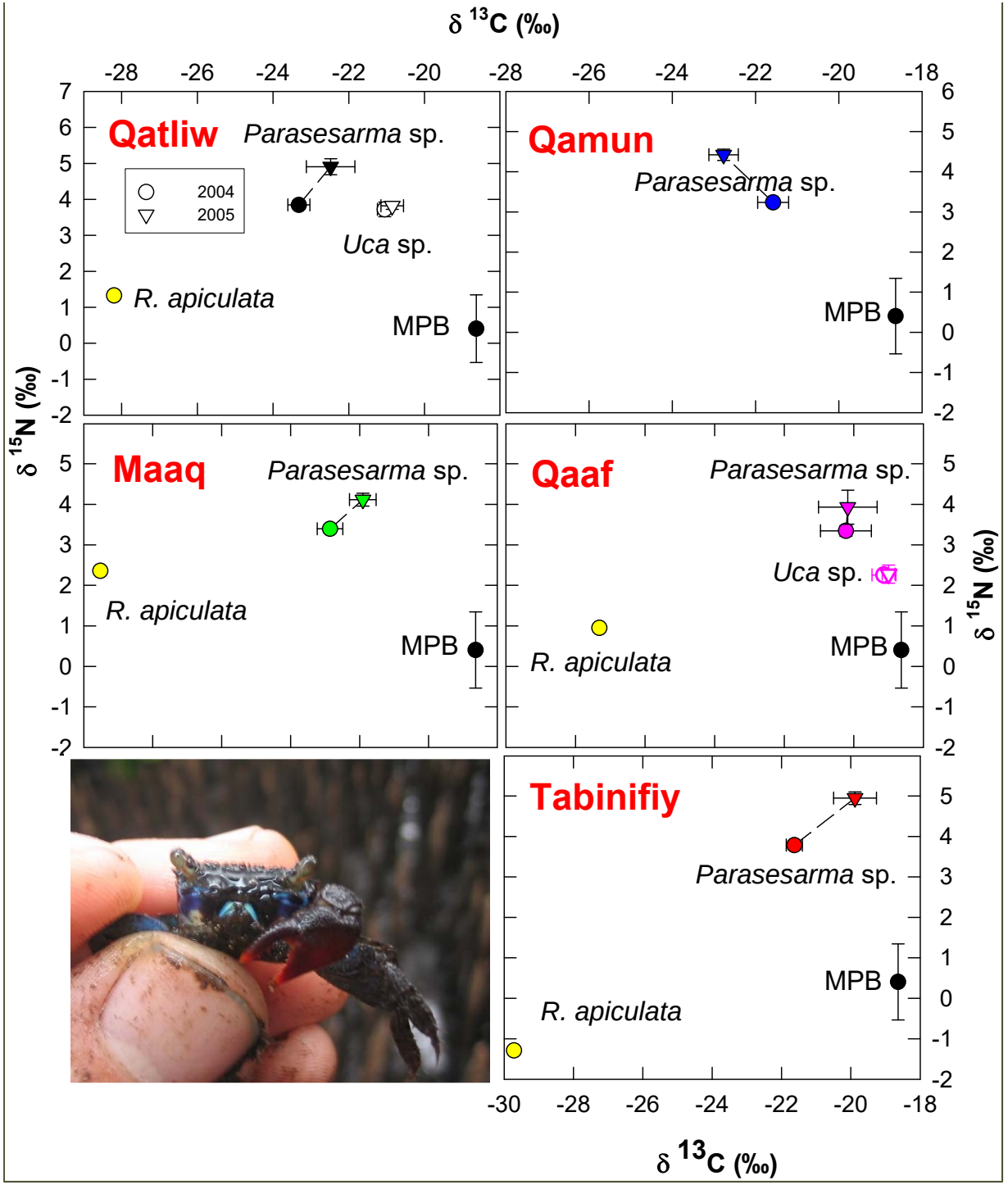

Japan
Hawaii
Philippines
CNMI
Guam
Yap
Palau
Chuuk
Pohnpei
Kosrae
Marshall Islands
Fiji
American Samoa
Tahiti
New Caledonia

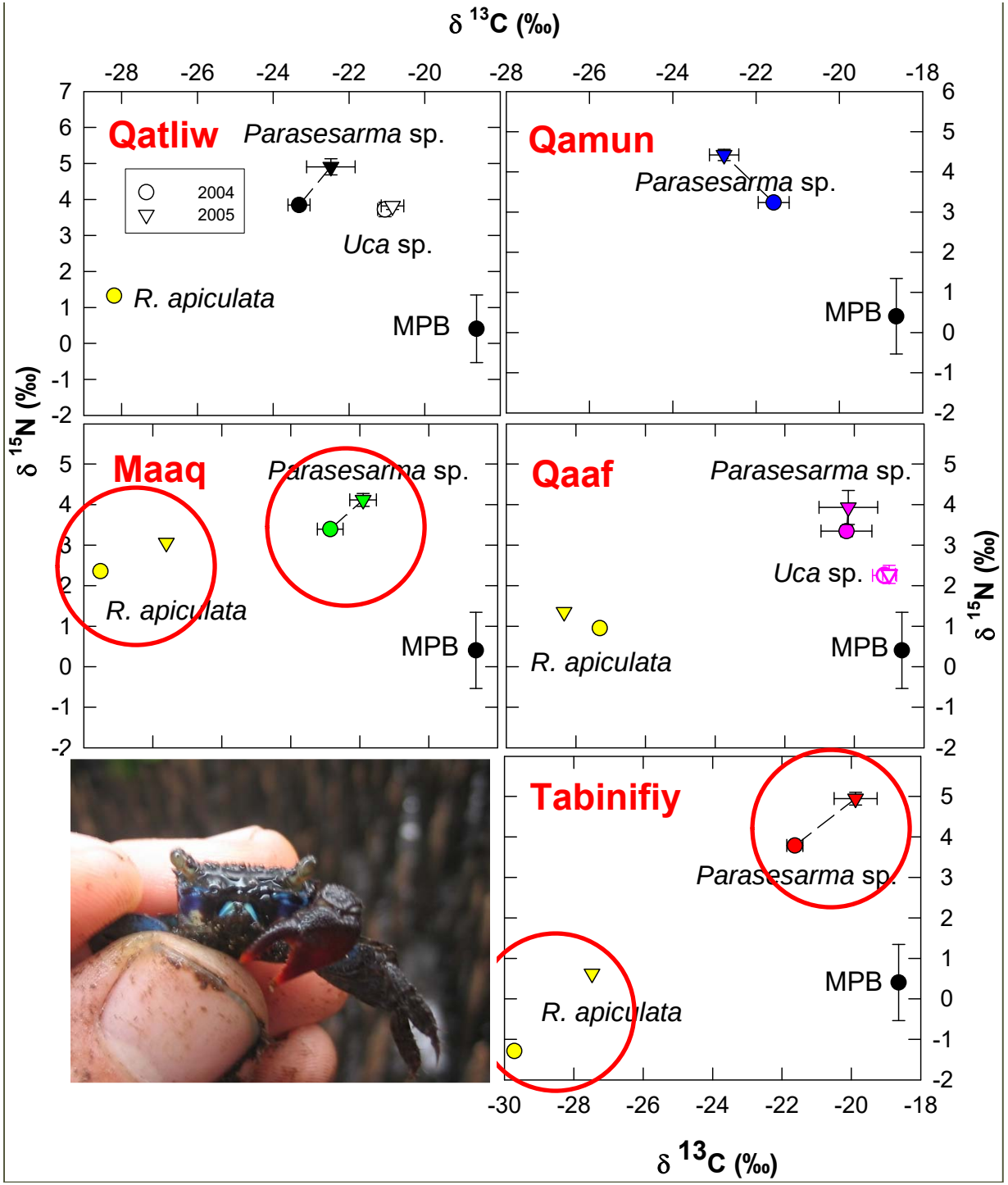


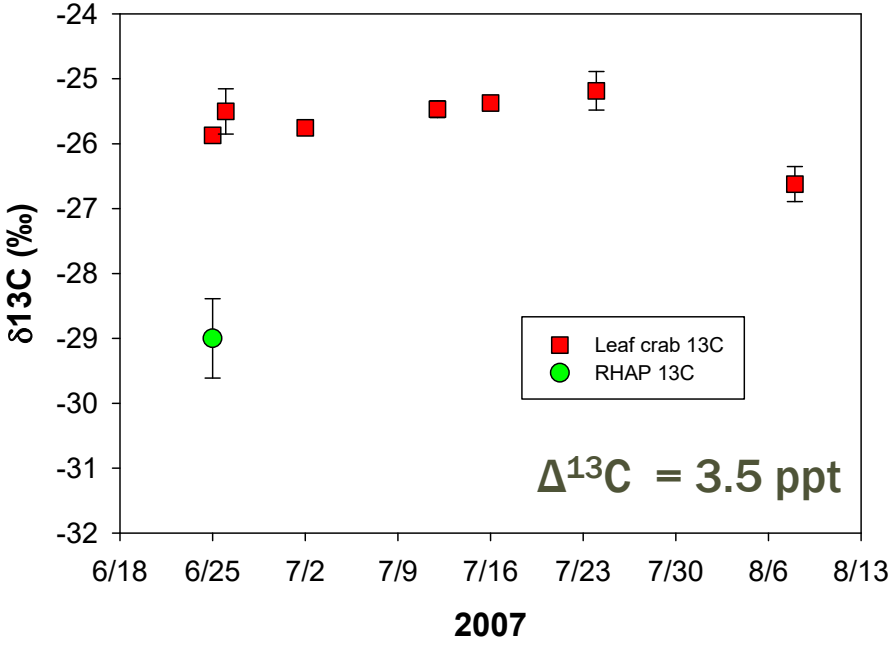
On April 9th, 2004, Typhoon Sudal a Category 3-4 storm passed directly over Yap with wind gusts over 240 kmph

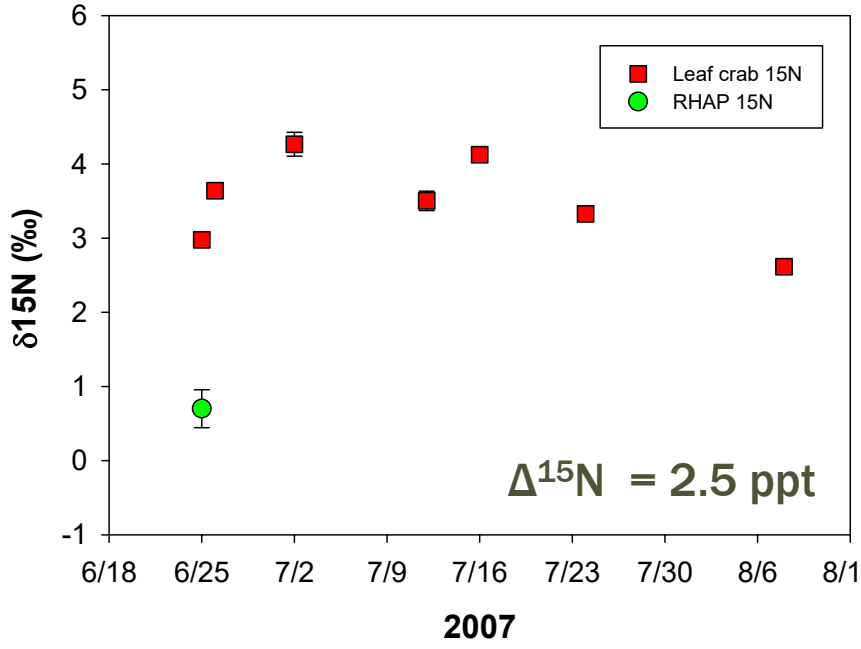
Snapped tree by Typhoon Sudal


Japan
Philippines
CNMI
Guam
Yap
Chuuk
Pohnp
Palau
Rumung
Mill Channel
Maap
Ruunuw
Yap
Qatliw
Qamun
Gufniuw Channel
Fanif
Maaq
Gagil
Weloy
Tomil
Colonia
Qaaf
N
Dalipebinaw
Airport
Rull
Tamil Harbor
Kanifay
Tabinifiy
Gilman


δ 13C (‰)
δ 15N (‰)
Qatliw
Parasesarma sp.
2004
2005
Uca sp.
R. apiculata
MPB
Qamun
Parasesarma sp.
MPB
Maaq
Parasesarma sp.
R. apiculata
MPB
Qaaf
Parasesarma sp.
Uca sp.
R. apiculata
MPB
Tabinifiy
Parasesarma sp.
MPB
R. apiculata


δ 13C (‰)
δ 15N (‰)
Qatliw
Parasesarma sp.
2004
2005
Uca sp.
R. apiculata
MPB
Qamun
Parasesarma sp.
MPB
Maaq
Parasesarma sp.
R. apiculata
MPB
Qaaf
Parasesarma sp.
Uca sp.
R. apiculata
MPB
Tabinifiy
Parasesarma sp.
R. apiculata
MPB


-24
-25
-26
-27
-28
-29
-30
-31
-32
δ13C (‰)
Leaf crab 13C
RHAP 13C
Δ13C = 3.5 ppt
6/18
6/25
7/2
7/9
7/16
7/23
7/30
8/6
8/13
2007


6
5
4
3
2
1
0
-1
δ15N (‰)
Leaf crab 15N
RHAP 15N
Δ15N = 2.5 ppt
6/18
6/25
7/2
7/9
7/16
7/23
7/30
8/6
8/13
2007

SIAR (Stable Isotope Analysis in R)

Multi-source, 2-isotope (^{13}C & ^{15}N) mixing model

LEAF LITTER CONTRIBUTIONS TO CRAB DIETS

	2004			2005		
SITE	[1]PUB $\Delta^{13}C$	OUR $\Delta^{13}C$		[1]PUB $\Delta^{13}C$	OUR $\Delta^{13}C$	
QAAF	0.138	0.220	37%	0.099	0.287	66%
MAAQ	0.294	0.449	35%	0.458	0.636	28%
TAB	0.425	0.593	28%	–	–	

1Vanderzanden and Rasmussen 2001

Study	[1]PUB $\Delta^{13}C$	
Mazumder & Saintilan 2010	0.492	
Bouillon et al. 2004	0.273	
Bouillon et al. 2002	0.500	
Guest and Connolly 2004	0.00	
Bouillon et al. 2008	0.139	
Kristensen et al. 2010	0.516	
Rodelli et al. 1984	0.312	

1Vanderzanden and Rasmussen 2001

Study	[1]PUB $\Delta^{13}C$	[2]AVG $\Delta^{13}C$	
Mazumder & Saintilan 2010	0.492	0.809	39%
Bouillon et al. 2004	0.273	0.729	63%
Bouillon et al. 2002	0.500	0.657	24%
Guest and Connolly 2004	0.00	0.667	–
Bouillon et al. 2008	0.139	0.495	72%
Kristensen et al. 2010	0.516	0.603	14%
Rodelli et al. 1984	0.312	0.648	52%

1Vanderzanden and Rasmussen 2001

[2]This study, Bui & Lee 2014, Herbon & Nordhaus 2013

Conclusions:

- Previous stable isotope studies have underestimated leaf litter input to sesarmid tree crabs in mangroves forests (IWP)

- Future stable isotope studies need to quantify isotope fractionation rates or at least utilize published values for their study organisms or sites

- Gut content studies can significantly increase the value of isotope data

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