CoastGIS 2021

CoastGIS 2021

Novia University, Raseborg Finland
Sept 16-17, 2021

‘Advancing Sustainable Coastal Planning through Effective Use of Open-Access Biodiversity Information Systems’

Where getting names right always matters!

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Outline ...

- Present situation ...
  - Ecosystem change
  - Information infrastructure
  - Challenges
  - Getting names right
- Using data science ...
  - Data Preparation
  - Data Visualisations
  - Control panel / Dashboard
- Recap
  - Software components
  - Benefits
  - More Challenges
- Conclusion
  - What’s next
  - Collaboration
- Demos

Ecosystem Change

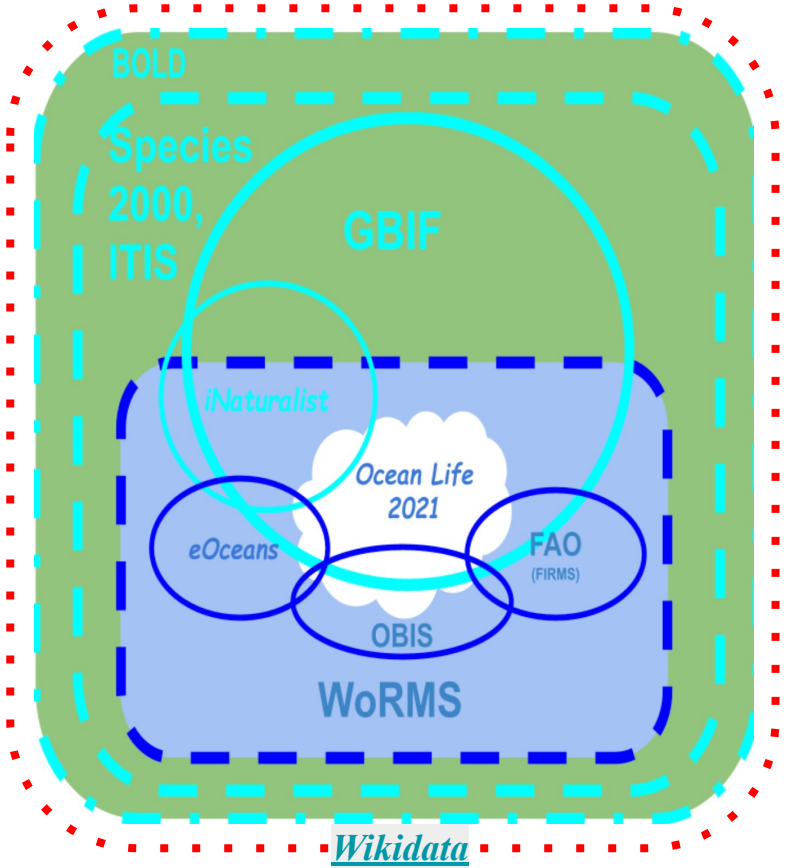
Invasive Species

"Removing green crab proves effective in controlling invasive species."

HALIFAX, 2016 … trap invented by a local fisherman was used to catch more than two million green crab [*Carcinus maenas* Linnaeus, 1758] from one estuary over a few years. Since then, eelgrass [*Zostera L.*] in that estuary has recovered by about 34 per cent and soft-shell clam [*Mya arenaria* Linnaeus] populations are on the rise ...

Atlantic CTV News

Information Infrastructure



What's in a name? Wikidata, World Register of Marine Species#History, Taxonomy (biology)#Taxonomic descriptions , Taxonomy mnemonic , Oceanlife-2021/domains…

Challenges

Scientific names change over time*

- 55 of 73 Ocean Life 1859 scientificNames required updating …

Data are not all in one place ..

- 63 of 78m OBIS obs (~80%) and 13 of 40m iNat Research Grade obs (~33%) not on GBIF

WoRMS/OBIS.authority not = GBIF.authority

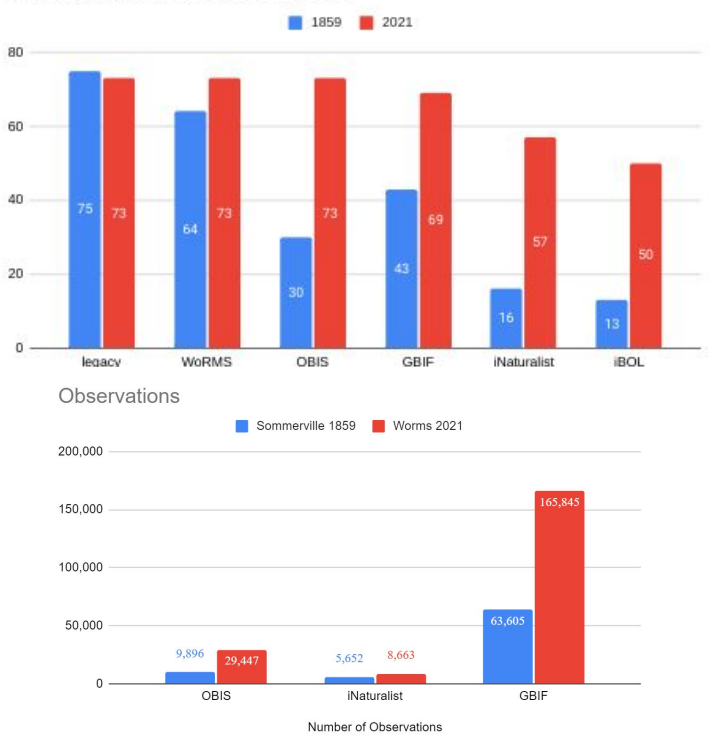
- 26 of 68 GBIF.authorities contained abbreviations, 14 of 68 GBIF.authorities did not include year . The GBIF search window rejected WoRMS/OBIS.scientificName that contained dates

Inconsistent approach between portals regarding data queries, downloads & citations

OBIS and GBIF downloads often **too large** for Google Sheets

Getting Names Right

Using World Registry of Marine Species (WORMS) accepted names greatly improve query results ...



See Oceanlife-2021/worms

Using Data Science ...

*ocean.si.edu/ocean-life/5-invasive-species-you-should-know

Species

Carcinus maenas [European Green Crab]*
Caulerpa taxifolia [Killer Algae]*
Codium fragile [Dead Man's Fingers]
Dreissena polymorpha [Zebra Mussel]*
Mnemiopsis leidyi [Sea Walnut]*
Pterois volitans [Lion Fish]
Rapana venosa [Veined Rapa Whelk]*

* https://docs.ropensci.org/spocc/

Providers

ala - Atlas of Living Australia [AUS]*
bison - Biodiversity Information Serving Our Nation [USA]*
eBird - Cornell Lab of Ornithology {Global]
gbif - Global Biodiversity Information System [Global]*
idigbio - Integrated Digitized Biocollections [USA]*
inat - iNaturalist [Global]*
obis - Ocean Biodiversity Information System [Global]*
Vertnet - Distributed databases with a backbone

*https://www.marineregions.org/

FAO*

Boundaries of the FAO Fishing Areas

See:https://www.marineregions.org/sources.php#fao

EEZ*

Marineregions: the intersect of the Exclusive Economic Zones and IHO ocean areas

See:https://www.marineregions.org/sources.php#ihoeez

Primary data products ...

Summary ...

	prov	species	year	date	OCCS	DUPS	longitude	latitude	eez	fao
	<chr>	<chr>	<int>	<date>	<dbl>	<dbl>	<dbl>	<dbl>	<chr>	<chr>
8687	UNIQUE	Carcinus maenas	2018	2018-09-28	1	3	-122.30957	37.86517	USA	99
11319	UNIQUE	Carcinus maenas	2017	2017-07-25	2	4	-127.76165	51.48631	CAN	67

See: species_style.r on GitHub

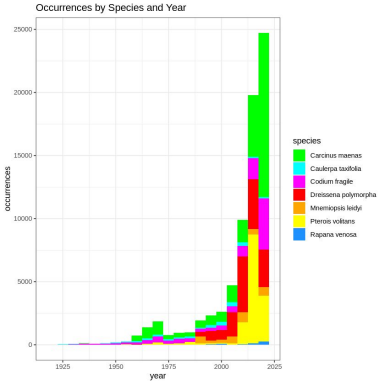
Expanded / hybercube ...

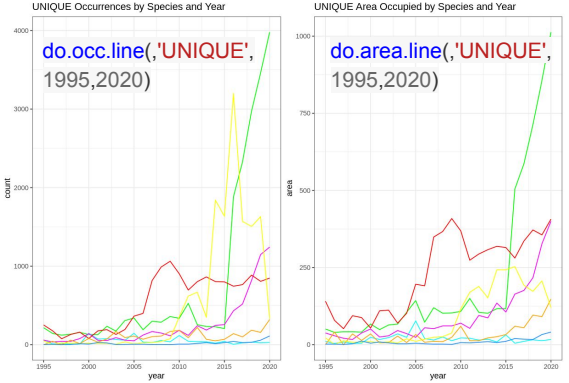
	species	prov	year	eez	fao	area
	<chr>	<chr>	<int>	<chr>	<int>	<chr>
1	Carcinus maenas	ala	1916	AUS	99	-38 145.1....
2	Carcinus maenas	ala	1916	AUS	99	-38 145.1....

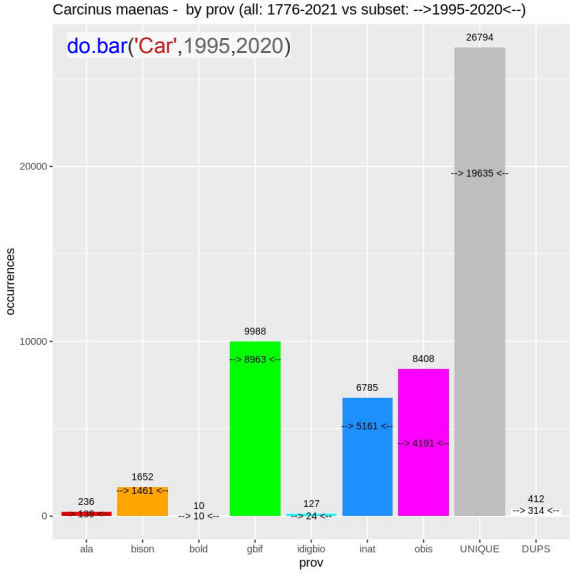
See: prepare_data.r on GitHub

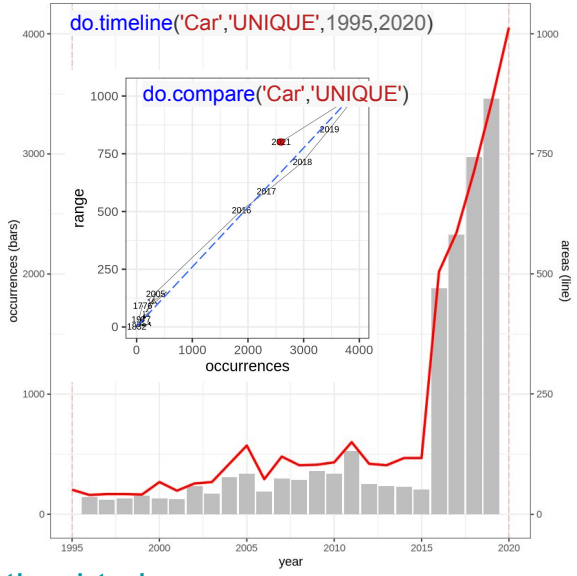
Visualizations ....

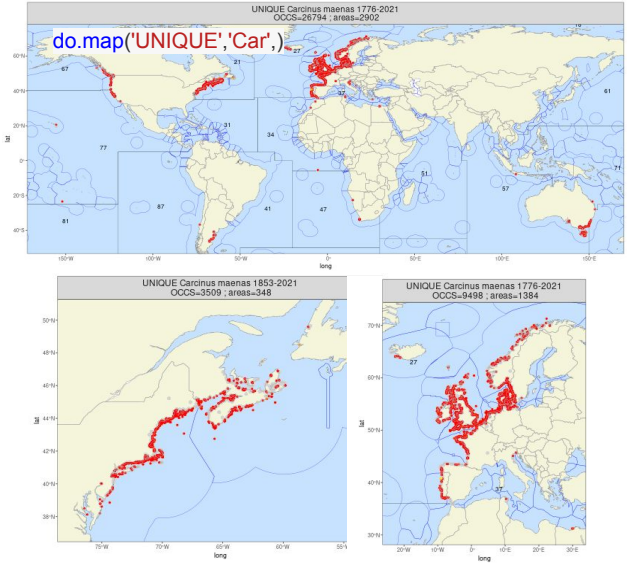
	ala	bison	bold	gbif	idigbio	inat	obis	UNIQUE	DUPS	total
Carcinus maenas	236	1652	10	9988	127	6785	8408	26794	412	54412
Caulerpa taxifolia	501	248	0	1355	403	55	637	2432	767	6398
Codium fragile	454	1268	0	6006	895	2341	759	10345	1378	23446
Dreissena polymorpha	0	4717	20	9979	514	1284	769	15185	2098	34566
Mnemiopsis leidyi	0	87	0	1166	12	262	2314	3479	362	7682
Pterois volitans	515	1213	0	9999	282	1523	2602	15175	959	32268
Rapana venosa	0	0	1	272	10	191	178	627	25	1304
total	1706	9185	31	38765	2243	12441	15667	74037	6001	160076









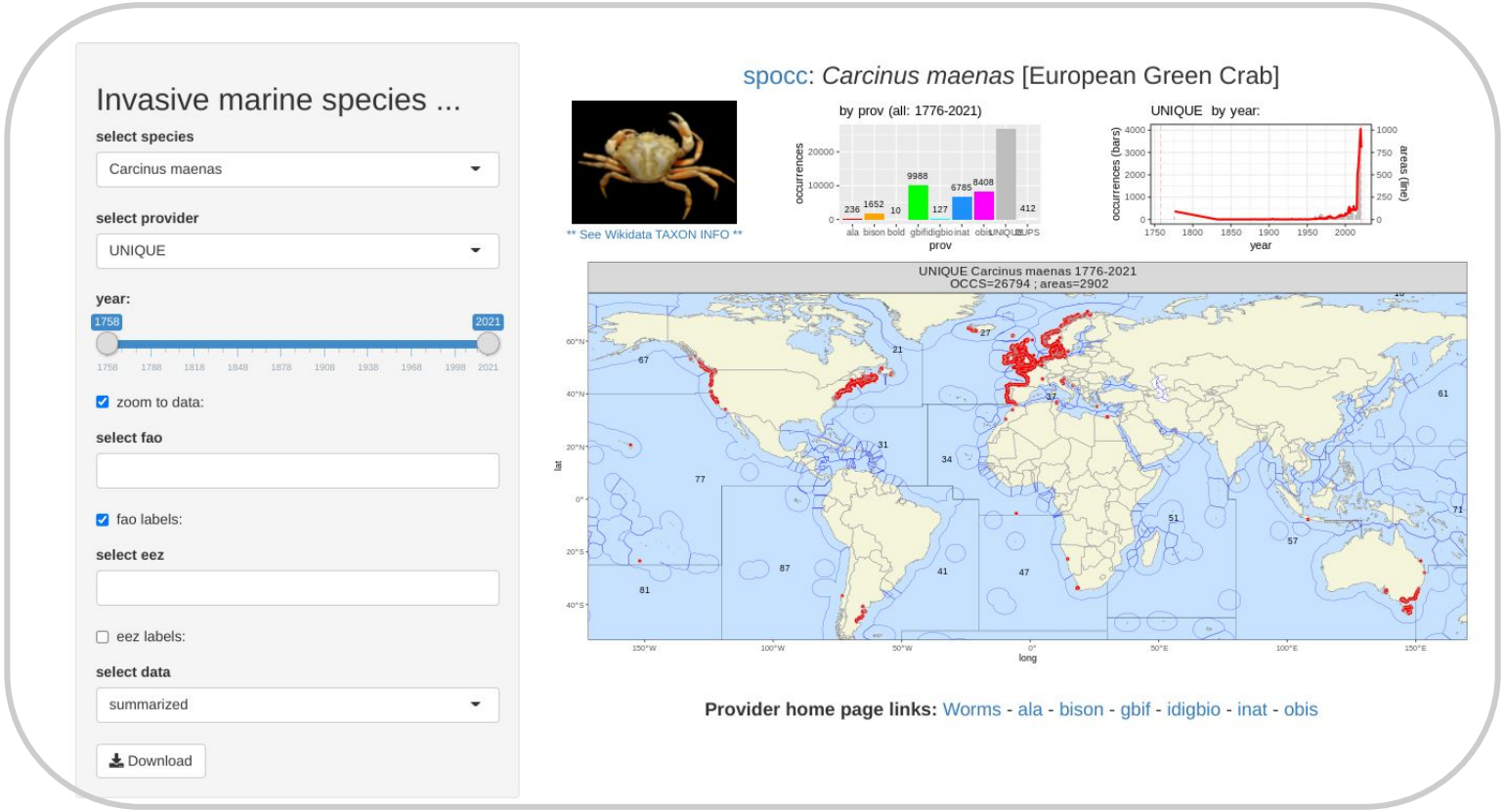


[See: https://ggplot2-book.org/introduction.html](https://ggplot2-book.org/introduction.html)

[See: Analytics.r on GitHub]

Dashboard / Control Panel

Live Access: https://rmbranto.shinyapps.io/invasives/



See: ShinyApps

See: dashboard on GitHub

Recap ...

Software Components:

- R: A highly programmable free computer environment under GNU General Public License;
- Jupyter: Combine software code, computational output & explanatory text into a single document;
- Spocc - (SPecies OCCurrence) query & collect species occurrence data from many sources;
- ggplot - a general scheme for creating graphs and maps;
- ShinyApp: build interactive web apps straight from R;
- GitHub; where the world builds software;

Features and benefits:

- Queries species occurrence data from available providers using list of WoRMS accepted names
- Generates synthetic UNIQUE / DUPlicate data objects from available provider data
- Generates provider specific Taxon IDs and Keys and so formulate the deep links into live provider portals
- Filter and zoom maps and graphs using list of Providers, date range, FAO fishing Area and EEZs

Challenges:

- Spocc queries limited to 9999 occurrence records per species and provider
- bison and inigbio providers do not support deep linking by species and or taxon key/id
- using EEZ and FAO shapefiles for Pacific centred mapping

See: Data Science on a Chromebook

See: github.com/rmbranto/CoastGIS2021

Last slide

Conclusion

Continue preparing for IOI 2022 ...

- More testing and refinement
- Add provider API links to dashboard
- Experiment with single species control panel
- Creation and use of defined area polygon queries
- Optional eez/fao and/or

Seek collaborations …

- marine plants, trawl bycatch species lists
- Create vignette for OpenSci
- Create wikipedia content

Demos

Dashboard

GitHub

Hyperslide

Wikidata

Appendices: synthetic data objects

```
species.style
```

A data.frame: 7 × 5

Names	cNames	sColors	wikidata	flmages
<chr>	<chr>	<chr>	<chr>	<chr>
Carcinus maenas	European Green Crab	green	Q27779	https://upload.wikimedia.org/wikipedia/commons/1/17/Carcinus_maenas.jpg
Caulerpa taxifolia	Killer Algae	cyan	Q310961	https://upload.wikimedia.org/wikipedia/commons/e/e7/CaulerpaTaxifolia.jpg
Codium fragile	Dead Mans Fingers	magenta	Q2712208	https://upload.wikimedia.org/wikipedia/commons/e/ed/Codiumfragile.jpg
Dreissena polymorpha	Zebra Mussel	red	Q752130	https://upload.wikimedia.org/wikipedia/commons/thumb/a/a9/Dreissena_polymorpha3.jpg/220px-Dreissena_polymorpha3.jpg
Mnemiopsis leidyi	Sea Walnut	orange	Q133630	https://upload.wikimedia.org/wikipedia/commons/thumb/1/1e/Sea_walnut%2C_Boston_Aquarium.jpg/220px-Sea_walnut%2C_Boston_Aquarium.jpg
Pterois volitans	Lion Fish	yellow	Q824672	https://upload.wikimedia.org/wikipedia/commons/thumb/b/bf/Pterois_volitans_Manado-e_edit.jpg/220px-Pterois_volitans_Manado-e_edit.jpg
Rapana venosa	Veined Rapa Whelk	dodgerblue	Q139053	https://upload.wikimedia.org/wikipedia/commons/thumb/f/fb/Rapana_Black_Sea_2008_G1.jpg/220px-Rapana_Black_Sea_2008_G1.jpg

```
head(prov.keys)
```

A data.frame: 6 × 7

	species	ala	bison	gbif	idigbio	inat	obis
	<chr>	<chr>	<chr>	<chr>	<chr>	<chr>	<chr>
1	Carcinus maenas	284294	98734	5178595	5178595	52523	107381
2	Caulerpa taxifolia	83052	6974	2643172	2643172	50919	144476
3	Codium fragile	84082	6897	5272096	5272096	67555	370562
4	Dreissena polymorpha	NA	81339	2287072	2287072	116340	181566
5	Mnemiopsis leidyi	NA	53917	2501248	2501248	180788	106401
6	Pterois volitans	189453	166883	2334438	2334438	47280	159559

```
head(df.prov[df.prov$DUPS>2&df.prov$species=='Carcinus maenas',])
```

A data.frame: 6 × 10

	prov	species	year	date	OCCS	DUPS	longitude	latitude	eez	fao
	<chr>	<chr>	<int>	<date>	<dbl>	<dbl>	<dbl>	<dbl>	<chr>	<chr>
8687	UNIQUE	Carcinus maenas	2018	2018-09-28	1	3	-122.30957	37.86517	USA	99
11319	UNIQUE	Carcinus maenas	2017	2017-07-25	2	4	-127.76165	51.48631	CAN	67
11320	DUPS	Carcinus maenas	2017	2017-07-25	6	3	-127.76165	51.48631	CAN	67
23906	UNIQUE	Carcinus maenas	2016	2016-08-18	1	3	-60.33113	46.80721	CAN	99
27236	UNIQUE	Carcinus maenas	2017	2017-10-13	1	3	-63.93700	44.51300	CAN	21
30240	UNIQUE	Carcinus maenas	2017	2017-05-31	1	3	-66.89060	45.03820	CAN	21

```
head(df.exp)
```

A data.frame: 6 × 6

	species	prov	year	eez	fao	area
	<chr>	<chr>	<int>	<chr>	<int>	<chr>
1	Carcinus maenas	ala	1916	AUS	99	-38 145.1....
2	Carcinus maenas	ala	1916	AUS	99	-38 145.1....
3	Carcinus maenas	ala	1955	AUS	99	-37.6 149.8..
4	Carcinus maenas	ala	1957	GBR	99	50.3 -4.1....
5	Carcinus maenas	ala	1958	AUS	57	-38.4 144.9..
6	Carcinus maenas	ala	1958	AUS	57	-38.7 145.7..

```
prov.style
```

A data.frame: 9 × 4

prov	id	color	order
<chr>	<chr>	<chr>	<dbl>
UNIQUE	UNI	grey	8
DUPS	DUP	white	9
ala	ala	red	1
bison	bis	orange	2
bold	bol	yellow	3
gbif	gbi	green	4
idigbio	idi	cyan	5
inat	ina	dodgerblue	6
obis	obi	magenta	7