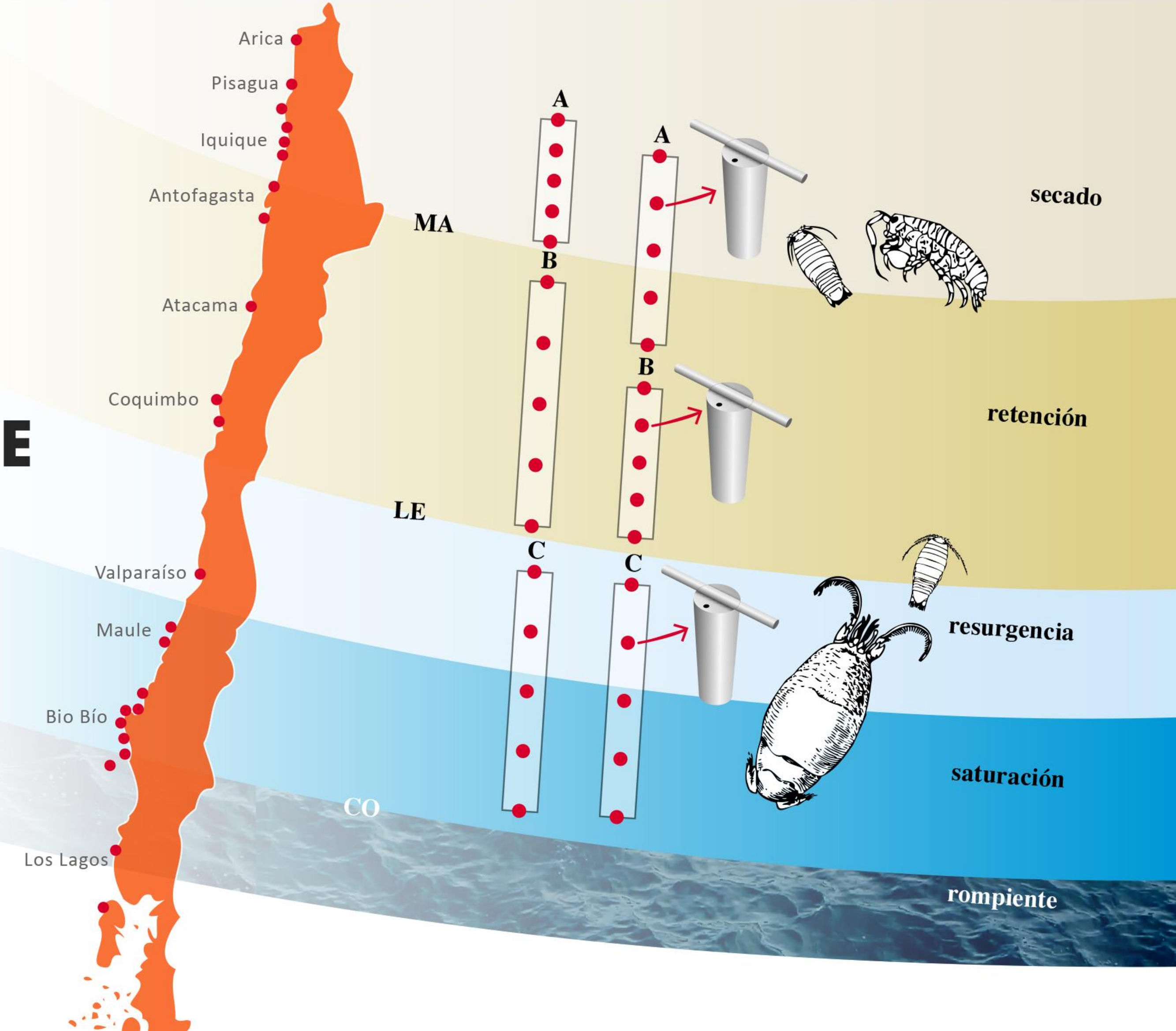
Seminario
"BAHÍAS EN CHILE: NUEVOS DESAFÍOS PARA SU GESTIÓN"

24-25 JULIO 2023

ESTADO DE SALUD AMBIENTAL DE PLAYAS ARENOSAS EN BAHIAS DE LA COSTA DE CHILE



Dr. Eduardo Jaramillo
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ESTA PRESENTACION:

i) Definiciones básicas

ii) Playas chilenas y su fauna

iii) Hipótesis y experimentos naturales

iv) Modificación de las playas arenosas naturales

v) Reconversión del hábitat

v) Una mirada que vá más allá de la playa misma

vi) Serendipia y resiliencia

¿ QUÉ ES UNA PLAYA DE ARENA ? COMO LA PODEMOS DEFINIR ?

Ambiente costero con sustrato no consolidado, móvil y “blando” ….facilmente perturbado o removido

¿ COMO DEFINIMOS A UNA PLAYA ARENOSA NATURAL ?

AQUELLA EN QUE EL CICLO NATURAL DE ACRECION Y EROSION DE ARENA, NO ES INTERRUMPIDO POR NADA ARTIFICIAL

Arroyo Quemado; CA, USA

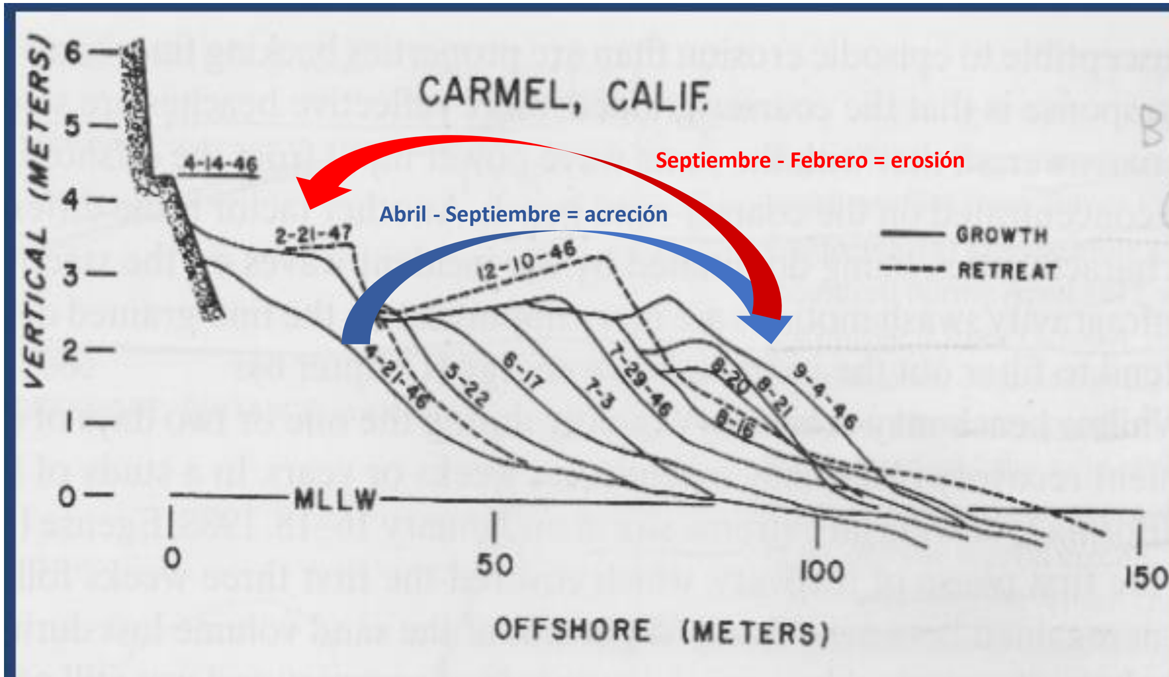

Figure 7-31 The progressive growth and retreat of the berm at Carmel, California, during 1946–1947. [Adapted from Characteristics of Natural Beaches, W. H. Bascom, *Proceedings of the 4th Coastal Engineering Conference*, 1953. Reproduced with permission from American Society of Civil Engineers.]


PLAYA SIN INTERRUPCION DEL CICLO NATURAL DE ACRECION Y EROSION DE ARENA

¿ HAY UN MODO OBJETIVO DE CATEGORIZAR UNA PLAYA DE ARENA ?

$$\Omega = Hb / T \times SFV$$

Hb = height of breaking waves (cm)

T = wave period (S)

SFV = sand fall velocity (cm s^{-1})

Los grandes “influencers”

Anton McLachlan   Andrew Short

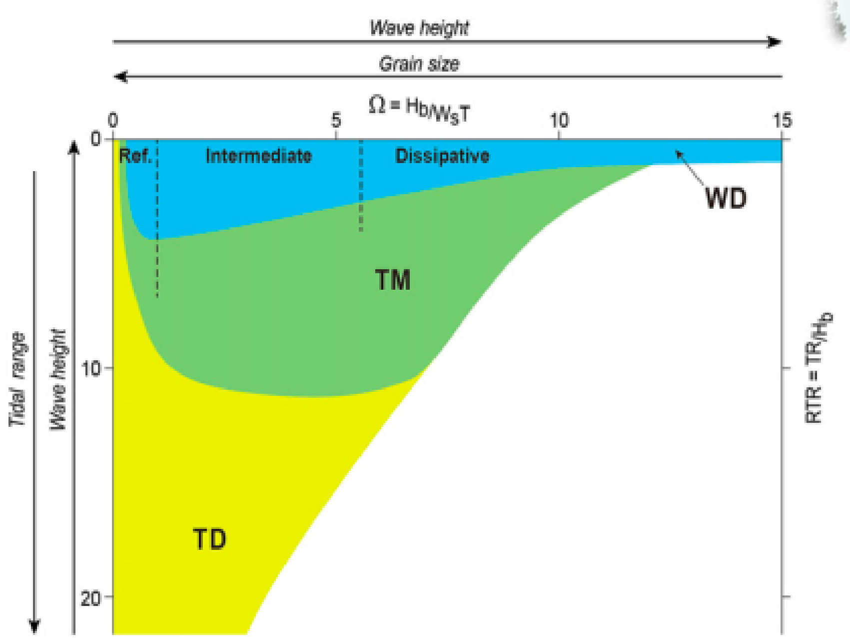

Fig. 1. Plot of dimensionless fall velocity (Ω) versus relative tide range (RTR) showing the general domain of reflective (ref), intermediate and dissipative beaches though the wave-dominated (WD), tide-modified (TM) and tide-dominated (TD) beach types (based on Scott et al., 2011; and Short and Jackson, in press).

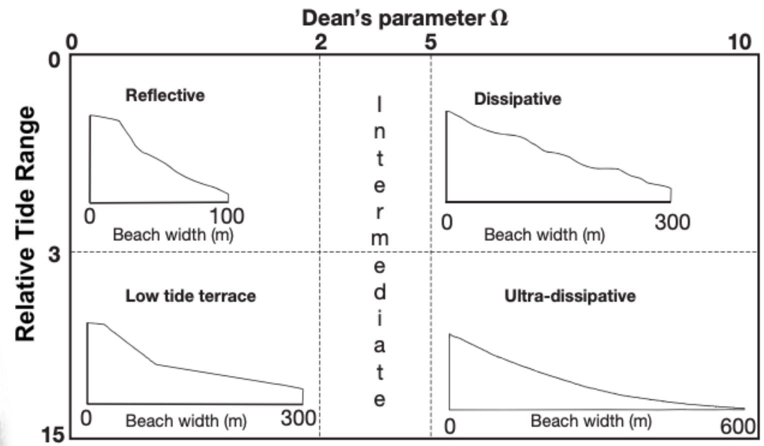

Fig. 1. Beach classification based on 2 composite indices developed for sandy shores: Dean's parameter (Ω) and the Relative Tide Range. Dissipative, intermediate and reflective domains are defined for microtidal open beaches where tide range < 2 m (after Short 1996)

RTR = MSTR (Mean Spring Tide Range / Hb (Breaker height)

Revista Chilena de Historia Natural
69: 589-604, 1996

The role of wave height, period, slope, tide range and embaymentisation in beach classifications: a review

El rol de la altura y período de la ola, pendiente, rango mareal y grado de protección en clasificaciones de playa: una revisión

ANDREW D. SHORT

Coastal Studies Unit, Department of Geography,
University of Sydney Sydney, NSW 2006, Australia
E-mail: A.Short@csu.usyd.edu.au

Journal of Coastal Research	SI	15	27–38	Fort Lauderdale, Florida	Spring 1993

Sandy Beach Macrofauna Communities and their Control by the Physical Environment: A Geographical Comparison

Anton McLachlan[1], Eduardo Jaramillo[2], Theodore E. Donn[1], and Francois Wessels[3]

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University of Port Elizabeth
Port Elizabeth 6000
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University of Port Elizabeth
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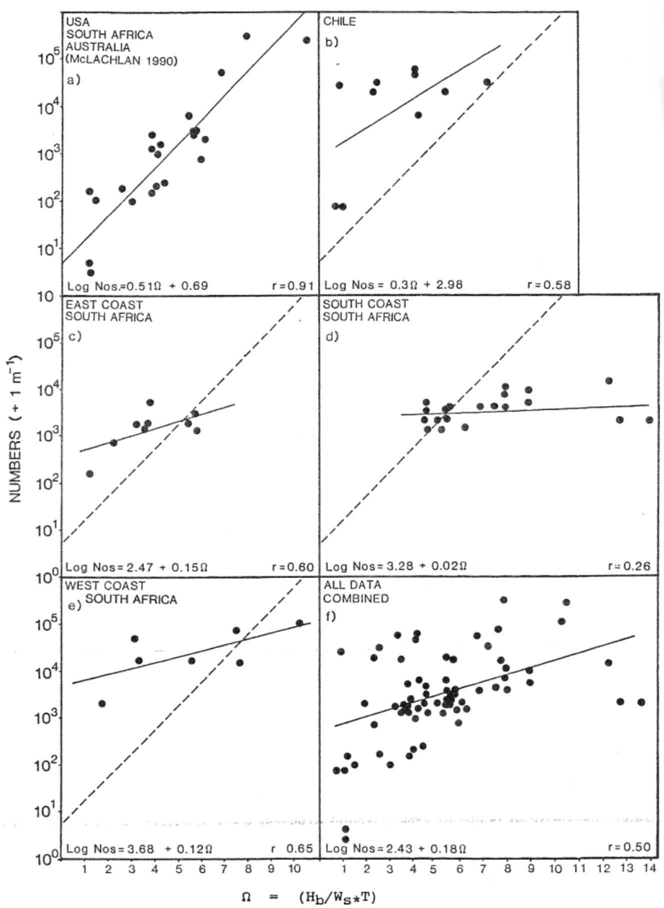


Figure 3. Relationships between total faunal abundance and beach type. Details as for Figure 2.

Ocean & Coastal Management 71 (2013) 256–268

Contents lists available at SciVerse ScienceDirect

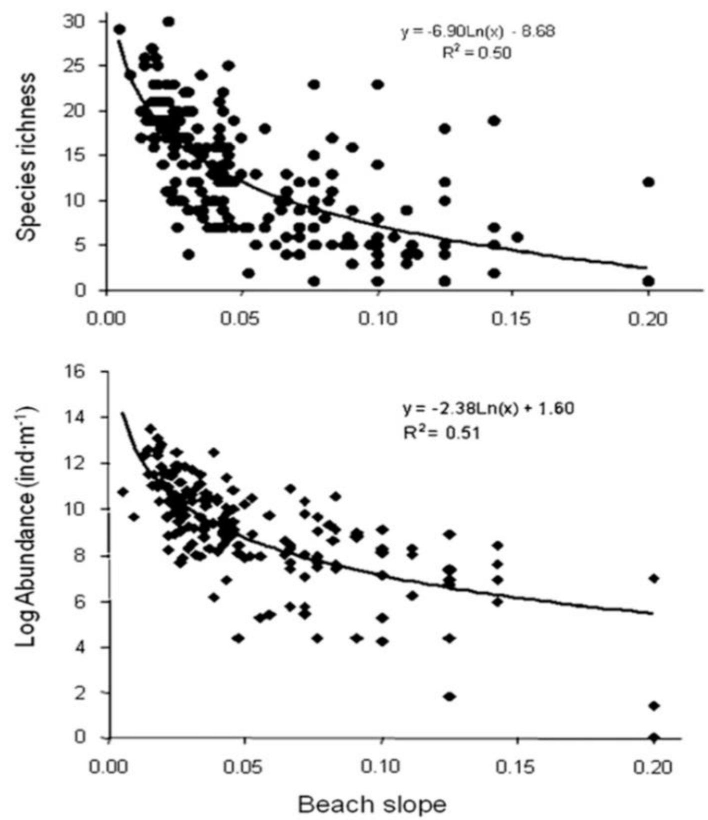
Ocean & Coastal Management

journal homepage: www.elsevier.com/locate/ocecoaman

Sandy beach conservation and recreation: Guidelines for optimising management strategies for multi-purpose use

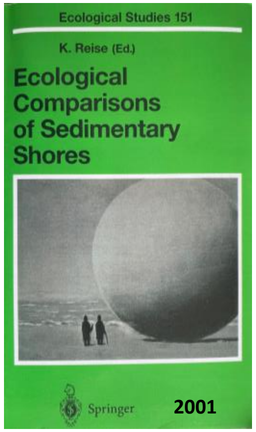
Anton McLachlan[a,*], Omar Defeo[b], Eduardo Jaramillo[c], Andrew D. Short[a]

[a] International Portfolio & School of Geosciences, University of Sydney, NSW 2006, Australia
[b] UNDECIMAR, Facultad de Ciencias, Montevideo, Uruguay
[c] Universidad Austral de Chile, Valdivia, Chile



Ω valores más bajos

Otoño 1999, Isla de Sylt, Alemania



LAS PLAYAS CHILENAS: UN PIEDRA EN EL ZAPATO

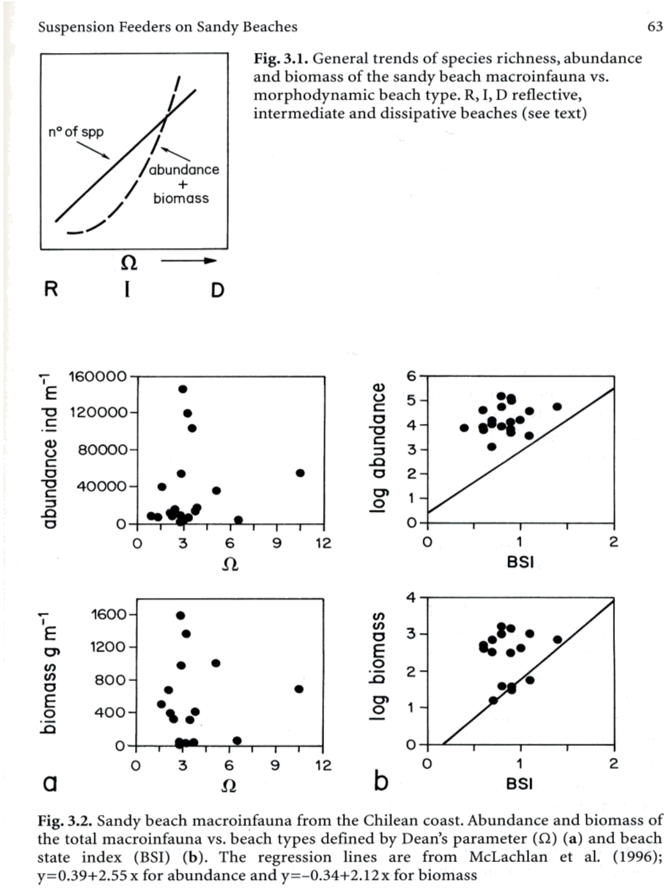


Fig. 3.1. General trends of species richness, abundance and biomass of the sandy beach macroinfauna vs. morphodynamic beach type. R, I, D reflective, intermediate and dissipative beaches (see text)

Fig. 3.2. Sandy beach macroinfauna from the Chilean coast. Abundance and biomass of the total macroinfauna vs. beach types defined by Dean's parameter (Ω) (**a**) and beach state index (BSI) (**b**). The regression lines are from McLachlan et al. (1996); y=0.39+2.55 x for abundance and y=−0.34+2.12 x for biomass

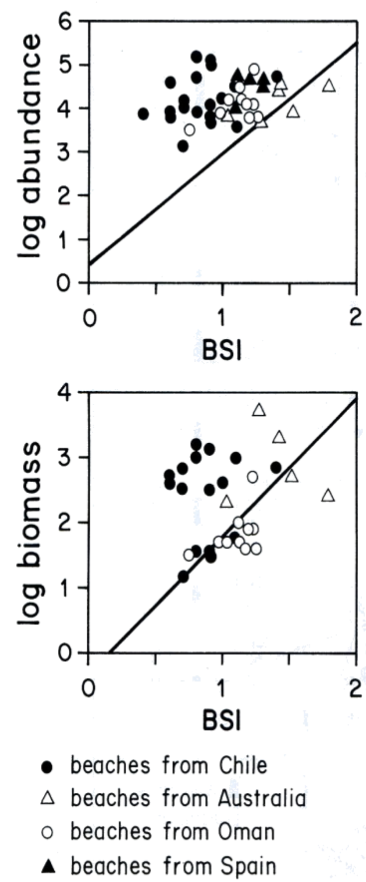
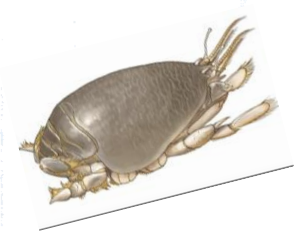
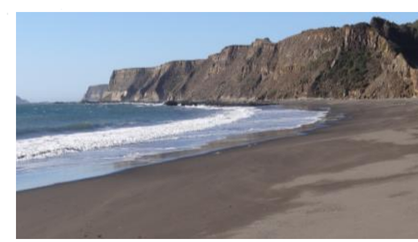


Fig. 3.4. Values of abundance and biomass of the total macroinfauna at Chilean, Australian, Omani and Spanish beaches. The Chilean data are taken from Jaramillo (2001), that of Australia from McLachlan et al. (1996), and those of Oman from McLachlan et al. (1998). The data from Spain are unpublished data of M. Lastra. The regression lines originate from the equations given by McLachlan et al. (1996)



Emerita analoga



LA MORFODINÁMICA DE LA PLAYA NO LO ES TODO

● ***Emerita analoga* es fuente relevante de alimento para aves migratorias (M) y residentes (R) en playas arenosas de Chile**

Tringa semipalmata (Playero grande)

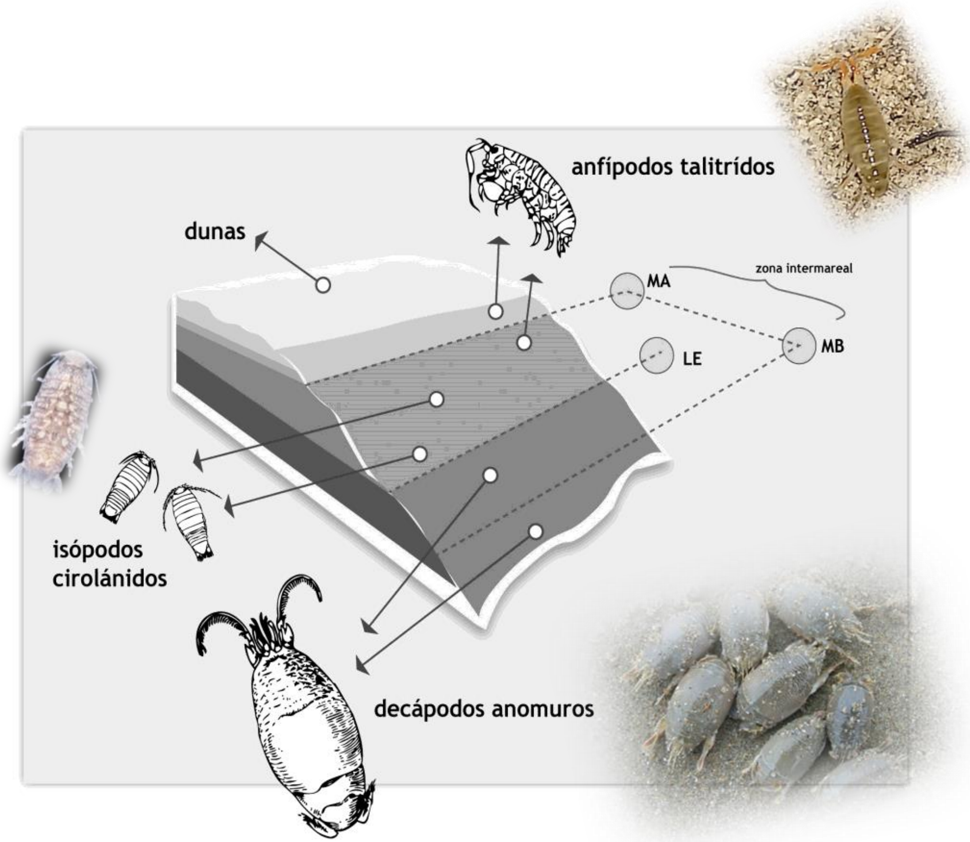
Haematopus palliatus (Pilpilén común)

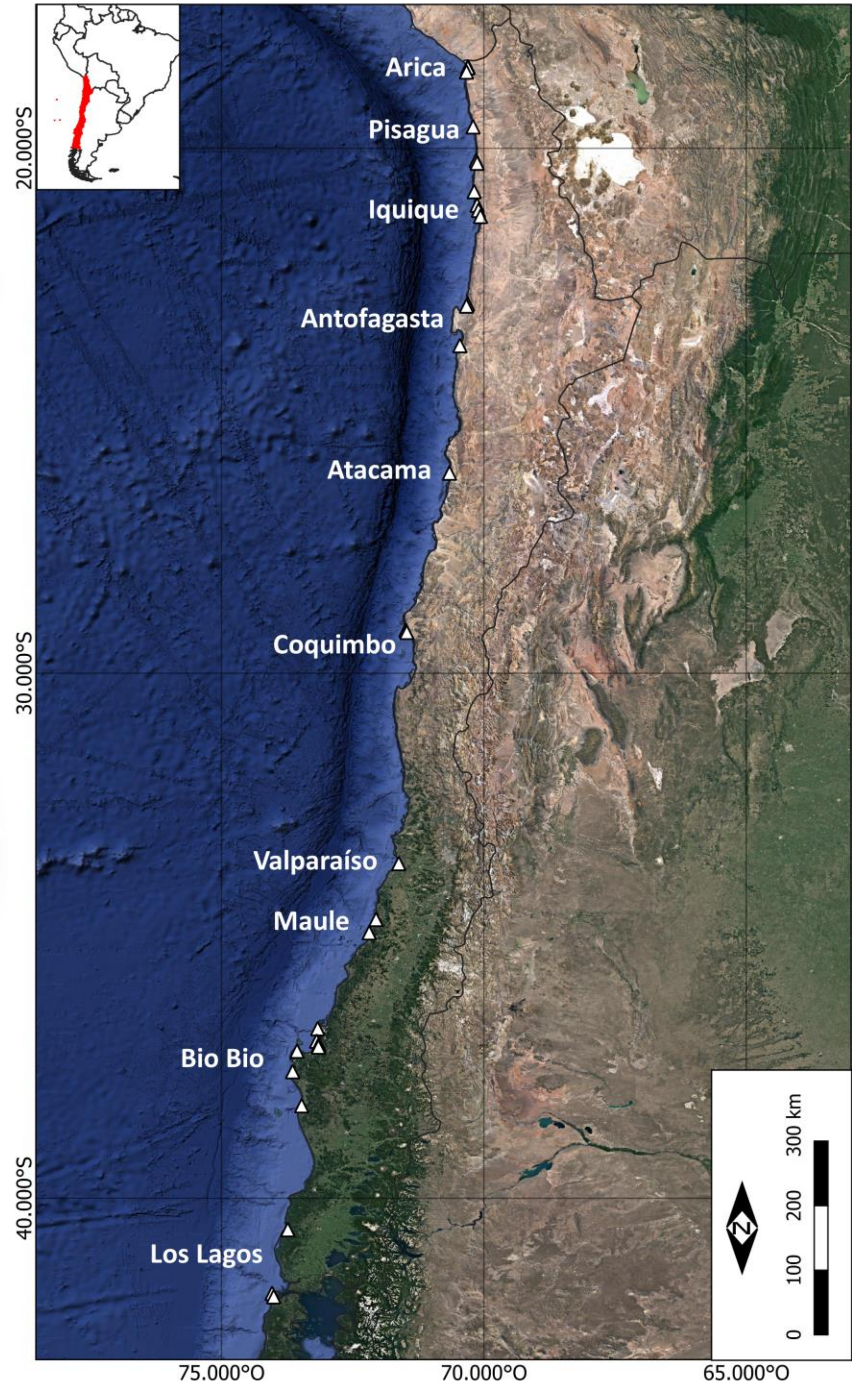
***Calidris alba* (Playero blanco)**

***Chroicocephalus maculipennis* (Gaviota cáhuil)**

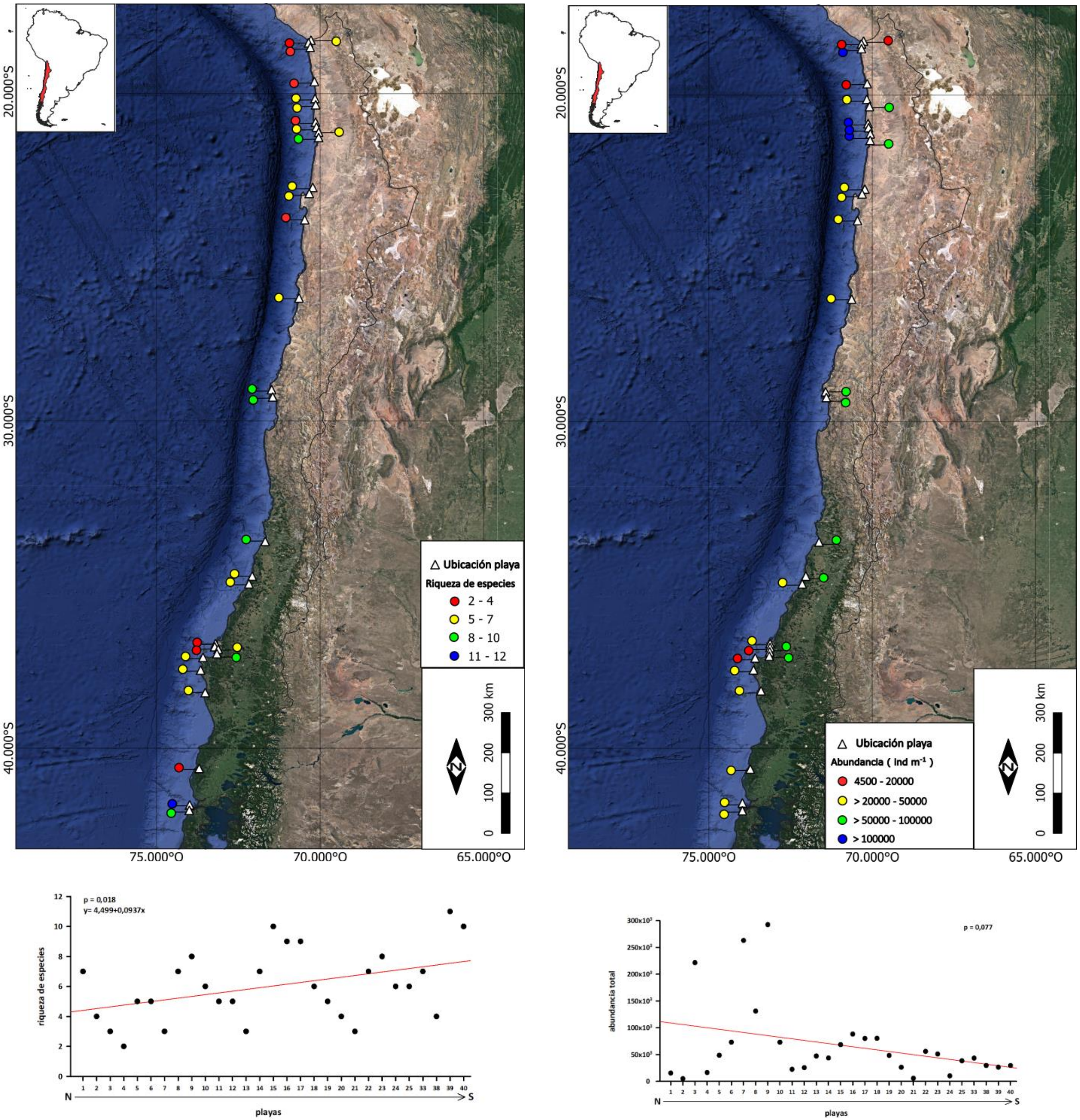
Fuente de las fotos: Víctor Bravo, Universidad de la Serena

● **MACROINFAUNA INTERMAREAL DE PLAYAS ARENOSAS CHILENAS**

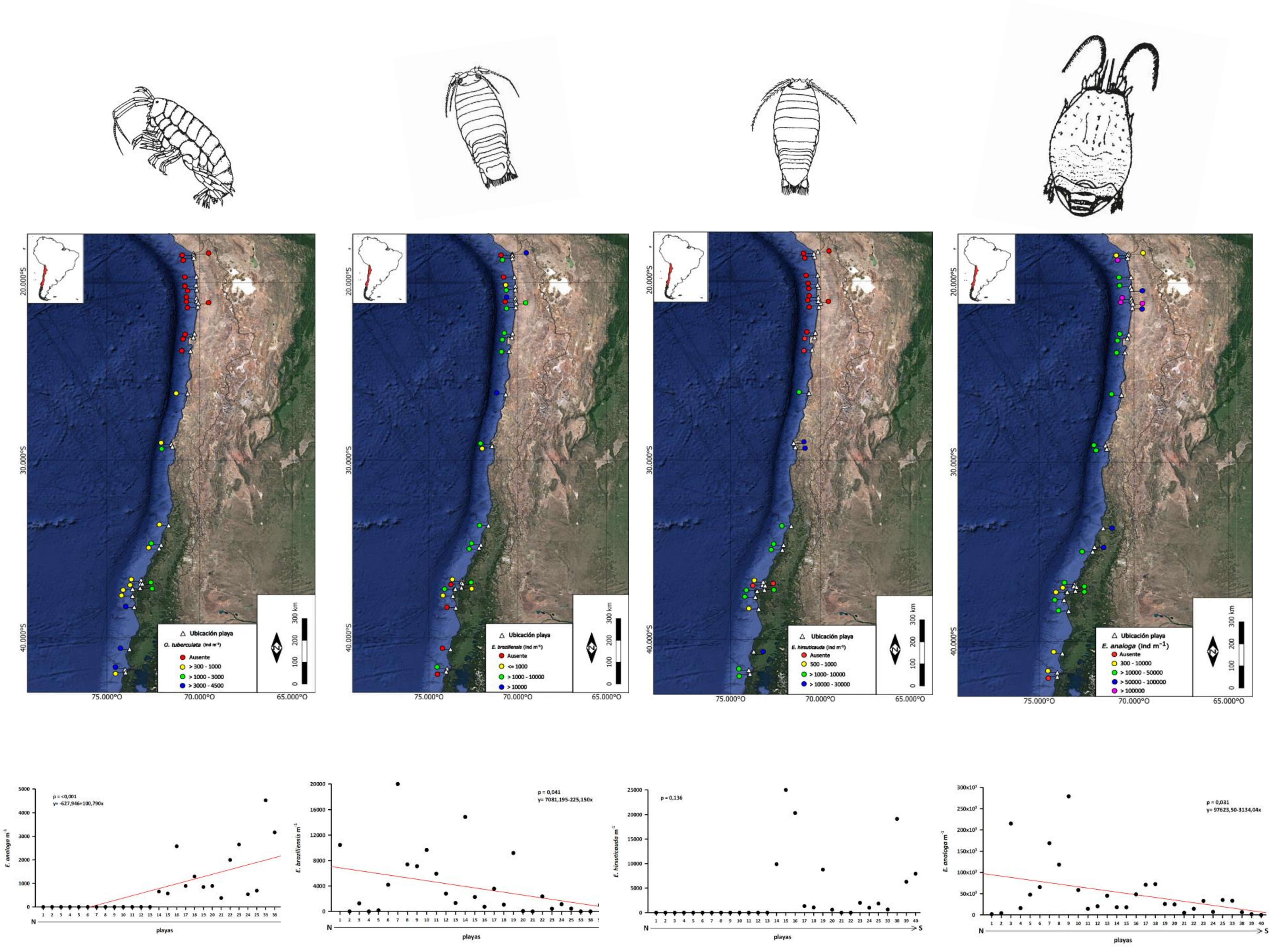




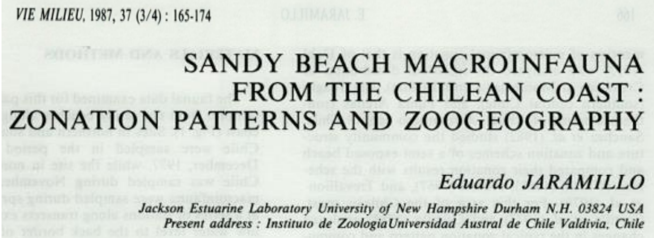
PLAYAS ARENOSAS NATURALES



20.000°S
30.000°S
40.000°S
75.000°O
70.000°O
65.000°O
Ubicación playa
Riqueza de especies
2 - 4
5 - 7
8 - 10
11 - 12
0
100
200
300 km
N
Abundancia (ind m⁻¹)
4500 - 20000
> 20000 - 50000
> 50000 - 100000
> 100000
p = 0,018
y= 4,499+0,0937x
riqueza de especies
playas
N
S
p = 0,077
abundancia total



Ubicación playa
O. tuberculata (ind m-1)
Ausente
> 300 - 1000
> 1000 - 3000
> 3000 - 4500
E. braziliensis (ind m-1)
Ausente
<= 1000
> 1000 - 10000
> 10000
E. hirsuticauda (ind m-1)
Ausente
500 - 1000
> 1000 - 10000
> 10000 - 30000
E. analoga (ind m-1)
Ausente
300 - 10000
> 10000 - 50000
> 50000 - 100000
> 100000
20.000°S
30.000°S
40.000°S
75.000°O
70.000°O
65.000°O
300 km
p = <0,001
y= -627,946+100,790x
E. analoga m-1
playas
p = 0,041
y= 7081,195-225,150x
E. braziliensis m-1
p = 0,136
E. hirsuticauda m-1
p = 0,031
y= 97623,50-3134,04x
N
S



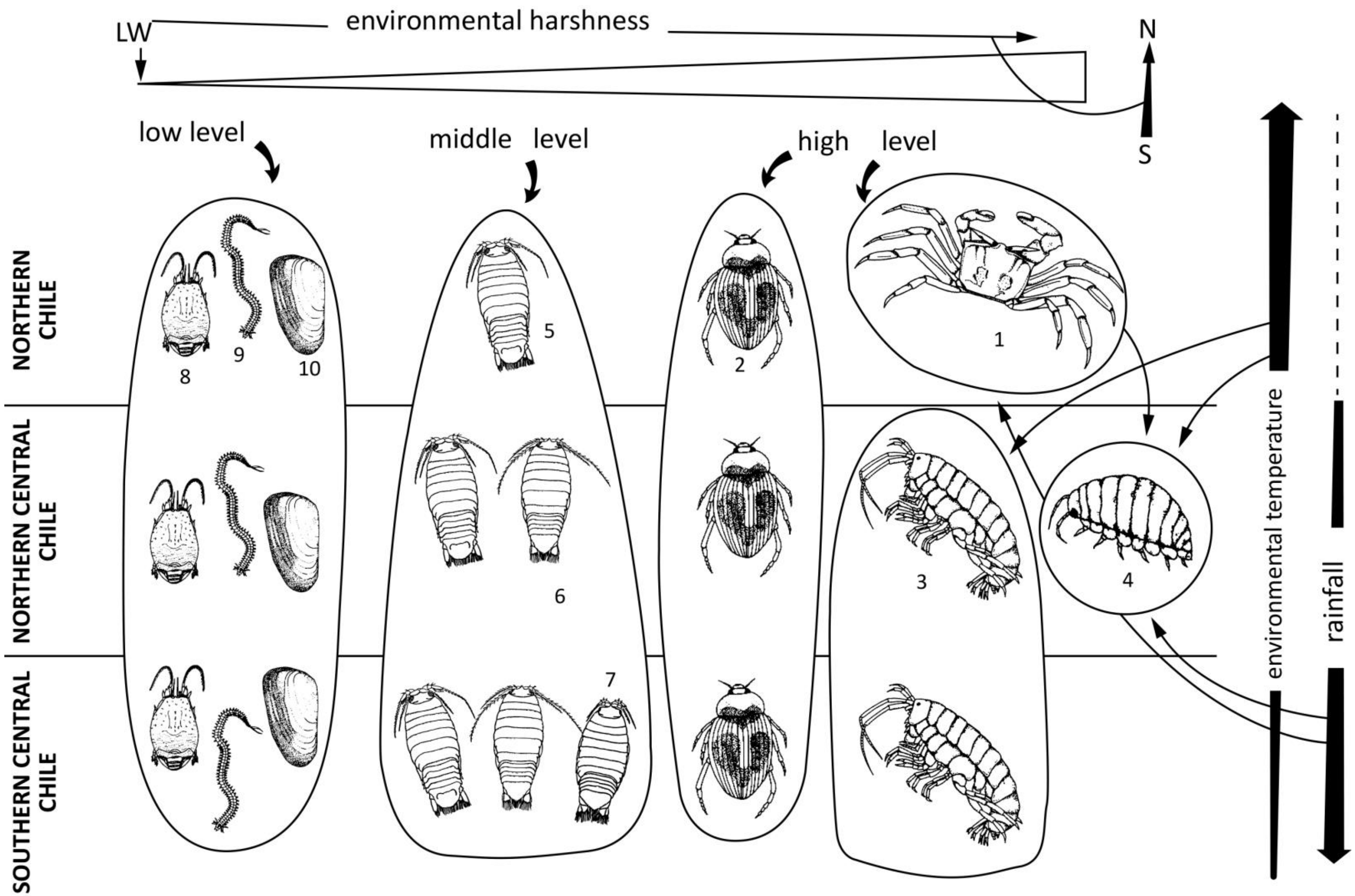
VIE MILIEU, 1987, 37 (3/4) : 165-174

SANDY BEACH MACROINFAUNA FROM THE CHILEAN COAST : ZONATION PATTERNS AND ZOOGEOGRAPHY

Eduardo JARAMILLO

Jackson Estuarine Laboratory University of New Hampshire Durham N.H. 03824 USA
Present address : Instituto de Zoologia Universidad Austral de Chile Valdivia, Chile

El Chanchito de mar *(Emerita analoga)* es la especie más abundante a lo largo de las playas arenosas de Chile



1. Ocypode gaudichaudii
2. Phalerisidia maculata
3. Orchestoidea tuberculata
4. Tylos spinulosus
5. Excirolana braziliensis
6. Excirolana hirsuticauda
7. Excirolana monodi
8. Emerita analoga
9. Nephtys impressa
10. Mesodesma donacium

¿ COMO SE HA MODIFICADO LA CONDICION NATURAL DE LAS PLAYAS CHILENAS ?

Casos de estudio

LIMPIEZA MECANICA DE LAS PLAYAS Y LUZ ARTIFICIAL

Playas de Iquique

Revista de Biología Marina y Oceanografía
Vol. 50, Nº2: 299-313, agosto 2015
DOI 10.4067/S0718-19572015000300008

ARTÍCULO

Macroinfauna en playas arenosas de la costa del Norte Grande de Chile sometidas a diferentes presiones antrópicas

Sandy beach macroinfauna from the coast of northern Chile affected by different anthropic pressures

Emilio O. Acuña[1] y Eduardo Jaramillo[2]

[1]Calle Nueva 375, Valdivia, Chile
[2]Facultad de Ciencias, Campus Isla Teja, Universidad Austral de Chile, Valdivia, Chile. ejaramillo@uach.cl

Figura 1. a) Cavancha, playa arenosa del centro urbano de Iquique. Nótese la perturbación de la arena producto de la limpieza de las mismas. b) Chomache, playa ubicada fuera del radio urbano de Iquique y donde no ocurre limpieza de la basura que se deposita periódicamente en los niveles superiores de la misma / a) Cavancha, an urban sandy beach of Iquique. Take note of the sand disturbance as a result of the artificial grooming of this site. b) Chomache, a non - urban beach without artificial grooming of the debris stranded on the upper shore levels

La riqueza de especies de la fauna intermareal, es más afectada por la perturbación mecánica, que por la cantidad de basura depositada en las playas de Iquique

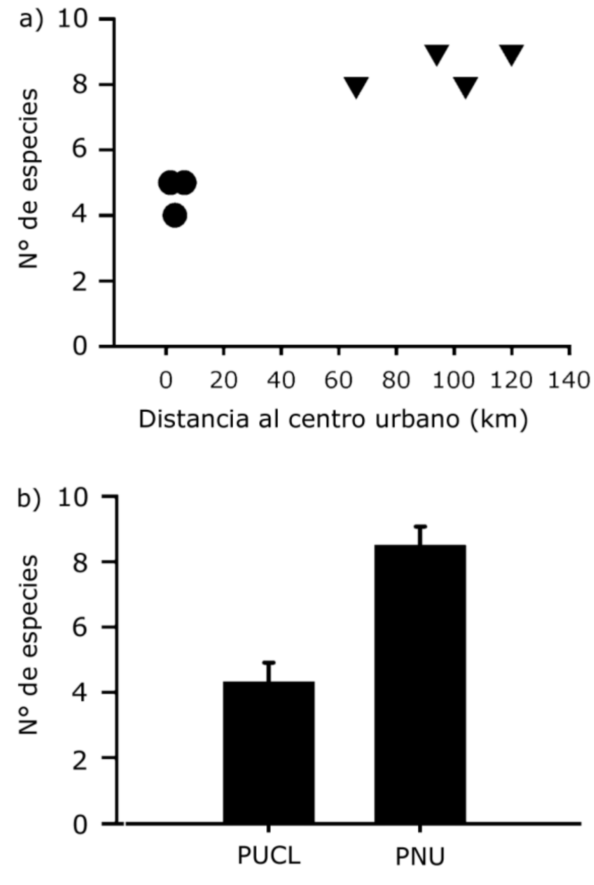
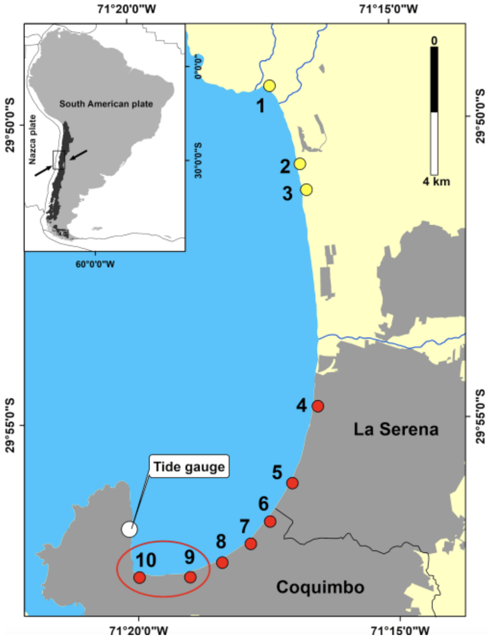
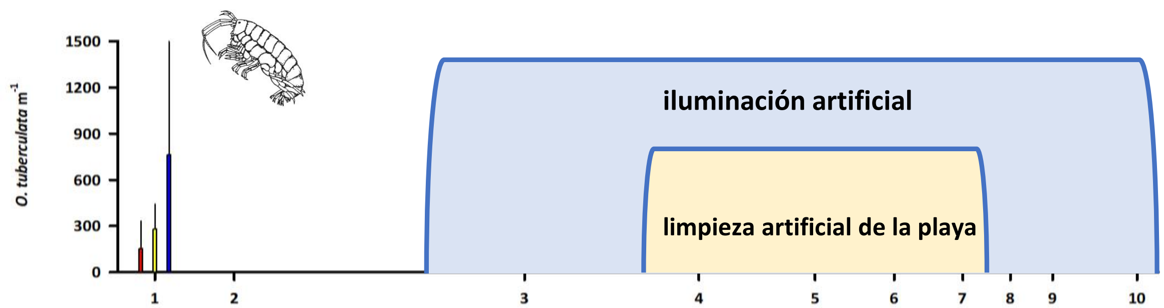
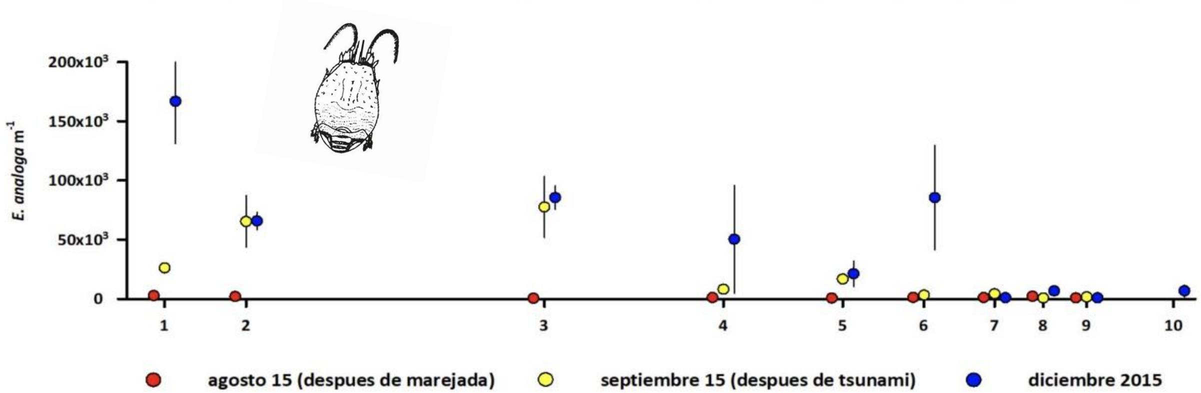


Figura 5. a) Riqueza especifica de la macroinfauna de las playas estudiadas en relación a distancias al centro urbano de Iquique. Los círculos negros representan a playas urbanas donde se realiza limpieza artificial de las mismas (Cavancha, Playa Brava y Huayquique), a la vez que los triángulos negros representan a las playas ubicadas fuera del área urbana de Iquique donde no se realiza limpieza (Chauca, Chomache, Boca del Diablo y Playa Larga). b) Valores promedio (+ 1 desviación estándar) de riqueza específica en playas urbanas con limpieza artificial (PUCL) y en playas no urbanas (PNU) ubicadas fuera del radio urbano de Iquique. Las líneas negras no unidas indican ausencia de diferencias significativas (*P* > 0,05) entre los grupos comparados (ver Materiales y Métodos) / a)

Playas de Bahía Coquimbo







Playa Marbella, Santo Domingo

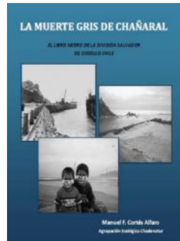
RELAVES DE LA MINERIA DEL COBRE EN COSTA DE ATACAMA

Experimento natural

Relaves vertidos desde Potrerillos y El Salvador a Bahía de Chañaral (1938 - 1975) via Río El Salado

desde Mina Potrerillos: 1938 - 1958 = 20 años
desde Mina El Salvador: 1959 - 1975 = 16 años

Relaves vertidos desde Potrerillos y El Salvador a Bahía de Chañaral (1938 - 1975) via Río El Salado



Bahía de Chañaral en el año 1919

Marine Pollution Bulletin, Vol. 14, No. 12, pp. 459-464, 1983
Printed in Great Britain

Environmental Impact in Sandy Beaches of Copper Mine Tailings at Chañaral, Chile

JUAN C. CASTILLA
Facultad de Ciencias Biológicas, Pontificia Universidad Católica de Chile, Casilla 114-D, Santiago, Chile

Avance hacia el mar de *ca. 1 km* y acumulación de *ca.* 150 millones ton relaves con un grosor estimado de 9 m

Bahía de Chañaral en la actualidad, su impacto ambiental físico es evidente.

1975 = desvío de relaves vía canal artificial a Caleta Palitos

desde Mina Potrerillos: 1938 - 1958 = 20 años
desde Mina El Salvador: 1959 - 1975 = 16 años
desvío de relaves a Caleta Palitos via canal artificial: 1975

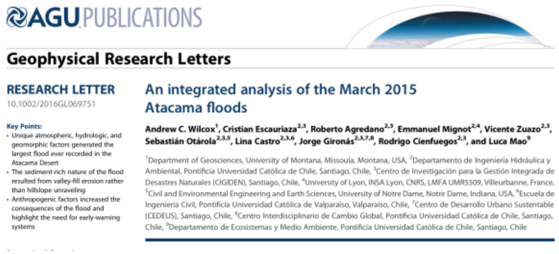
1990 = Corte Suprema prohibió eliminar desechos: CODELCO construyó estanque de relaves *ca.* Diego de Almagro (Pampa Austral)

desde Mina Potrerillos: 1938 - 1958 = 20 años
desde Mina El Salvador: 1959 - 1975 = 16 años
desvío de relaves a Caleta Palitos via canal artificial: 1975
desde Pampa Austral: 1990


Los Amarillos, año 2017
500 m
playa de relaves


Los Amarillos, año 1975

Aluviones en Chañaral: marzo 2015 y mayo 2017


AGU PUBLICATIONS

Geophysical Research Letters

RESEARCH LETTER
10.1002/2016GL069751

Key Points:
- Unique atmospheric, hydrologic, and geomorphic factors generated the largest flood ever recorded in the Atacama Desert
- The sediment-rich nature of the flood resulted from valley-fill erosion rather than hillslope unraveling
- Anthropogenic factors increased the consequences of the flood and highlight the need for early-warning systems

An integrated analysis of the March 2015 Atacama floods

Andrew C. Wilcox[1], Cristian Escauriaza[2,3], Roberto Agredano[2,3], Emmanuel Mignot[2,4], Vicente Zuazo[2,3], Sebastián Otárola[2,3,5], Lina Castro[2,3,6], Jorge Gironás[2,3,7,8], Rodrigo Cienfuegos[2,3], and Luca Mao[9]

[1]Department of Geosciences, University of Montana, Missoula, Montana, USA, [2]Departamento de Ingeniería Hidráulica y Ambiental, Pontificia Universidad Católica de Chile, Santiago, Chile, [3]Centro de Investigación para la Gestión Integrada de Desastres Naturales (CIGIDEN), Santiago, Chile, [4]University of Lyon, INSA Lyon, CNRS, LMFA UMR5509, Villeurbanne, France, [5]Civil and Environmental Engineering and Earth Sciences, University of Notre Dame, Notre Dame, Indiana, USA, [6]Escuela de Ingeniería Civil, Pontificia Universidad Católica de Valparaíso, Valparaíso, Chile, [7]Centro de Desarrollo Urbano Sustentable (CEDEUS), Santiago, Chile, [8]Centro Interdisciplinario de Cambio Global, Pontificia Universidad Católica de Chile, Santiago, Chile, [9]Departamento de Ecosistemas y Medio Ambiente, Pontificia Universidad Católica de Chile, Santiago, Chile

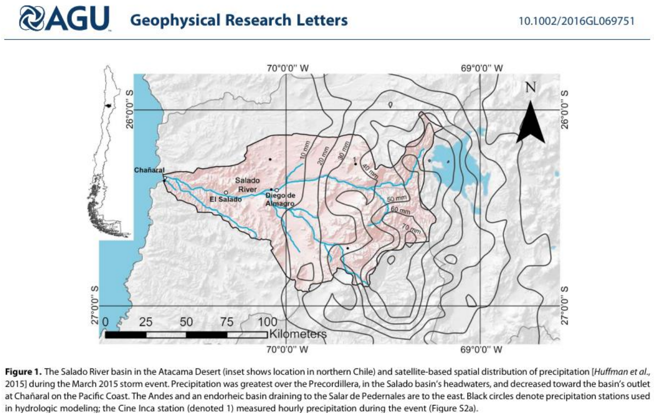

AGU Geophysical Research Letters 10.1002/2016GL069751

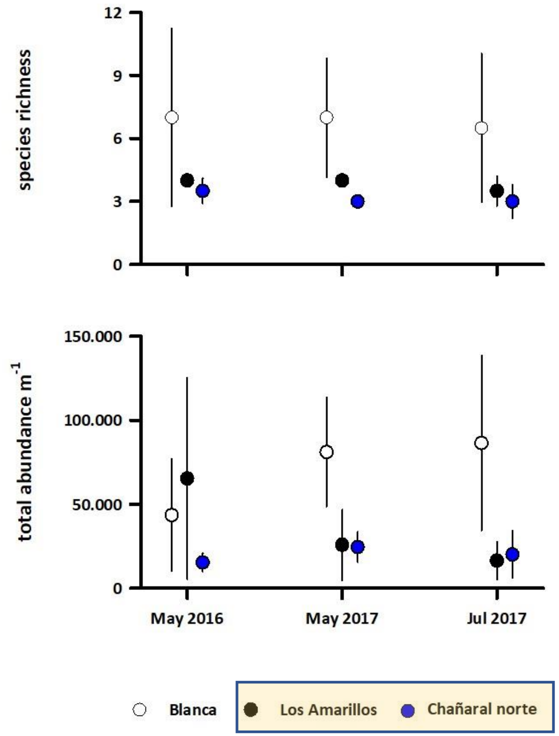
Figure 1. The Salado River basin in the Atacama Desert (inset shows location in northern Chile) and satellite-based spatial distribution of precipitation [*Huffman et al.*, 2015] during the March 2015 storm event. Precipitation was greatest over the Precordillera, in the Salado basin's headwaters, and decreased toward the basin's outlet at Chañaral on the Pacific Coast. The Andes and an endorheic basin draining to the Salar de Pedernales are to the east. Black circles denote precipitation stations used in hydrologic modeling; the Cine Inca station (denoted 1) measured hourly precipitation during the event (Figure S2a).

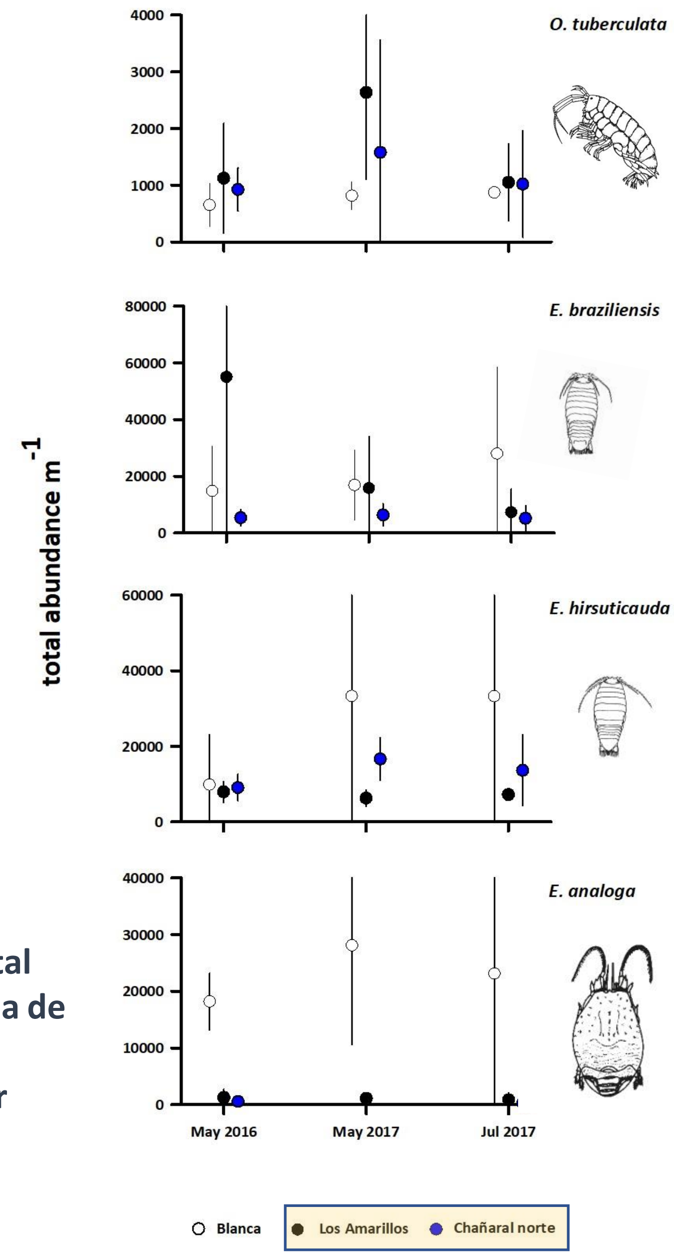
aluvión marzo 2015
terrreno 1: mayo 2016

aluvión mayo 2017
terreno 2: mayo 2017
terreno 2: julio 2017

El experimento natural

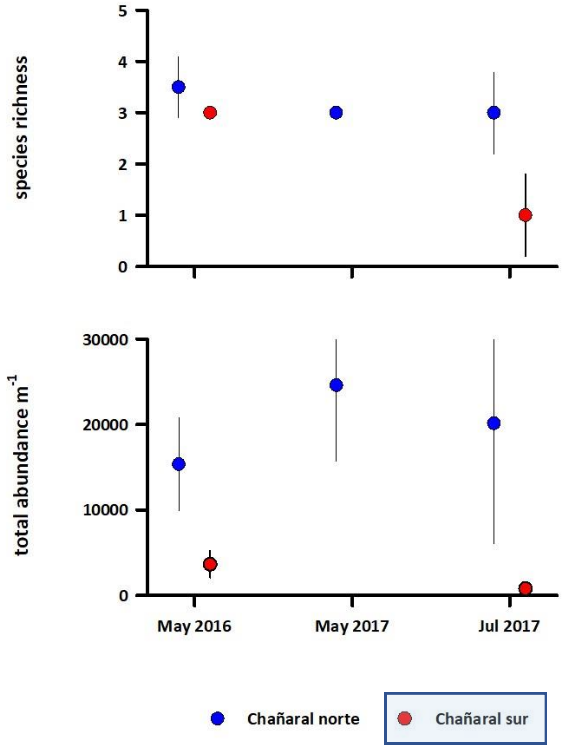
EFECTO DE LOS RELAVES

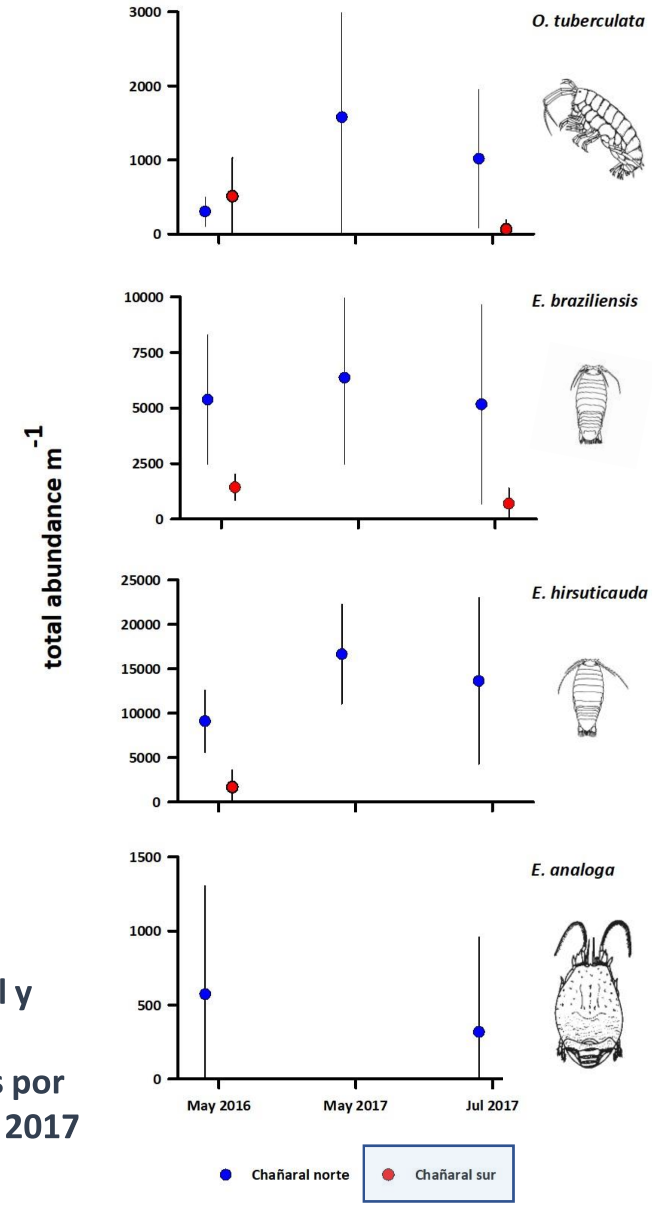




Riqueza de especies, abundancia total de la fauna intermareal y abundancia de *Excirolana hirsuticauda* y *Emerita analoga,* mayormente afectados por relaves

EFECTO DE LOS ALUVIONES





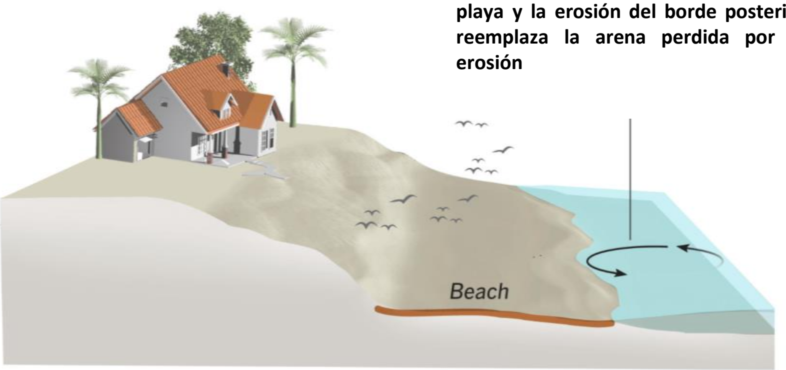
Abundancia total de la fauna intermareal y abundancia de *Excirolana hirsuticauda* y *Emerita analoga,* mayormente afectados por aluviones, especialmente durante el año 2017

INSTALACION DE DEFENSAS COSTERAS

Experimento natural

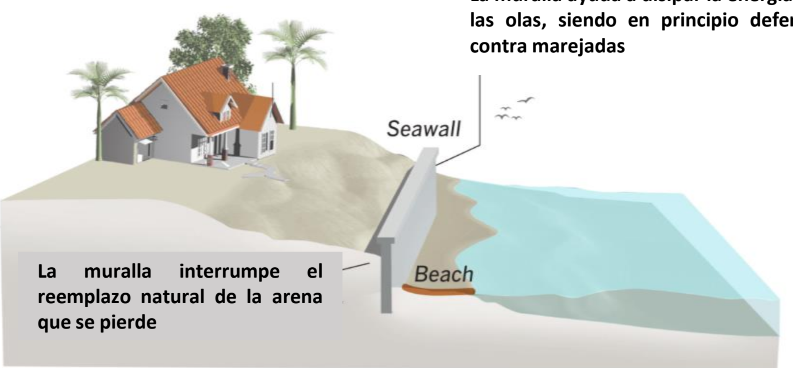
Playa sin muralla (“seawall”)

Las olas mueven arena hacia y desde la playa y la erosión del borde posterior reemplaza la arena perdida por la erosión



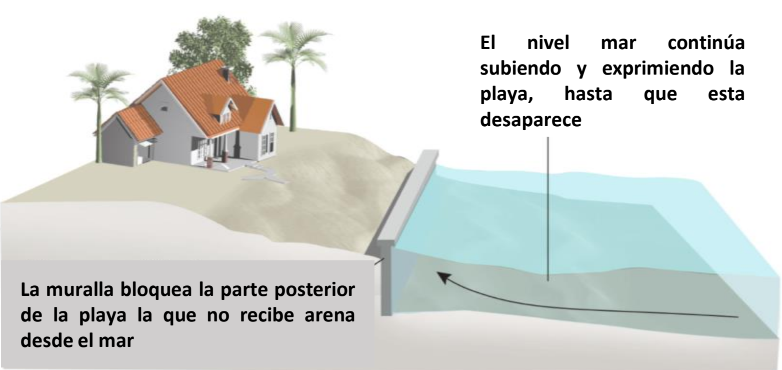
Playa con muralla

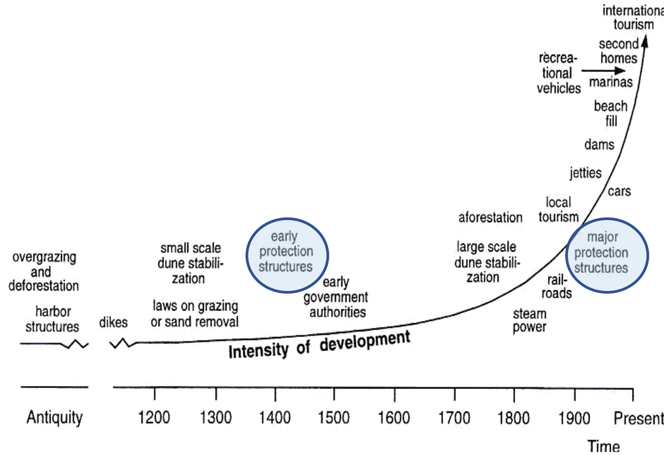
La muralla ayuda a disipar la energía de las olas, siendo en principio defensa contra marejadas



Pérdida gradual de la playa

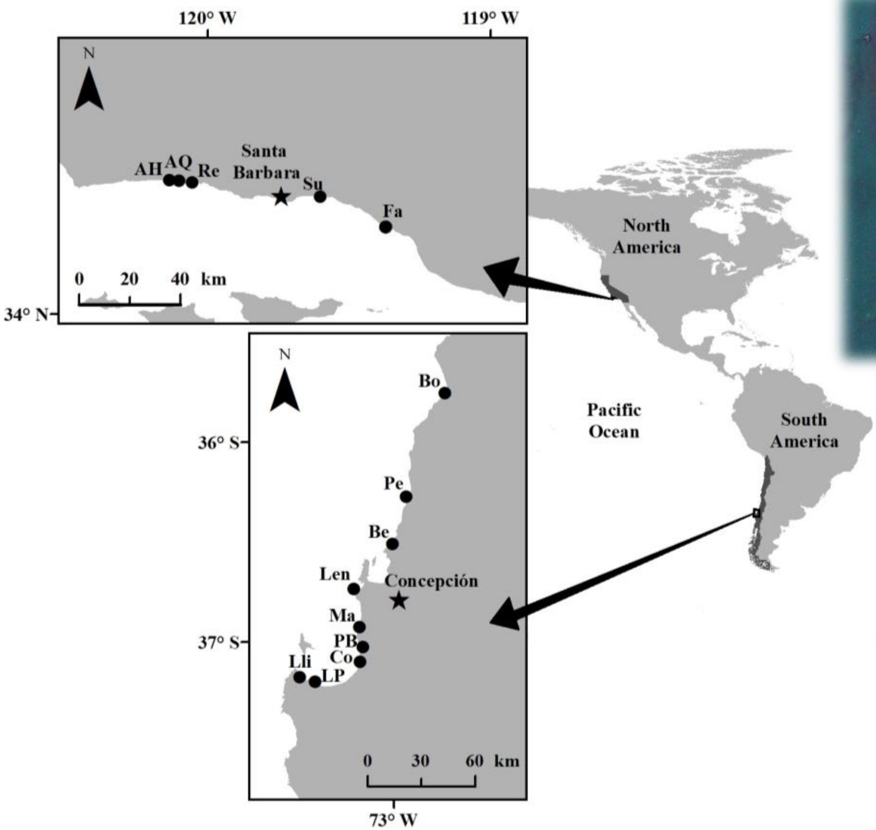
El nivel mar continúa subiendo y exprimiendo la playa, hasta que esta desaparece





UN EXPERIMENTO NATURAL DE GRAN ESCALA

¿ Donde ?



Science of the Total Environment 755 (2021) 142573

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Ranking the ecological effects of coastal armoring on mobile macroinvertebrates across intertidal zones on sandy beaches

Eduardo Jaramillo [a,*], Jenifer Dugan [b], David Hubbard [b], Mario Manzano [a], Cristian Duarte [c,d]

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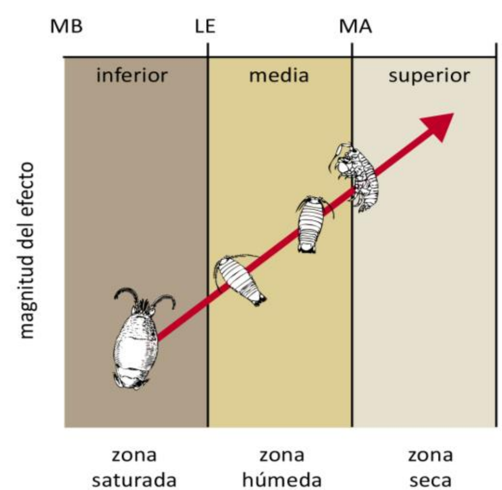
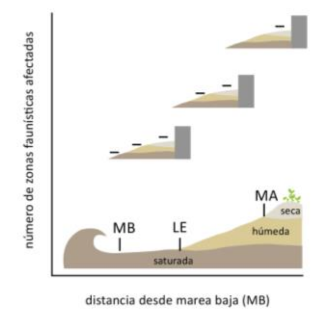
[d] Centro de Investigación Marina de Quintay (CIMARQ), Facultad de Ciencias de la Vida, Universidad Andres Bello, Chile

¿ Como ?

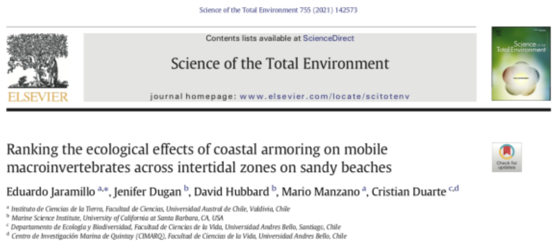
La hipótesis



"La magnitud del efecto de una defensa costera, es mayor en la zona húmeda y seca de la playa"



"El número de zonas afectadas en la playa, aumenta a medida que la defensa coistera se ubica más cerca del nivel de marea baja "


Science of the Total Environment 755 (2021) 142573
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Ranking the ecological effects of coastal armoring on mobile macroinvertebrates across intertidal zones on sandy beaches

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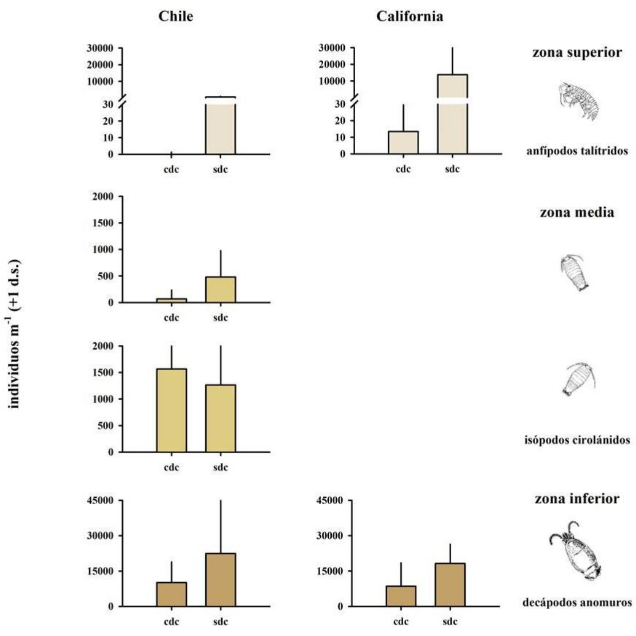
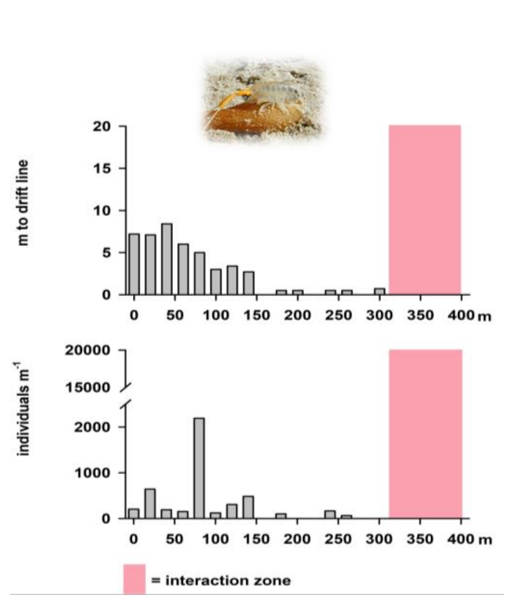
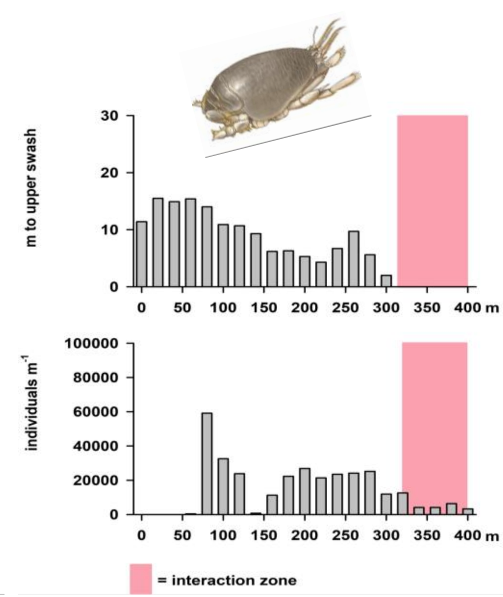


cdc = con defensa costera   sdc = sin defensa costera

Faria, Carpinteria; CA, USA

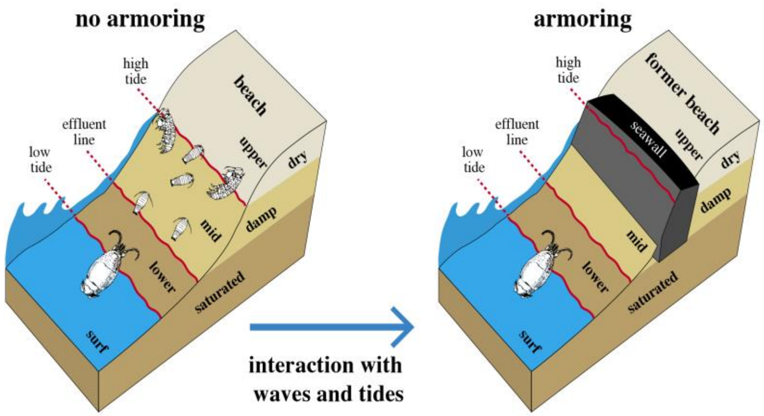


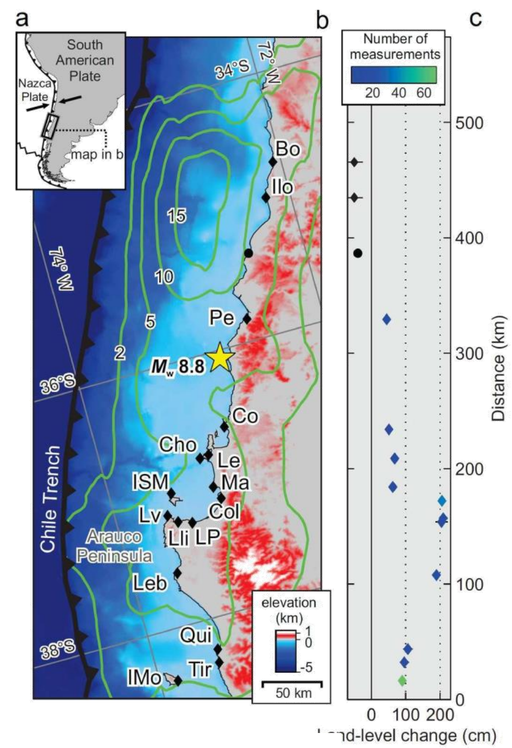


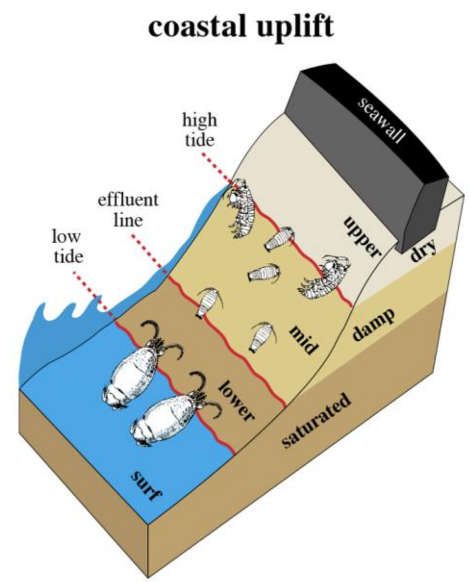
Organismos de los niveles sueriores y medios de la playa los más afectados

CONCLUSIONES DE UN MUESTREO PUNTUAL ("SNAPSHOT SAMPLING") Y NO DE UN EXPERIMENTO MANIPULATIVO !!!!!

NO HEMOS MANIPULADO EL SISTEMA PARA VALIDAR NUESTRAS HIPÓTESIS !!!







Restauración del hábitat… una playa sin defensas costeras y con el complemento de especies típico de una playa natural !!! LA VALIDACIÓN FINAL DE LA HIPÓTESIS

OPEN ACCESS Freely available online

PLoS one

Ecological Implications of Extreme Events: Footprints of the 2010 Earthquake along the Chilean Coast

Eduardo Jaramillo[1]*, Jenifer E. Dugan[2], David M. Hubbard[2], Daniel Melnick[3], Mario Manzano[1], Cristian Duarte[4], Cesar Campos[1], Roland Sanchez[1]

1 Instituto de Ciencias Ambientales y Evolutivas, Universidad Austral de Chile, Valdivia, Chile, 2 Marine Science Institute, University of California Santa Barbara, Santa Barbara, California, United States of America, 3 Institut für Geowissenschaften, Universität Potsdam, Potsdam, Germany, 4 Instituto de Ciencias Marinas y Limnológicas, Universidad Austral de Chile, Valdivia, Chile

MAREJADAS Y TSUNAMIS

Experimento natural

Bahía de Coquimbo: marejadas *vs.* tsunami


cooperativa.cl
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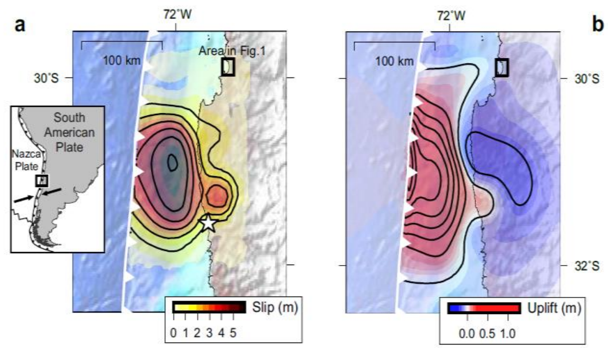
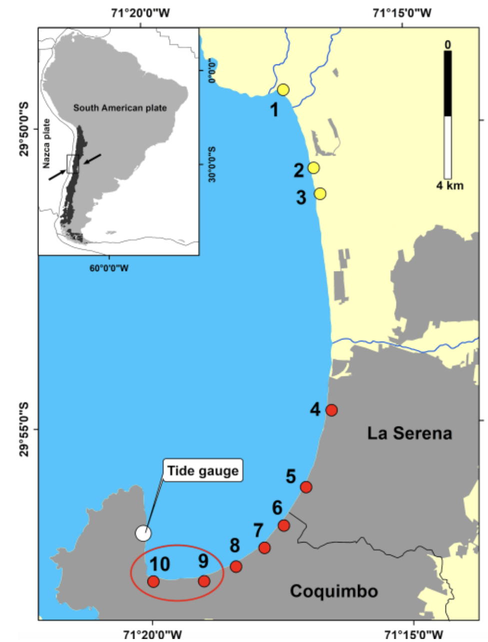
Tópicos: País | Tiempo

Sistema frontal: Olas de hasta seis metros por marejadas en el litoral central

Publicado: Sabado, 8 de Agosto de 2015 a las 13:48hrs. Autor: Cooperativa.cl

- Entre Coquimbo y Biobío se registran vientos de hasta 120 kilómetros por hora.
- Las autoridades realizaron un llamado al autocuidado por las marejadas.

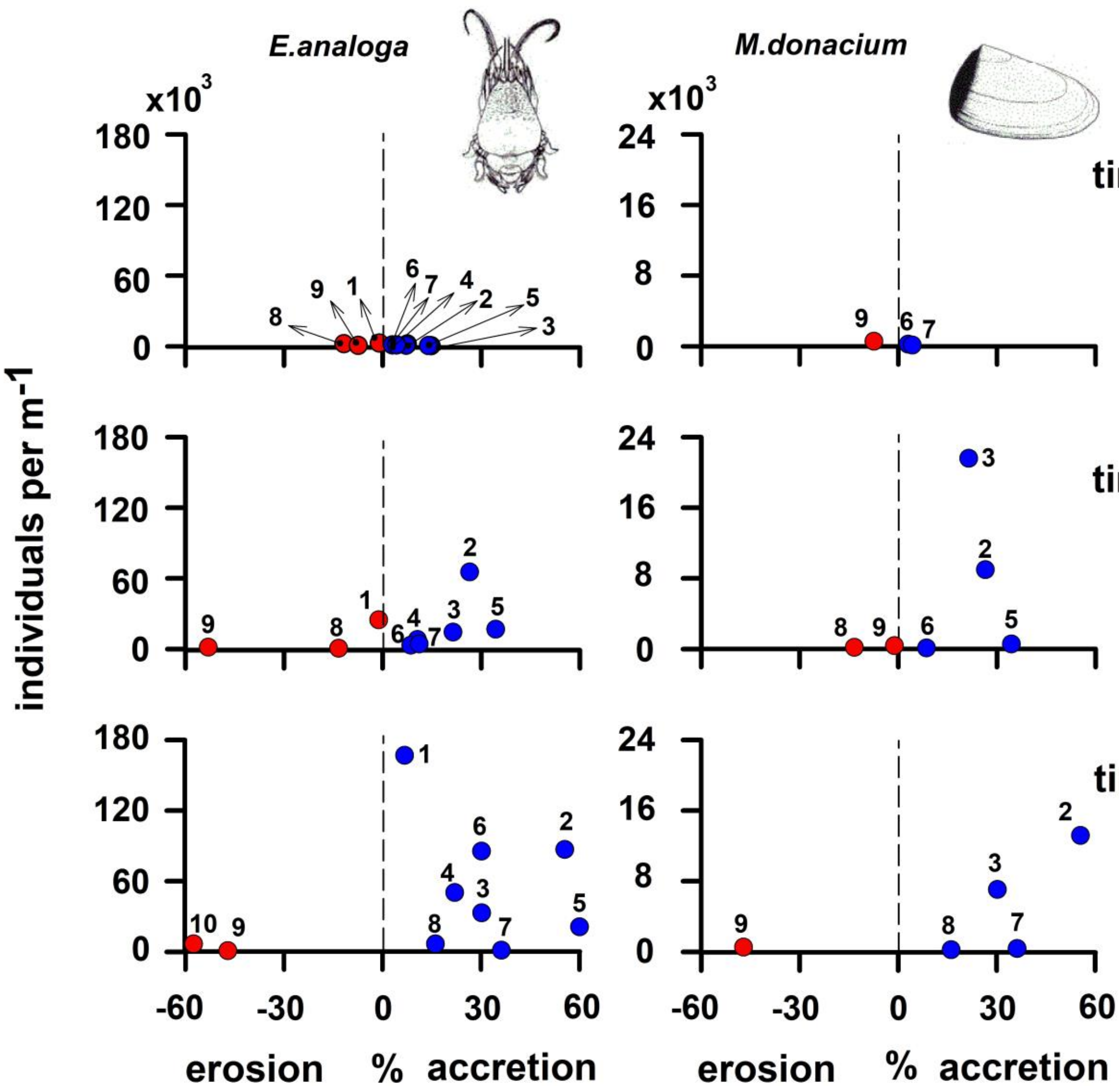




<u>tiempo 1</u> = datos recolectados 3 semanas después de las marejadas (27-29 August, 2015) *vs.* 1 semana después de las mismas (recuperación de la playa luego de las marejadas)

<u>tiempo 2</u> = datos recolectados 10 días después del T (25-26 September, 2015) *vs.* datos recolectados 3 semanas después de las marejadas (27-29 August, 2015) (respuesta de corto plazo al tsunami)

<u>tiempo 3</u> = datos recolectados tres meses después del T (13-15 December, 2015) *vs.* datos recolectados 10 días después de la ocurrencia del mismo (respuesta de mediano plazo al tsunami)



time 1 **= 3 weeks after storm surges**

time 2 **= 10 days after tsunami**

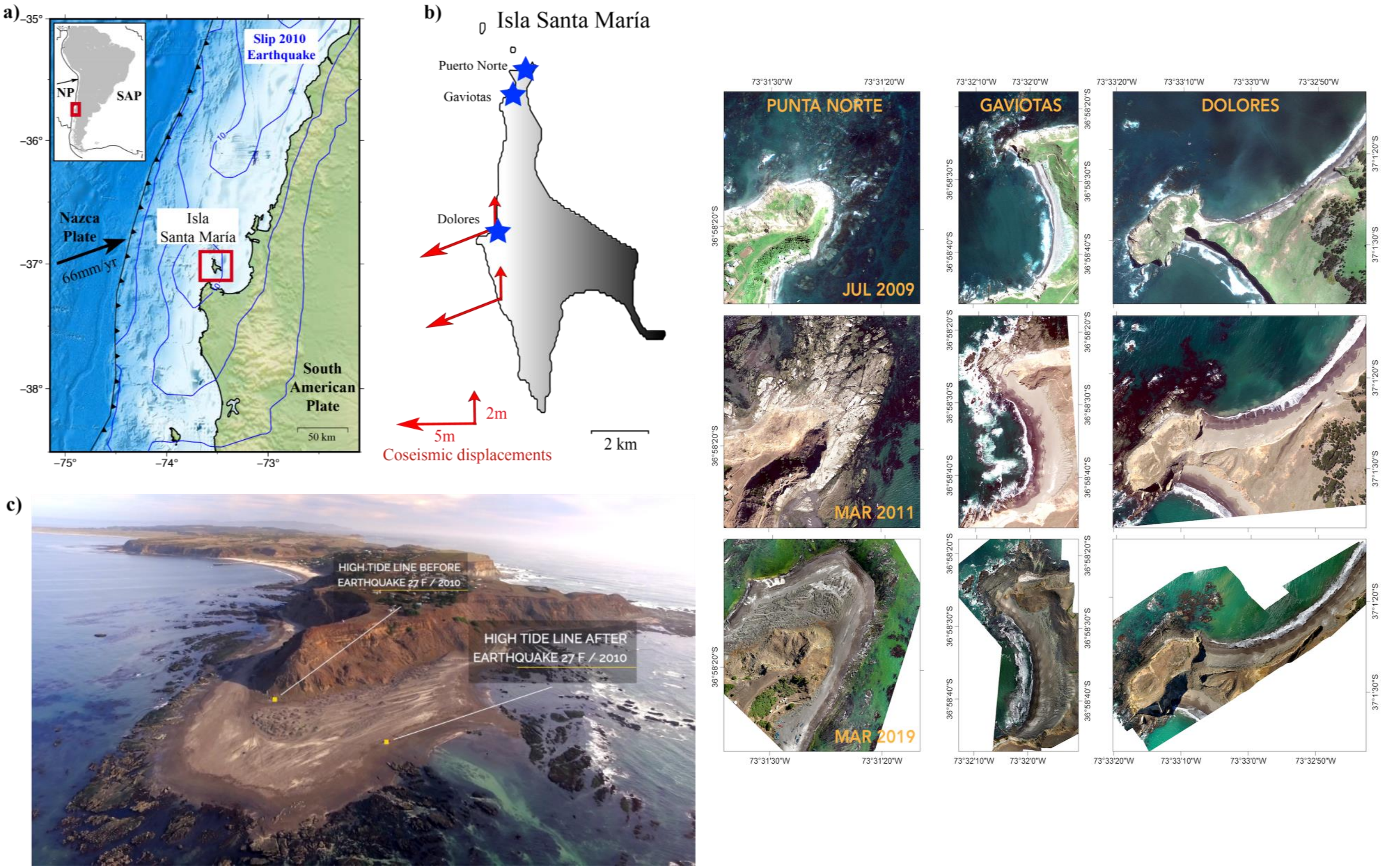
time 3 **= 3 months after tsunami**

Mayor afectación de las marejadas - el tsunami restuaró el volumen de arena y abundancia de especiés icónicas de la playa

RECONVERSION DE HABITAT

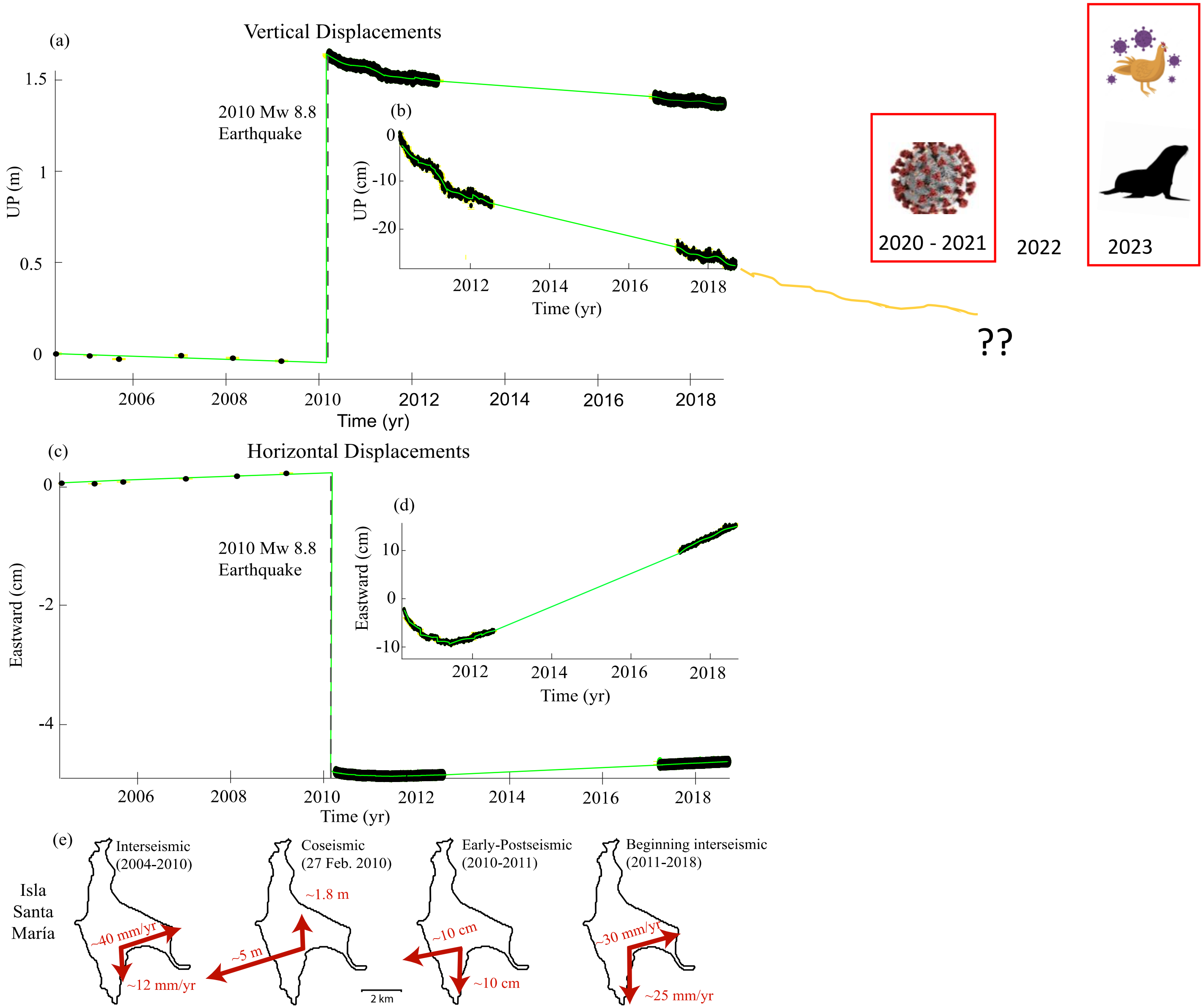
Experimento natural

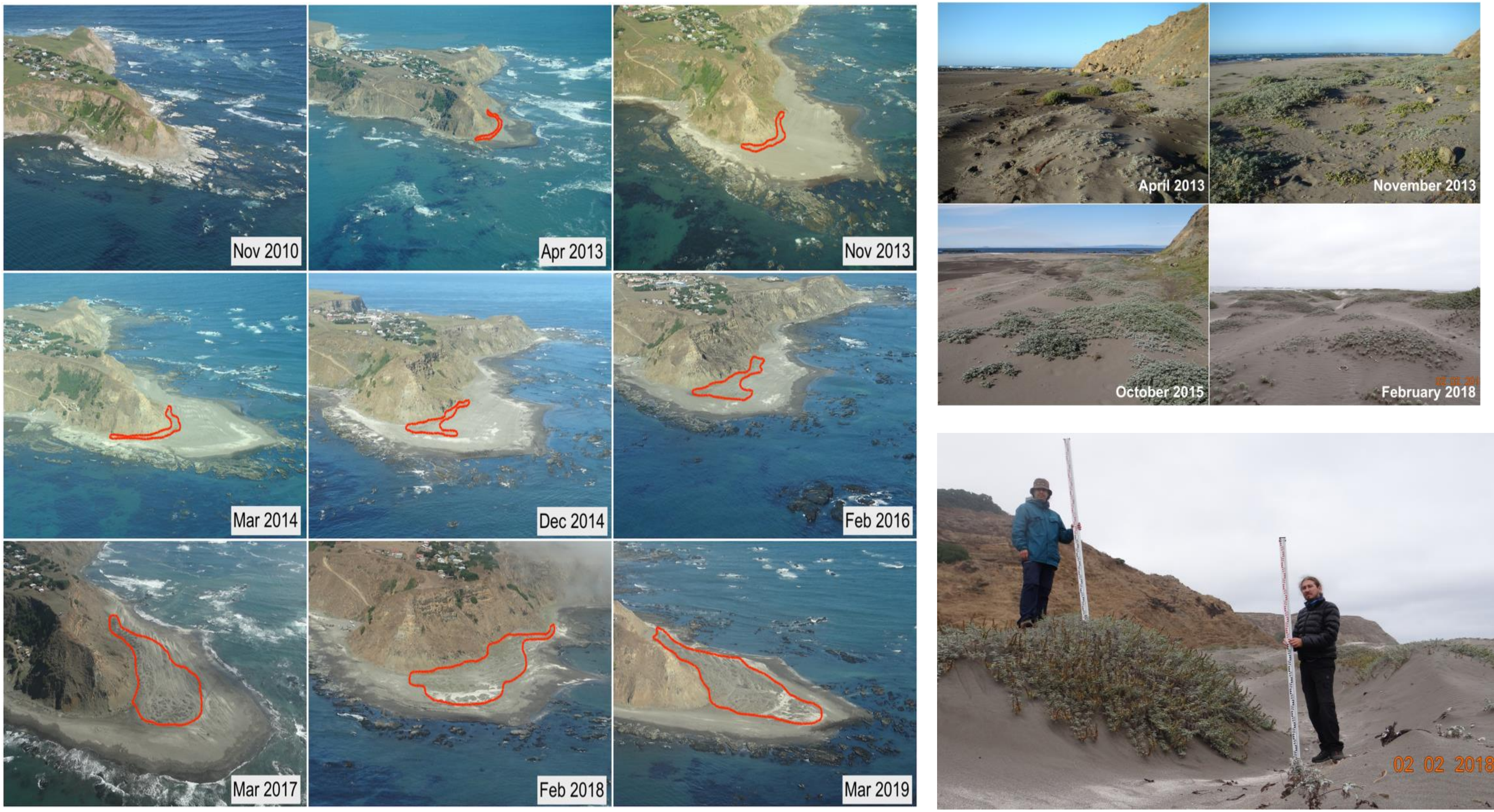
ISLA SANTA MARIA, TERREMOTOS, FITZROY Y GEODESIA BIOLOGICA



RAPID COASTAL HABITAT CONVERSIONS AND RESPONSES OF BIODIVERSITY DURING THE FIRST DECADE OF A CYCLE OF GREAT EARTHQUAKES IN CHILE

Jaramillo, E., Moreno, M., Baez, J.C., Hernandez, A. (*in litteris*)




Nov 2010
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April 2013
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October 2015
February 2018
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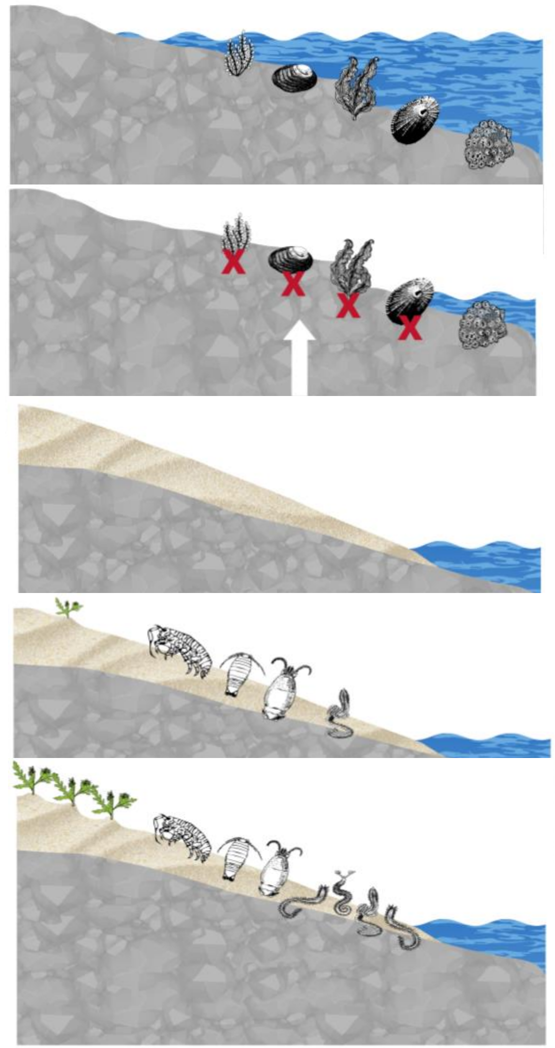


INTERSISMICO (pre 27F 2010)

Submareal rocoso = algas e invertebrados

COSISMICO (27F 2010)

Intermareal rocoso = mortandad masiva de algas e invertebrados

POST SISMICO ABIOTICO (inicios 2012)

Aparición de playa arenosa

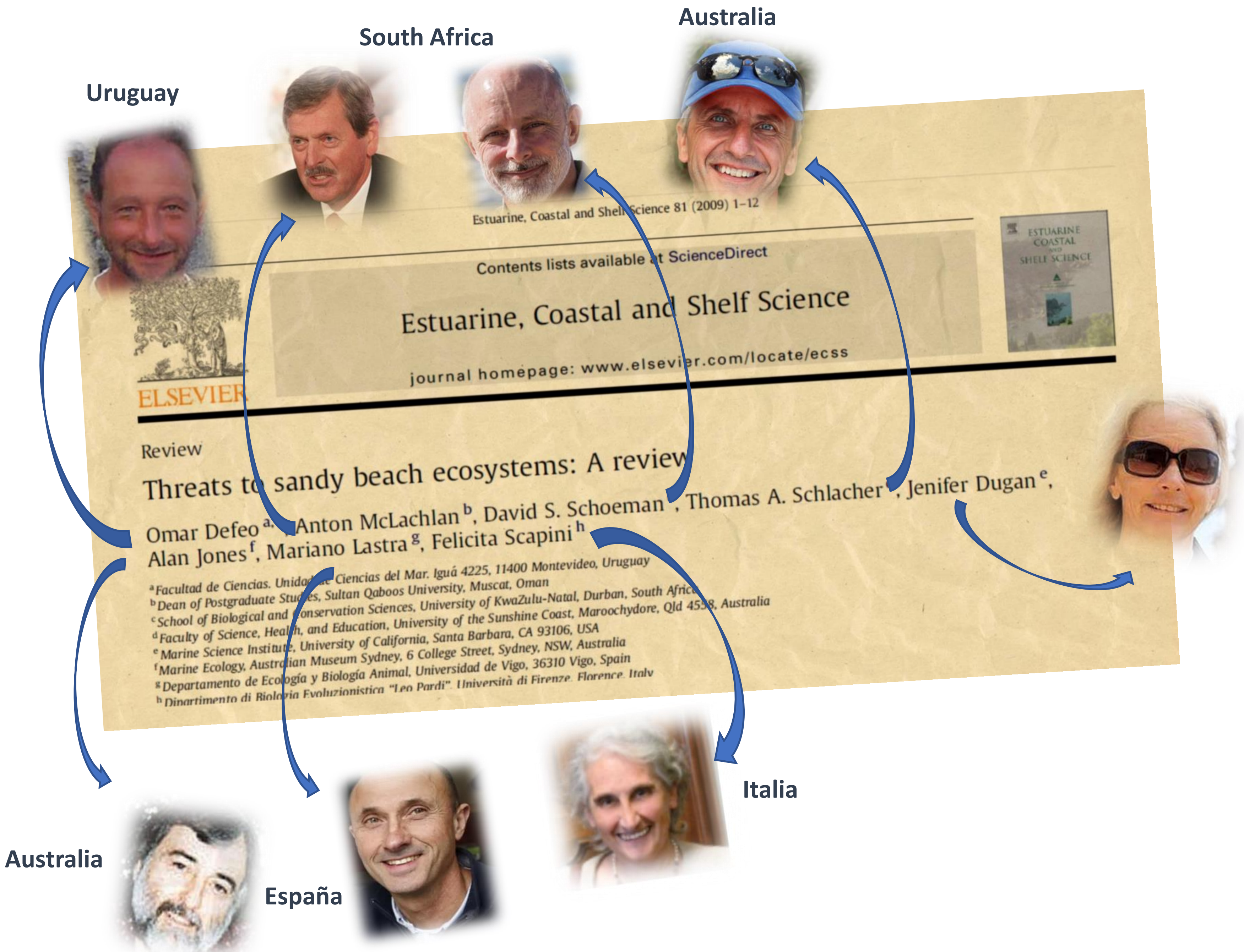
POST SISMICO BIOTICO (mediados 2012)

Colonización de plantas terrestres e invertebrados con dominancia de crustáceos

POST SISMICO CON UNA PLAYA EN BAHIA (2018 al presente ?????????)

Estabilización de dunas y cambio de dominancia de invertebrados (anélidos poliquetos se convierten en la fauna dominante) (EMBAYMENTIZATION = playa en bahía = hábitat no expuesto directamente al oleaje)

EL MIRAR MAS ALLA DE LA PLAYA



Estuarine, Coastal and Shelf Science 81 (2009) 1–12

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Estuarine, Coastal and Shelf Science

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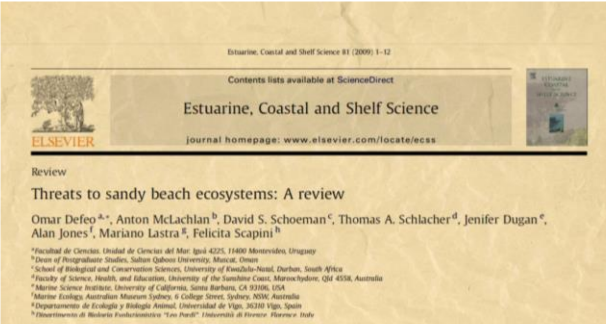
ELSEVIER

Review

Threats to sandy beach ecosystems: A review

Omar Defeo[a,*], Anton McLachlan[b], David S. Schoeman[c], Thomas A. Schlacher[d], Jenifer Dugan[e], Alan Jones[f], Mariano Lastra[g], Felicita Scapini[h]

[a] Facultad de Ciencias. Unidad de Ciencias del Mar. Iguá 4225, 11400 Montevideo, Uruguay
[b] Dean of Postgraduate Studies, Sultan Qaboos University, Muscat, Oman
[c] School of Biological and Conservation Sciences, University of KwaZulu-Natal, Durban, South Africa
[d] School of Science, Health, and Education, University of the Sunshine Coast, Maroochydore, Qld 4558, Australia
[e] Marine Science Institute, University of California, Santa Barbara, CA 93106, USA
[f] Marine Ecology, Australian Museum Sydney, 6 College Street, Sydney, NSW, Australia
[g] Departamento de Ecología y Biología Animal, Universidad de Vigo, 36310 Vigo, Spain
[h] Dipartimento di Biologia Evoluzionistica "Leo Pardi", Università di Firenze, Florence, Italy



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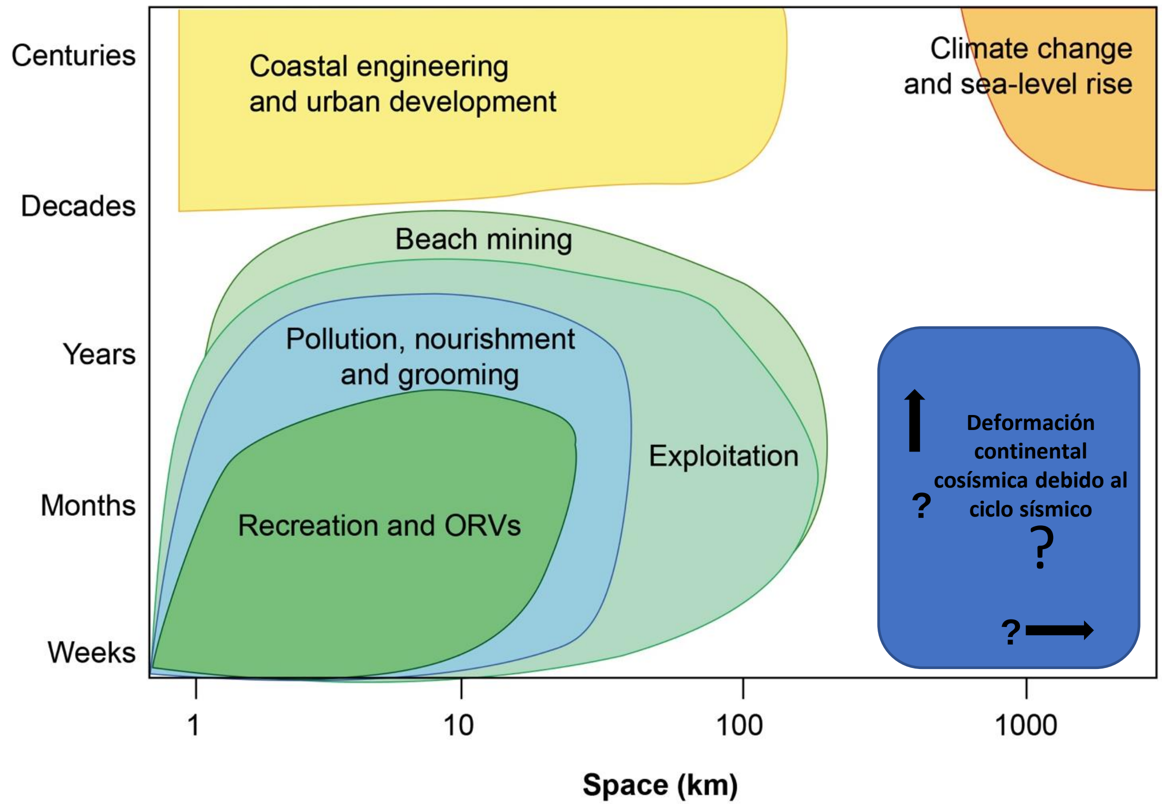

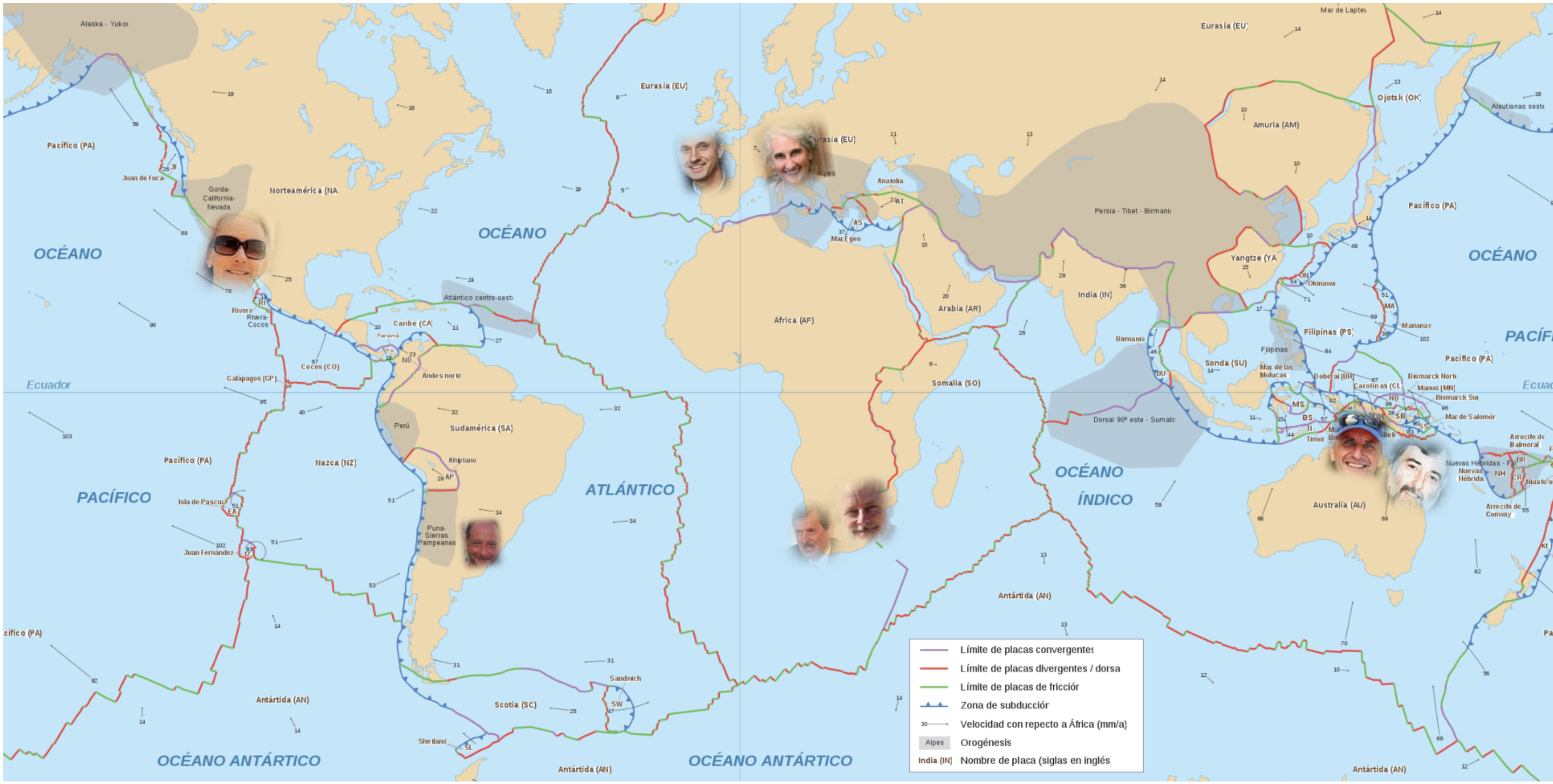

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Ojotsk (OK)
Aleutianas oeste
Mar de Laptev
Yangtze (YA
Okinawa
Filipinas (PS)
Marianas
India (IN)
Arabia (AR)
África (AF)
Somalia (SO)
Birmania
Sonda (SU)
Mar de las Molucas
Dorsal 90º este - Sumatra
Atlántico centro-oeste
Caribe (CA)
Panamá
Andes norte
Rivera
Rivera-Cocos
Cocos (CO)
Galápagos (GP)
Nazca (NZ)
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Puna-Sierras Pampeanas
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Juan Fernández
Scotia (SC)
Sandwich
Shetland
Antártida (AN)
Australia (AU)
Bismarck Norte
Manus (MN)
Bismarck Sur
Mar de Salomón
Carolinas (CL)
Nuevas Hébridas - Fiji
Arrecife de Balmoral
Arrecife de Conway
Niuafo'ou
Timor
Límite de placas convergentes
Límite de placas divergentes / dorsa
Límite de placas de fricción
Zona de subducción
Velocidad con repecto a África (mm/a)
Orogénesis
Nombre de placa (siglas en inglés

Subducción tectónica + malas prácticas = aniquilamiento de la resiliencia ecológica y social

Cómo se vive en Timbulsloko, la re… …a que se hunde 20 centímetros al año y… …sumergida

La crisis climática golpeará duramente a… …adas e incluso se ha proyectado que gran parte de su capital, Yakarta, esté i…

24 de Julio de 2023 | 18:25 | AFP / E…

8

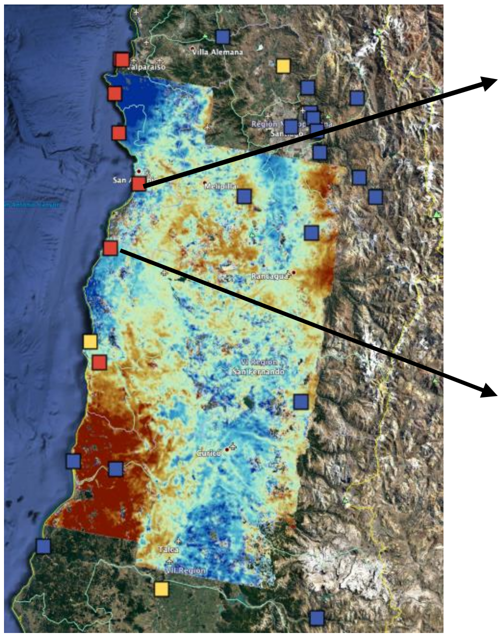
CHILE 1973 - 2023

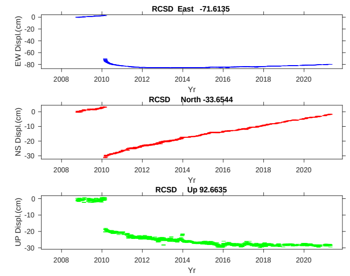
El MAPU, una escisión de la DC que quería ir más allá del "reformismo"

51

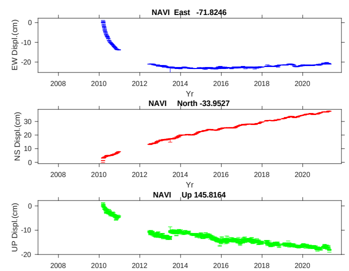
LOS EFECTOS DEL CICLO SISMICO VARIAN LATITUDINALMENTE EN LA COSTA CHILENA

subsidencia



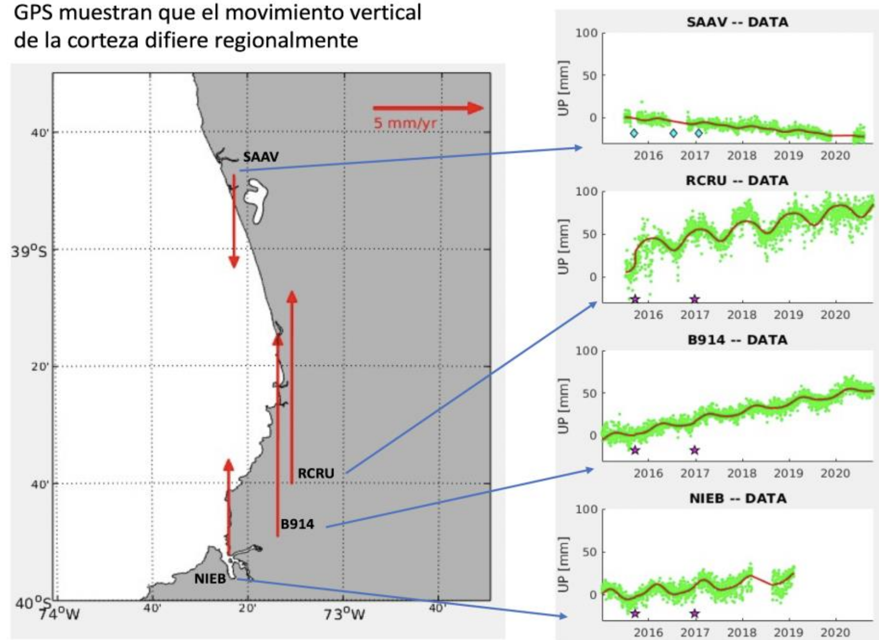


subsidencia

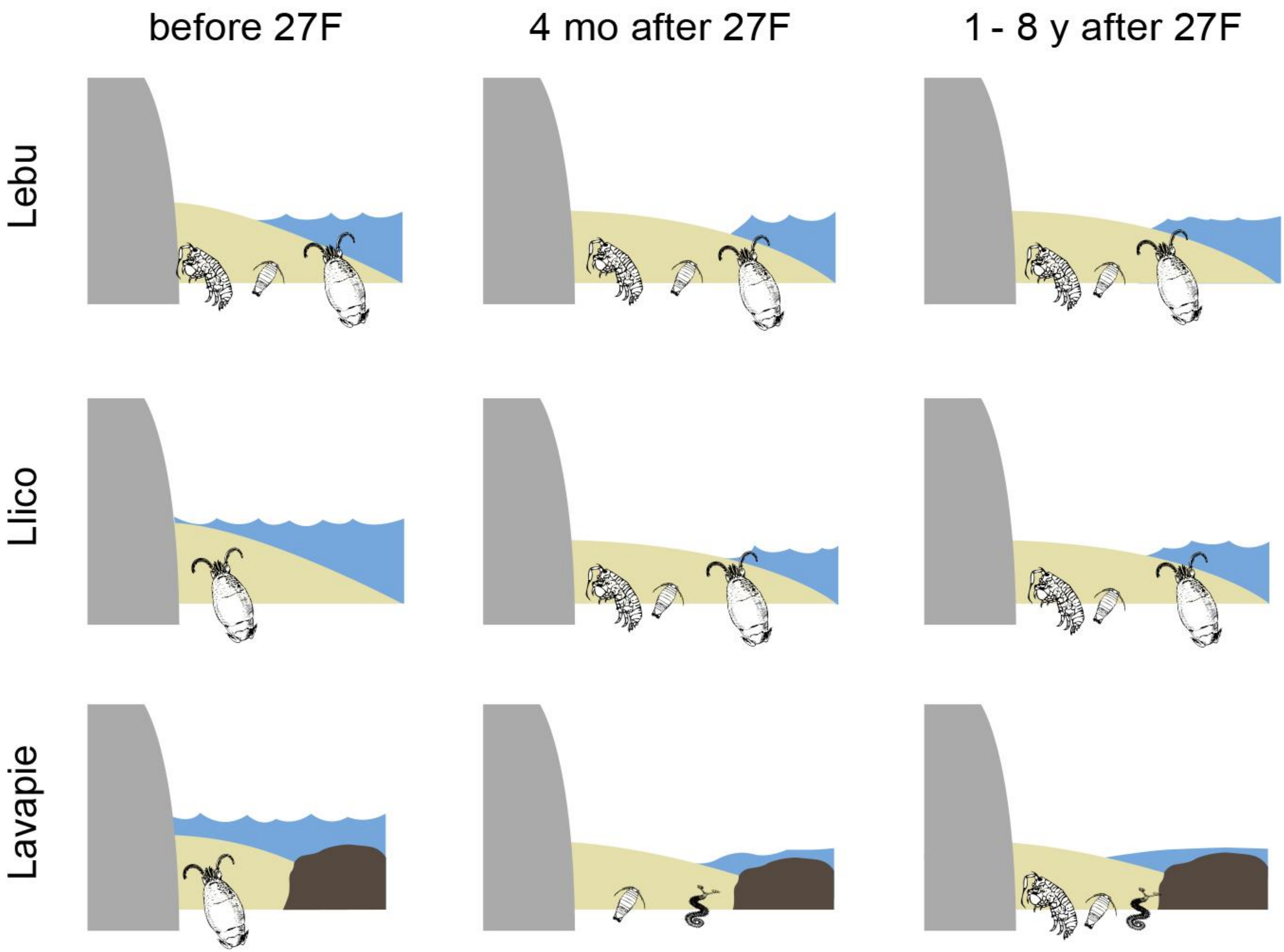


Fuente: Dr. JC Baez, Centro Sismológico Nacional, U Chile

GPS muestran que el movimiento vertical de la corteza difiere regionalmente



Fuente: Dr. M Moreno, PUC


before 27F
4 mo after 27F
1 - 8 y after 27F
Lebu
Llico
Lavapie

VIII International Sandy Beach Symposium

ISBS 2018

Heraklion, Greece • Ηράκλειο, Ελλάδα

May, 25 - 29, 2018

Linking knowledge to build integrated paradigms and face global change challenges

urbanización y defensas costeras = pérdida de hábitat por ocupación

aumento del nivel del mar y frecuencia de marejadas = pérdida de hábitat por arrastre

Ciclo sísmico = deformación continental

ORIGINAL ARTICLE

Sandy beach ecosystems: key features, sampling issues, management challenges and climate change impacts

Thomas A. Schlacher[1], Dave S. Schoeman[2], Jenifer Dugan[3], Mariano Lastra[4], Alan Jones[5], Felicita Scapini[6] & Anton McLachlan[7]

Marine Ecology 29 (Suppl. 1) (2008) 70–90 © 2008 The Authors. Journal compilation © 2008 Blackwell Publishing Ltd

Table 1. Environmental values of sandy beaches[a].

value	mainly human (socio-economic)	mainly environmental (ecological)
recreation & tourism	X	
cultural/historical connections	X	
wilderness quality/experience	X	
education & research	X	
sport & entertainment venues	X	
transport corridors	X	
boating (craft launching, jet skies)	X	
fishing and shellfish harvesting	X	
mining	X	
maintaining human health & well-being	X	
real estate	X	
military installations	X	
storm protection (properties, infrastructure, dunes)	X	X
wildlife (birds & other larger, easily visible fauna)	X	X
seawater filtration & nutrient recycling – water quality	X	X
bequest value	X	X
nursery and foraging sites for fishes	X	X
biodiversity		X
habitat		X
nesting and foraging sites for birds and turtles		X
intrinsic ecological value		X

[a]Because environmental values strongly depend on the specific social and cultural context, they are not ranked or prioritised in this table.

Ecosystem Services 57 (2022) 101477

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Full Length Article

Sandy shore ecosystem services, ecological infrastructure, and bundles: New insights and perspectives

Linda R. Harris[a,*], Omar Defeo[b]

Table 1
Relative supply of sandy shore ecosystem services (sensu CICES v5.1), within each component of the littoral active zone: foredunes (dune), beach, and surf zone (surf). Colours from light to dark, and bubble size from small to large, indicate low, medium, and high supply; the empty cells indicate absence. Section, Code and Class correspond to those columns in CICES v5.1 (Appendix A.2); ID refers to the sandy shore ecosystem service number, from 1 to 56. Refer to Appendix A.2 for examples of each service for sandy shores. (For a colour version of this table, the reader is referred to the web version of this article).

Section	Code	ID	Class (ecosystem service)	Dune	Beach	Surf
Provisioning (Biotic)	1.1.4.1	1	Animals reared by in-situ aquaculture for nutritional purposes		•	·
	1.1.5.1	2	Wild plants (terrestrial and aquatic, including fungi, algae) used for nutrition	·		
	1.1.5.2	3	Fibres and other materials from wild plants for direct use or processing (excluding genetic materials)	·	·	
	1.1.6.1	4	Wild animals (terrestrial and aquatic) used for nutritional purposes	·	●	●
	1.1.6.2	5	Fibres and other materials from wild animals for direct use or processing (excluding genetic materials)		•	·
	1.2.1.1	6	Seeds, spores and other plant materials collected for maintaining or establishing a population	·		
	1.2.2.1	7	Animal material collected for the purposes of maintaining or establishing a population		•	·
Regulation and Maintenance (Biotic)	2.1.1.1	8	Bio-remediation by micro-organisms, algae, plants, and animals	·	•	·
	2.1.1.2	9	Filtration/sequestration/storage/accumulation by micro-organisms, algae, plants, and animals	•	●	·
	2.1.2.1	10	Smell reduction	·	●	●
	2.1.2.2	11	Noise attenuation	·		
	2.1.2.3	12	Visual screening	·		
	2.2.1.1	13	Control of erosion rates	●		
	2.2.1.2	14	Buffering and attenuation of mass movement	●		
	2.2.1.3	15	Hydrological cycle and water flow regulation (including flood control, and coastal protection)	●	·	•
	2.2.1.4	16	Wind protection	●		
	2.2.2.1	17	Pollination (or 'gamete' dispersal in a marine context)	•	●	●
	2.2.2.2	18	Seed dispersal	•		
	2.2.2.3	19	Maintaining nursery populations and habitats (including gene pool protection)	●	●	●
	2.2.4.1	20	Weathering processes and their effect on soil quality	·	•	•
	2.2.4.2	21	Decomposition and fixing processes and their effect on soil quality	●	•	
	2.2.5.2	22	Regulation of the chemical condition of salt waters by living processes	•	●	●
	2.2.6.1	23	Regulation of chemical composition of atmosphere and oceans	·	·	•
	2.2.6.2	24	Regulation of temperature and humidity, including ventilation and transpiration	·		●
Cultural (Biotic)	3.1.1.1	25	Characteristics of living systems that that enable activities promoting health, recuperation or enjoyment through active or immersive interactions	•	●	●
	3.1.1.2	26	Characteristics of living systems that enable activities promoting health, recuperation or enjoyment through passive or observational interactions	●	●	●
	3.1.2.1	27	Characteristics of living systems that enable scientific investigation or the creation of traditional ecological knowledge	●	●	●
	3.1.2.2	28	Characteristics of living systems that enable education and training	●	●	●
	3.1.2.3	29	Characteristics of living systems that are resonant in terms of culture or heritage	●	●	●
	3.1.2.4	30	Characteristics of living systems that enable aesthetic experiences	●	●	●
	3.2.1.1	31	Elements of living systems that have symbolic meaning	●	•	●
	3.2.1.2	32	Elements of living systems that have sacred or religious meaning	•	•	●
	3.2.1.3	33	Elements of living systems used for entertainment or representation	●	●	●
	3.2.2.1	34	Characteristics or features of living systems that have an existence value	●	●	●
	3.2.2.2	35	Characteristics or features of living systems that have an option or bequest value	●	●	●
Provisioning (Abiotic)	4.2.1.1	36	Surface water for drinking			·
	4.2.1.2	37	Surface water used as a material (non-drinking purposes)			·
	4.2.1.4	38	Coastal and marine water used as energy source			·
	4.2.2.1	39	Ground (and subsurface) water for drinking		·	
	4.3.1.1	40	Mineral substances used for nutritional purposes			•
	4.3.1.2	41	Mineral substances used for material purposes	●	•	
	4.3.2.1	42	Non-mineral substances or ecosystem properties used for nutritional purposes	●	●	●
	4.3.2.2	43	Non-mineral substances used for materials	●	•	
	4.3.2.4	44	Solar energy	·	·	
Regulation and Maintenance (Abiotic)	5.1.1.1	45	Dilution by freshwater and marine ecosystems		•	•
	5.1.1.3	46	Mediation by other chemical or physical means (e.g. via filtration, sequestration, storage or accumulation)	·	●	·
	5.1.2.1	47	Mediation of nuisances by abiotic structures or processes	●		
	5.2.1.1	48	Mass flows	·	·	•
	5.2.1.2	49	Liquid flows	●	·	•
	5.2.1.3	50	Gaseous flows	●		
	5.2.2.1	51	Maintenance and regulation by inorganic natural chemical and physical processes	●	•	●
	5.3.X.X	52	Other: Seed, larval and gamete dispersal by physical processes	●	●	●
Cultural (Abiotic)	6.1.1.1	53	Natural, abiotic characteristics of nature that enable active or passive physical and experiential interactions	●	●	●
	6.1.2.1	54	Natural, abiotic characteristics of nature that enable intellectual interactions	●	●	●
	6.2.1.1	55	Natural, abiotic characteristics of nature that enable spiritual, symbolic and other interactions	●	●	●
	6.2.2.1	56	Natural, abiotic characteristics or features of nature that have either an existence, option or bequest value	●	●	●

CICES www.cices.eu

Towards a common classification of ecosystem services

European Environment Agency

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CICES: COMMON INTERNATIONAL CLASIFICATION OF ECOSYSTEM SERVICES

SERENDIPIA Y EXPERIMENTOS NATURALES

"hallazgo fortuito de algo que no se estaba buscando y que dice relación con el interés de búsqueda…"

- **Terremoto de subdución seguido de un tsunami**
- **Erupciones volcánicas y lahares**
- **Aluviones**
- **Gripe aviar y humedal costero estuarial**

¿ Ocurre recuperación de una playa afectada por una perturbación puntual ? Cuan resiliente es una playa reflectiva *versus* una disipativa ? Podemos preparar la resiliencia ecológica de una playa ? Podemos adelantarnos al futuro en la era del Antropoceno ?

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PERSPECTIVES

Messages from a Mountain

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The eruptive episode of Mount St. Helens that began on 18 May 1980 [HN1] created an unprecedented natural laboratory for studying the effects of large disturbances on ecosystems and the processes that affect ecological recovery [HN2]. Its richness lay not only in its size but also in the complexity of the disturbance (comprising a decapitating landslide, the blast, pyroclastic and debris flows, and volcanic ash depositions) and in the interaction of subsequent eruptive events over space and time. Following the erup-

GRACIAS