WHAT HAVE I BEEN DOING SINCE LAST HERE

RESPONSIBLE EDRR
INVASIVE MANGROVE
Limtzera removal project

LUMITZERA is an Indo-pacific mangrove genus that was grown in Fairchild Tropical Garden and had propogated and spread.

This is an ongoing project with partners: Fairchild Tropical Garden, EELS, FWC, FDA, IPHAS and now NOAA

2014 NOAA HOSTING:

>April survey – outliers

>October survey (looking for flowering individuals)

…as well as cooperating in removal or survey days over the remainder of 2014

Florida invasive on the horizon: Caiman lizard vs. Snail Kite

Everglades restoration has a number of "focus species" one of which is the endangered snail kite. The snail kite has a preference for eating native, Pomacea paludosa, (and non native) apple snails and depends upon them for survival.

Caiman lizards are from Northeastern South America. These are very attractive and desired lizards which are bright colored (orange/red and green), look like an alligator (desired), and get over a meter in length. They are large relatives to the Tegu (a current management problem invasive in Florida), but instead of terrestrial habitats, live in semi-aquatic habitats. It was rare in trade but recent advances (they like cat food) meant that their production has skyrocketed and costs have come down from a few thousand dollars 10 years ago to less than $300 now. The Caiman lizard also has a preference for freshwater molluscs, and crustaceans, which includes snails. My alerts have made this species a topic of future concern for the Tropical Audobon society and restoration goals.

REGIONAL invasive on the horizon:

Xenia macrospiculata

(for now only in Venezuala)

Initially seen in 2007 as small colony off east Venezualan coast of Anzoategui, Valle Seco, *Xenia macrospiculata* has spread several km away from first observation site covering 20% of substrate as a monoculture. This is considered a pest in the trade rapidly overgrowing more desired takmates.

Important to NOAA coral conservation program;

" it overgrows scleractinian corals including Diploria, Orbicellia, Montastera, and Millepora " species critical to NOAA restoration goals. It is a short living reaching maturity quickly, and it is a prolific " ephemeral pioneering species". They have a short planktonic phase and metamorphose into polyps immediately after settlement.

"It exhibits a remarkably high reproduction potential, which contributes to its dominance in the Red Sea coral reefs".

This is considered an aquarium pest and an agressive colonizer

This is a future ballast water / hull fouling (?) risk for transfer to other locations

IMAGE: reefs2rainforest.com

SOURCE: J. P. Ruiz Allais, M. E. Amaro, C. S. McFadden, A. Halász, Y. Benayahu. The first incidence of an alien soft coral of the family Xeniidae in the Caribbean, an invasion in eastern Venezuelan coral communities. Coral Reefs 2014 DOI 10.1007/s00338-013-1122-1.

SPENDING TIME EXPLAINING THAT LIONFISH DID NOT COME FROM A KEY BISCAYNE RELEASE DURING HURRICANE ANDREW!

Most agree the source was released (ornamental) lionfish along the SE US coast possibly starting in the late 70's (they were being imported) but not documented until the early 80's.

Science, Service, Stewardship

2014 ORNAMENTAL SPECIES;

UNDERSTNDING RELELASE RISKS IN FLORIDA, BIOME IMPLICATIONS, OPPORTUNITIES OF EXPOSURE AND IMPLICATIONS TO RISK ASSESSMENTS

Tom Jackson / NOAA SEFSC

NOAA FISHERIES SERVICE

SUMMARY

1) Estimation of pet releases in Florida
2) Understanding the invasion curve and what is effective (VS how we are focussing our activities)
3) Our growing understanding or organisms as “composite – super organisms” and implications to trade exposure, release risks, and its debilitation of representative risk assessment methods

(1) Estimation of pet releases in Florida

What do we know about pet releases in Florida?

Q: What is the most common pathway for exotic species into Florida's terrestrial and aquatic habitats?

A: THE PET TRADE (trade / escapees/ releases)

According to FFWCC: http://www.myfwc.com/wildlifehabitats/nonnatives/exotic-information/

"The most common pathway by which exotic fish and wildlife species find their way into Florida's habitats is through escape or release by pet owners."

EX: THERE ARE 5 EXOTIC / 1 NATIVE REPTILE SPECIES IN FL! (2011)

Krysko, K.L., J.P. Burgess, M.R. Rochford, C.R. Gillette, D. Cueva, K.M. Enge, L.A. Somma, J.L. Stabile, D.C. Smith, J.A. Wasilewski, G.N. Kieckhefer III, M.C. Granatosky, and S.V. Nielsen. 2011. Verified non-indigenous amphibians and reptiles in Florida from 1863 through 2010: Outlining the invasion process and identifying invasion pathways and stages. Zootaxa 3028:1-64.

THESE ARE THE OTHER 31 MARINE EXOTIC FISH THAT HAVE BEEN SEEN OFF FLORIDA


Acanthurus guttatus 2003


Acanthurus sohal 2002


Naso lituratus 2000


Zebrasoma desjardinii 1999


Zebrasoma flavescens 2001


Zebrasoma scopas 2008


Zebrasoma veliferum 2001


Zebrasoma xanthurum 2001


Balistoides conspicillum 2010


Rhinecanthus aculeatus 2006


Rhinecanthus verrucosus 1995


Chaetodon lunula 2001


Heniochus diphreutes 2011


Heniochus intermedius 2006


Platax orbicularis 1999

INFO:
USGSNAS


Gramma loreto 1994


Chiloscyllium punctatum 2007


Pomacanthus annularis 2001


Pomacanthus asfur 1995


Pomacanthus imperator 2001


Pomacanthus maculosus 2000


Pomacanthus semicirculatus 1999


Pomacanthus xanthometopon 1995


Dascyllus aruanus 2009


Dascyllus trimaculatus 2006


Scatophagus argus 1992


Cephalopholis argus 2004


Chromileptes altivelis 1984


Epinephelus ongus 2010


Arothron diadematus 1994

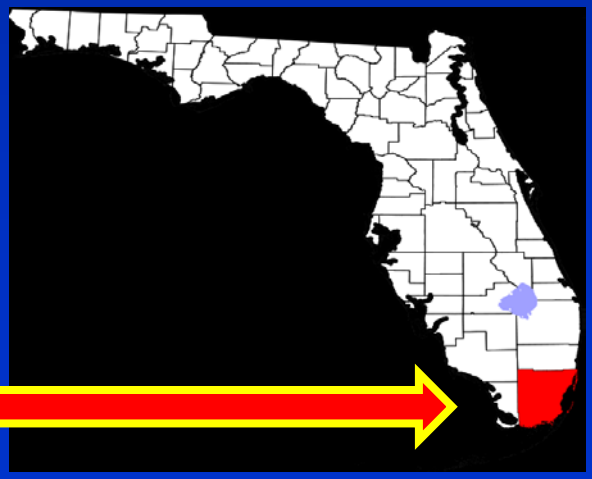

Zanclus cornutus 2001

CAN WE ESTIMATE DADE COUNTY YEARLY RELEASES?

DADE COUNTY (2011) stats

if; (conservative estimate) of ½ of 1% / year

Where of 1% of **624,564 homes (= 6,246)** Dade households with a pet where ½ of these might release a pet



= ***3,123*** */ yr Dade potential releases.*

CAN WE ESTIMATE FLORIDA YEARLY RELEASES?

For Florida with 9,031,051 “housing units”

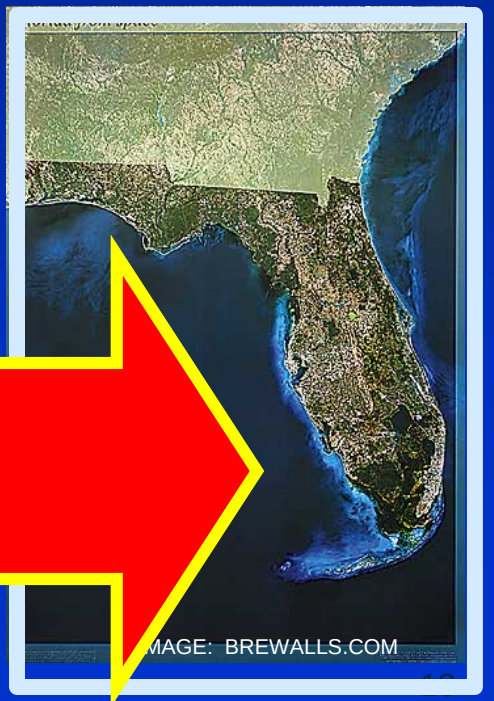
(63% of..)

= 5,689,562 have at least one pet

(again ½ of 1%)

= **28,448 potential Florida releases PER YEAR**

This is many more than all collected at pet amnesty days



Obviously after a hurricane this # would be significantly higher

EDUCATING THE INVASION FORCE (YOU); *HOW DO WE EDUCATE THE PUBLIC ABOUT INVASIVE PET RELEASES?*

Such releases continue to occur despite large local, regional campaigns (don't let it loose), as well as national ones in cooperation with industry (habitatitude). All were developed for outreach to inform pet owners that releasing pets is not good for the pets, us, or the environment. These campaigns have been started with cooperation between state and federal agencies (NOAA, FWCC, FL DEP, NPS, SEAGRANT, COAST GUARD, etc) as well as representatives of commercial interest for the ornamental industry (PIJAC). At inception Habitatitude organizers proposed that pets could be returned "with receipt" to the initial purchase vendor, but that part of the program was quickly rescinded.

Outreach is great- but there is no place to turn in unwanted pets which puts pet owners in a dilema: kill it or release it (!?) Enough don't have the stomach for euthanasia more species are being released and observed over time initially as singular exotics, then for some with more released individuals, becoming resident invasive populations.

AND FOR LIONFISH THE REST IS HISTORY……

Lionfish impacts are well documented some as being ecosystem level impacts predicted to affect coastal fisheries. There is no effective control at this time

We agree:

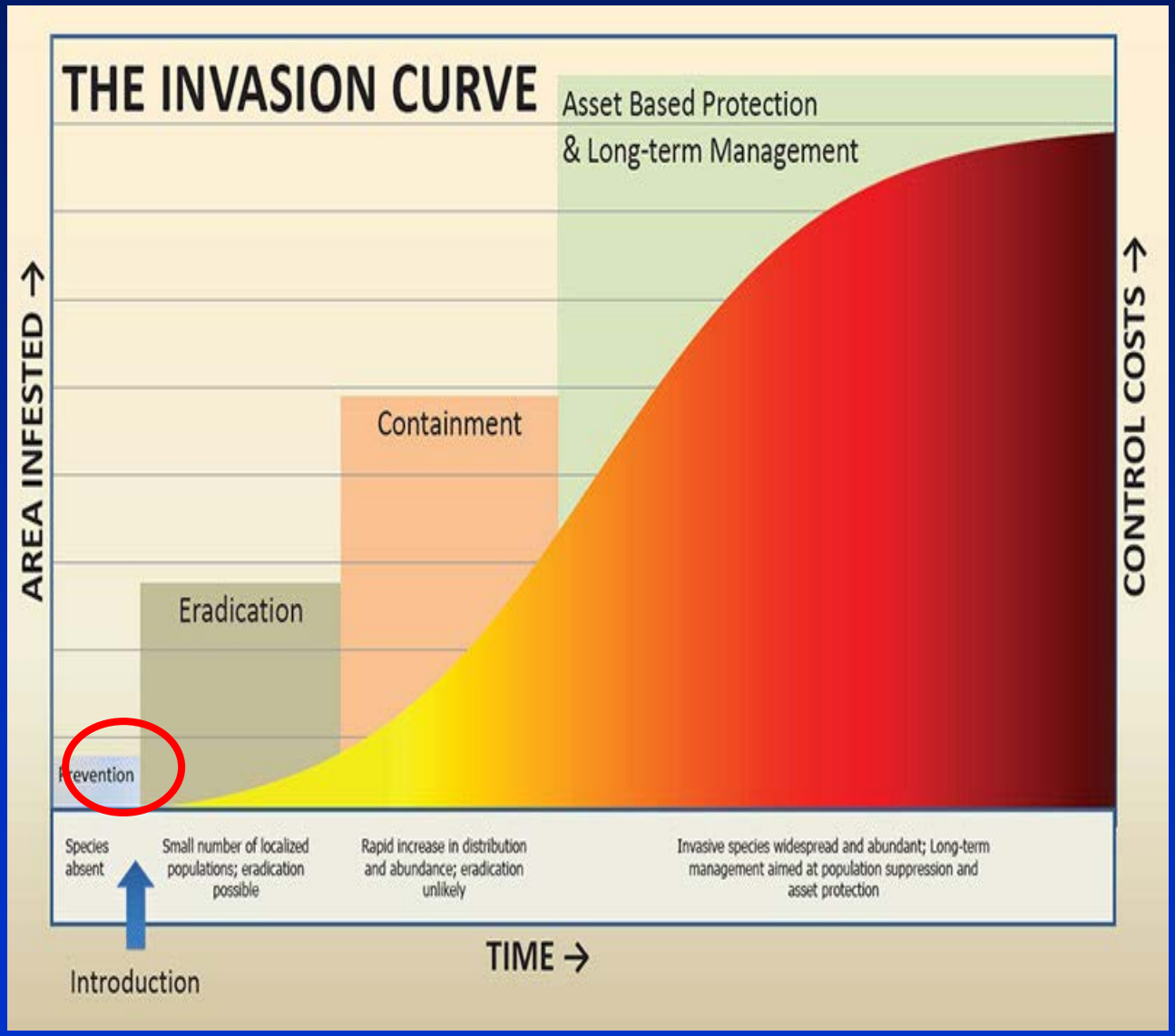
The lionfish invasion was started by released "pet" lionfish, due to their aggression (eating tank mates), eventual size, and or loss of interest causing "empathetic releases".

SCOPE OF IMPACT:

Within 40 years these 2 lionfish species populated 7.3 million km^2 including the Caribbean, Gulf of Mexico, the Southeastern US coastline, and the Bermuda coastline, to over 300 m depth in salinities ranging from oceanic (35 ppt) to estuarine (8 ppt). The invaded range includes habitats for every non pelagic commercial species at some point in their life cycles. They are a management problem for 36 countries

(2) Understanding the invasion curve and what is effective VS how we are currently refocussing our activities on less effective yet more conspicuous activities (EDRR etc)

UNDERSTANDING THE "INVASION CURVE"

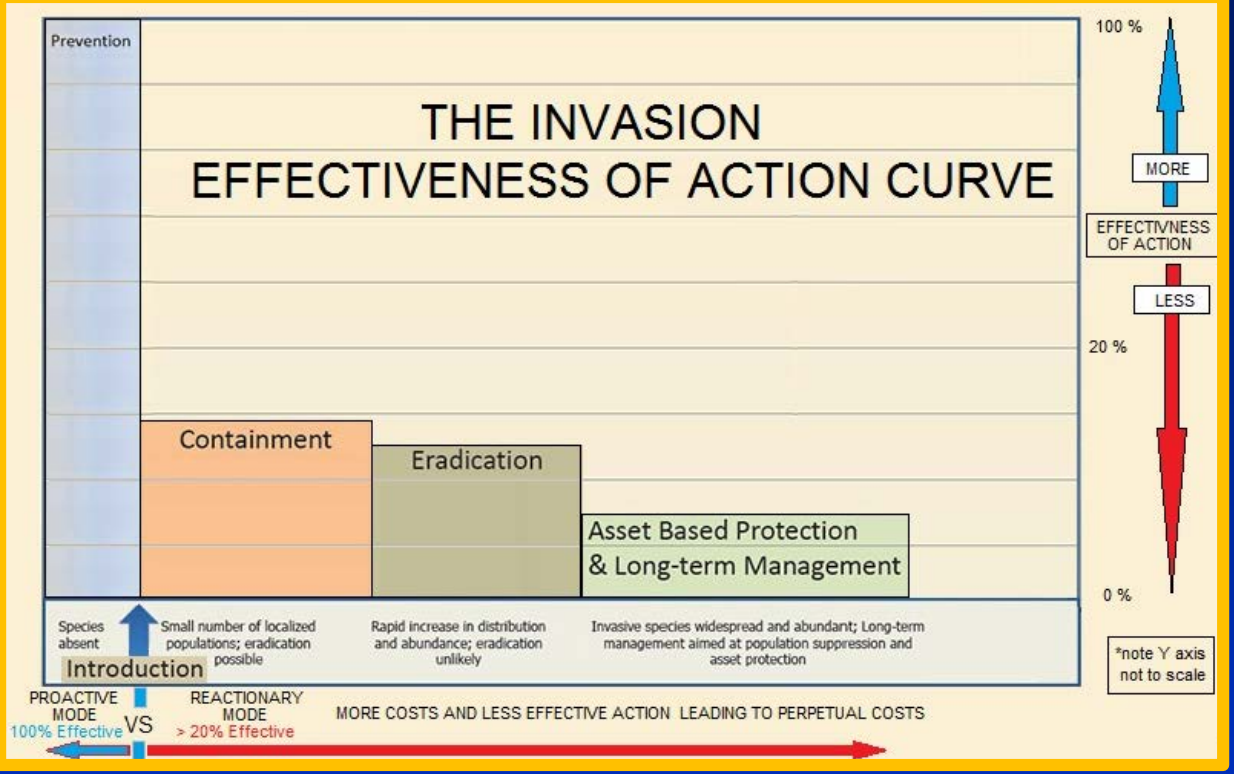


This is the widely circulated "invasion curve" describing the actions and relative costs of invasive species activities as time passes (to the right) , costs and commitment increases substantially.

The most conspicuous part of this curve is the YELLOW to RED section, to the right of prevention illustrating where action is the least effective / with continuing often permanent impacts and costs and includes the most expensive activities.

The least conspicuous part is the tiny blue box on the bottom left " PREVENTION " which is recognized by all as the most effective and least expensive strategy. This is the focus of CDC actions.

UNDERSTANDING THE "INVASION EFFECTIVNESS OF ACTION"



This graph estimates the "effectiveness of action" against invasive species. What was the most insignificant in the prior curve – prevention, is the most effective action. Successful prevention is 100% effective whereas the other 3 actions are less effective as you go to the right (none to 100%). Once you get to *"Asset-Based Protection & Long Term Management"* you have a continuous cost to manage in future with each consecutive species adding costs to strapped budgets.

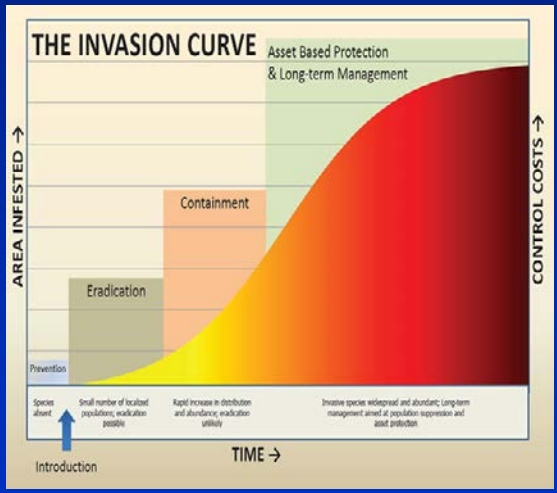
Generally it is very difficult to completely eradicate a species once introduced. Understand all methods of control are not means of eradication only attempts to put their numbers in check. As an example FL is still (8 years) attempting to remove exotic Gambian Pouch rats from Grassy Key. (NOTE* Gambian Pouch Rats were ornamental releases- but are also documented human disease vectors (monkey pox)).

THE CONSTANT SHIFT AWAY FROM (EFFECTIVE) PREVENTION DUE TO OUR SYSTEM OF "MEASUREABLES"

OUR GOVERNMENT AND BUSINESS SYSTEMS ARE GAUGED BY "MEASURABLES"

The most effective action (prevention) has no effective measurable post action – you cannot quantify what won't occur, you can only understand that it could be comparable to a similar species past invasion example.

PREVENTION EX: The restriction of other lionfish species importation since there is no invasion and no action (costs) associated to measure even if "significantly immeasurable savings in lieu of impacts" are accomplished



The less effective action (anything post prevention; containment, EDRR etc) is conspicuous, thereby having measurable activities, driving short term interest, media (press/ outreach) and possibly promotion for those involved. ***Since we are judged on measurables there is pressure to shift away from immeasurable but 100% effective prevention (most effective) focus of activities.***

ATTEMPT OF PREVENTION: PRACTICAL EXAMPLE 2014 PROPOSED PREVENTION: LIONFISH (PARTIAL) BAN: SHELVED!!

IMAGE: play.google.com

Holly Raschein (R-Key Largo) and Senator Greg Evers (R- Pensacola) filed 2 FL bills;

HB 1069,

"Lionfish; Prohibits importation, aquaculture, & sale of illegally imported lionfish; provides penalties; authorizes FWCC & DACS to adopt rules."

and SB 1336

"Lionfish; Providing a definition; prohibiting the importation and aquaculture of lionfish and the sale of illegally imported lionfish; providing penalties; authorizing the Fish and Wildlife Conservation Commission and the Department of Agriculture and Consumer Services to adopt rules, etc. Effective Date: 8/1/2014"

("lionfish" unspecified species list).

However, it would have allowed "Florida caught lionfish" to be sold as pets for the purpose of trade, and allowed continued commercial fisheries development, both being proposed as a "forms of control". (Why is this an issue?)

Still in committee – but there are issues in that it does not trump authority of USFWS.

One criticism, both are too general (all "lionfish"), as opposed to the genera *Pterois sp.*

Visit:

http://www.flsenate.gov/Session/Bill/2014/1069

http://www.flsenate.gov/Session/Bill/2014/1336

#6

#11

#13

14 Lionfish species (Eschmeyer 1998)

1) Hawaiian lionfish	*Dendrochirus barberi*
2) Twinspot / Ocellated lionfish	***Dendrochirus biocellatus***
3) Dwarf lionfish	***Dendrochirus brachypterus***
4) Zebra lionfish	***Dendrochirus zebra***
5) Bleeker's lionfish	*Ebosia bleekeri*
6) Gurnard lionfish	***Parapterois heterura***
7) Spotfin lionfish	***Pterois antennata***
8) Clearfin lionfish	*Pterois kodipungi*
9) Luna lionfish	***Pterois lunulata***
10) Soldier lionfish	***Pterois miles*** **> (INVASIVE IN ATLANTIC & MED)**
11) African lionfish	***Pterois mombasae***
12) Clearfin lionfish	***Pterois radiata***
13) Russel's lionfish	***Pterois russelii*** **<<<< first species imported 1931**
14) *Lionfish (red)*	***Pterois volitans*** **> *(INVASIVE IN ATLANTIC)***

GREEN = SPECIES THAT ARE IMPORTED (5)
BLUE = NEW IMPORTS SINCE 2008 (4)
ORANGE = INVASIVE SPECIES (2)
WHITE = RARELY IMPORTED (3)

> ALL ORNAMENTAL SPECIES

Eschmeyer, William N. (1998). Paxton, J.R. & Eschmeyer, W.N., ed. *Encyclopedia of Fishes*. San Diego: Academic Press. pp. 175–176. ISBN 0-12-547665-5

Q1: WHY BAN FL ORNAMENTAL OWNERSHIP of PTEROIS sp. ? IF NOT THIS PINNICAL EXAMPLE.....

After 2 (genus Pterois) lionfish species populated 7.3 million km squared* including the Caribbean, Gulf of Mexico, the Southeastern US coastline, and the Bermuda **coastline to over 300 m depth in salinities ranging from oceanic (35 ppt) to estuarine (8 ppt), where the invaded range includes habitats for every non pelagic commercial fish species at some point in their life cycles, being a management problem for 36 countries with ecosystem level impacts documented**, and with more expected (with increasing observations).... Why would there be any question about a total ban on ornamental import, sale, or ownership with such a pinnacle bad example, a truly "injurious exotic", documented on an unprecedented scale, at an unprecedented rate(?)

What could possibly (beside human pathogen vectors) be a worse marine example (?)

*SOURCE: Côté, Isabelle M., Stephanie J. Green, and Mark A. Hixon. "Predatory fish invaders: Insights from Indo-Pacific lionfish in the western Atlantic and Caribbean." Biological Conservation 164 (2013): 50-61.

Q2: WHY BAN FL ORNAMENTAL OWNERSHIP ?
WHY NOT ALLOW OWNERSHIP OF "ATLANTIC LIONFISH IN FLORIDA?“

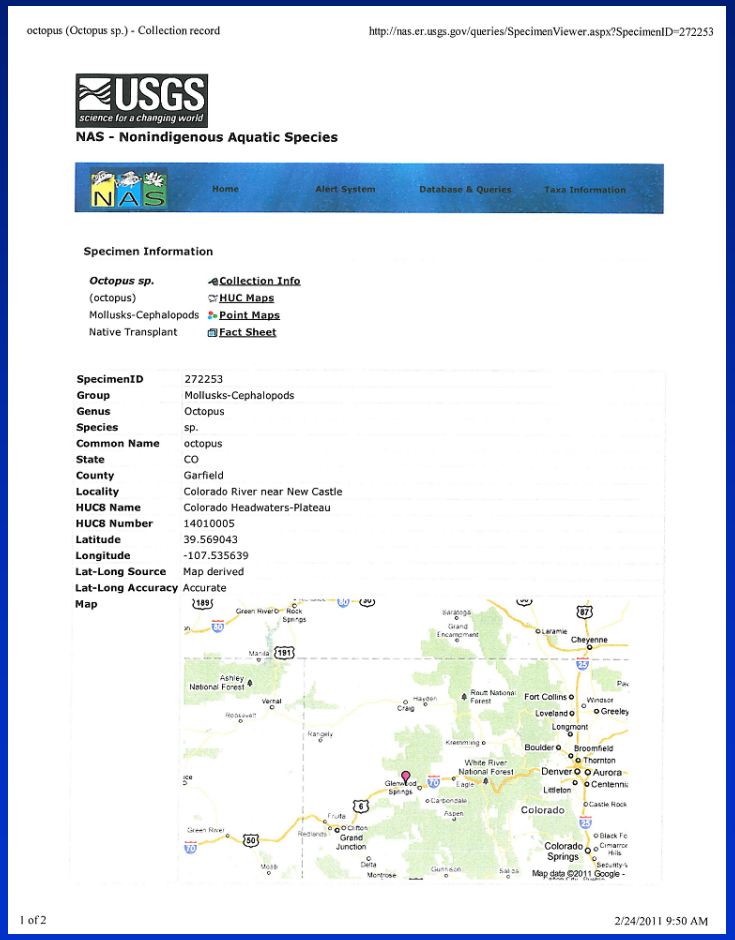
Understand, release pressures for lionfish have not decreased- but probably have increased due to their larger (2X) size in the Atlantic. An "Atlantic lionfish" placed in a SW tank could grow to a size that troubles tank owners (due to gobbled others).

Like many led by emotion not able to "kill Muffy the lionfish", they dump it into Biscayne Bay (or whatever "seemingly habitat appropriate" body of water is closer). These "larger Atlantic lionfish" while in the owners tank, although were not exposed to pathogens as imported lionfish in the lines of trade, however their purchased co-inhabitants were - in open filtration systems often with species having global coverage - exposure. Dumping of the lionfish re-establishes "global exposure" release risks/ pathogen transfers albeit indirectly.

RELEASE

IMAGES: CORVIS / DADE COUNTY

MARINE PETS ARE RELEASED IN ALL KINDS OF (NON MARINE) PLACES
(one EX: octopus in a Colorado lake)



octopus (Octopus sp.) - Collection record http://nas.er.usgs.gov/queries/SpecimenViewer.aspx?SpecimenID=272253

USGS science for a changing world

NAS - Nonindigenous Aquatic Species

Home | Alert System | Database & Queries | Taxa Information

Specimen Information

Octopus sp. (octopus)
Mollusks-Cephalopods
Native Transplant

Collection Info
HUC Maps
Point Maps
Fact Sheet

SpecimenID	272253
Group	Mollusks-Cephalopods
Genus	Octopus
Species	sp.
Common Name	octopus
State	CO
County	Garfield
Locality	Colorado River near New Castle
HUC8 Name	Colorado Headwaters-Plateau
HUC8 Number	14010005
Latitude	39.569043
Longitude	-107.535639
Lat-Long Source	Map derived
Lat-Long Accuracy	Accurate
Map	

1 of 2 2/24/2011 9:50 AM

octopus (Octopus sp.) - Collection record http://nas.er.usgs.gov/queries/SpecimenViewer.aspx?SpecimenID=272253

Collection Day	21
Collection Month	8
Collection Year	2009
Year Accuracy	Actual
Status	failed
Comments	one of the two spot octopuses from California or one of several species in the Gulf of California.
Record Type	Specimen
Earliest Record	nation
Verifier	Roland Anderson
Fresh Marine Intro	Freshwater
Number Collected	1
Photo	

Pete Walker - Colorado DNR - Division of Wildlife
Pete Walker - Colorado DNR - Division of Wildlife
Pete Walker - Colorado DNR - Division of Wildlife
Pete Walker - Colorado DNR - Division of Wildlife

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URL: http://nas.er.usgs.gov
Page Contact Information: Pam Fuller - NAS Program
Page Last Modified: Aug 19, 2009

2 of 2 2/24/2011 9:50 AM

Source: USGSNAS

FILE UNDER: whatever "seemingly habitat appropriate" body of water is closer

Q2: WHY BAN FL ORNAMENTAL OWNERSHIP ?
THERE IS NO SAFETY NET IN PLACE AND NO CURRENT PLANS TO CREATE ANY

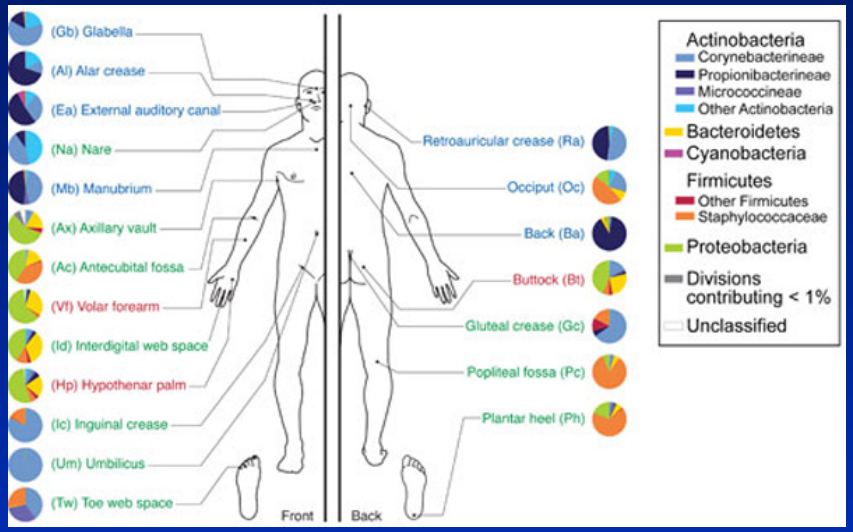
Until there are formal widely recognized trade or nonprofit sources to turn in pets (fish) there is no reason to think that future releases of lionfish or any unwanted ornamental won't occur despite years of outreach due to no options.

The choice managers are trying to rationalize is that " with enough outreach releases will decrease" but this is in diametric opposition to established owners emotional ties to their animals who not willing to euthanize (without an alternative).

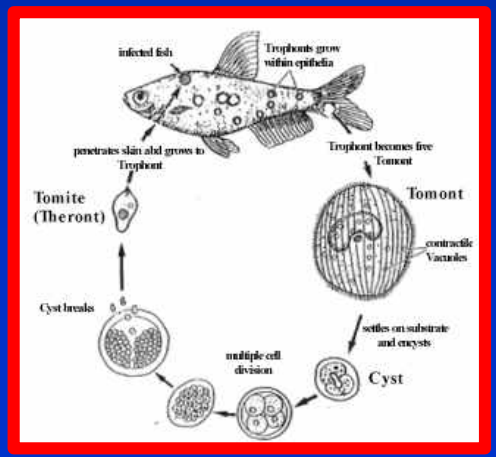
Fish returns have been absent form "PET AMNESTY DAYS" due to logistics, housing and quarantine issues and their related costs there is no solution for marine fish at this time.

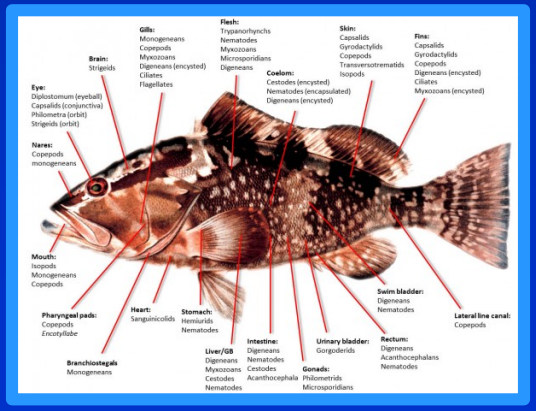
IMAGE: FWC

(3) Our growing understanding or organisms as “composite – super organisms” and implications to trade exposure, release risks, and risk assessments



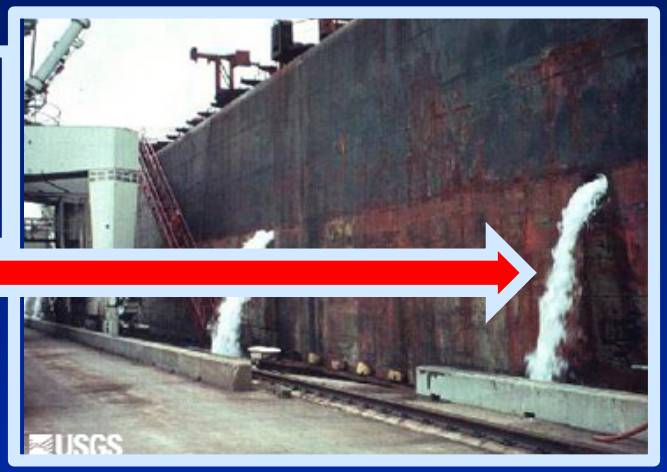
CAN WE GET A DISEASE FROM OUR FISH?





BOAT BALLAST vs. "BIOLOGICAL BALLAST" ALL ORGS ARE "BIOMES" FOR OTHERS

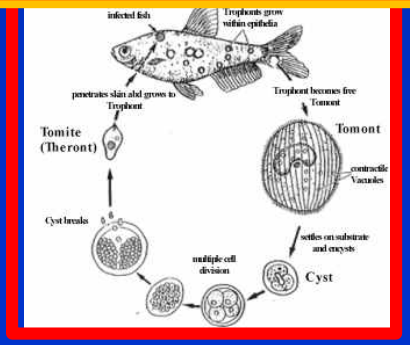
It is easy to understand boat ballast carries a large number of organisms from microscopic plankton to large fish



However: many don't extend that understanding to a released pet; the number of organisms living on the outside and inside it

"AN ORGANISMS" IS NOT SINGLE!

has



Parasites + (benneficials)

Can lead to sick sailfin tang

ALL ARE "SUPER-ORGANISMS" MADE OF MANY ORGNISMS

In 2000 Nobel laureate Joshua Lederberg called for an end to our thinking that we (GOOD) and microbes (BAD) that has been our guiding principle in relation to dealing with infections etc.

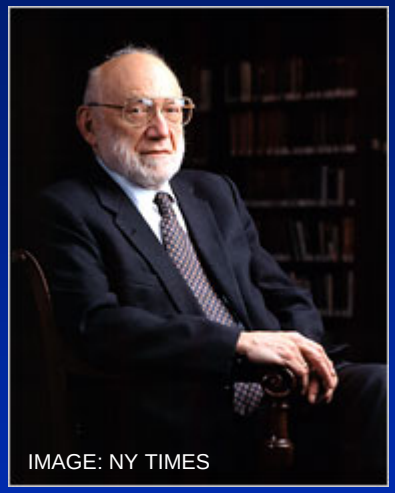


IMAGE: NY TIMES

"We should think of each host and its parasites as a super-organism with the respective genomes yoked into a chimera of sorts…"

Meaning that us, our biome and our virome are metagentically tied and inseparable as one SUPER-ORGANISM and this understanding needs to be better incorporated in discussions of exposure and risk.

SOURCE:
http://subrealism.blogspot.com/2010/12/ideas-of-microbiome-and-virome.htm

Joshua Lederberg. Infectious History. Science 14 April 2000: Vol. 288 no. 5464 pp. 287-293 DOI: 10.1126/science.288.5464.287

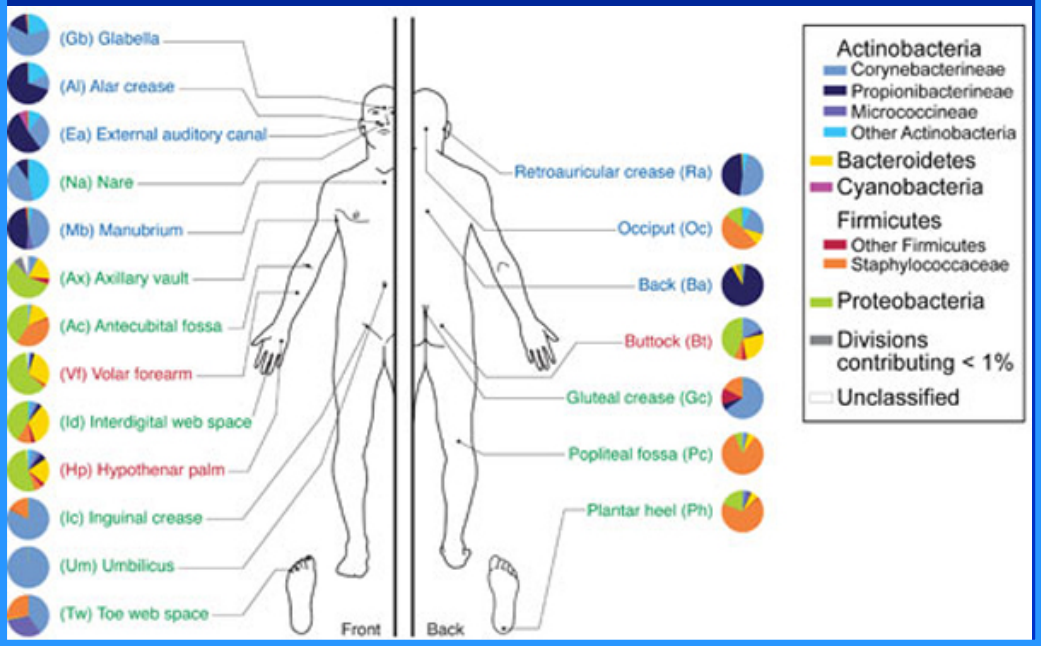
THE NIH "HUMAN MICROBIOME PROJECT"

New technologies, knowledge gaps, and shared interest were the drivers for the "**HUMAN BIOME PROJECT**" designed to document the range of microbes involved in all aspects of the" human system".

We are comprised of a large number of "microhabitats" awaiting opportunists.

1,415 infectious human pathogens (not counting inverts) have been identified in humans.

(Some) HUMAN **MICROBIOMES** (bacterial communities)



VIROMES; (viruses) VIRAL FAMILIES IN THE GUT INCLUDE:

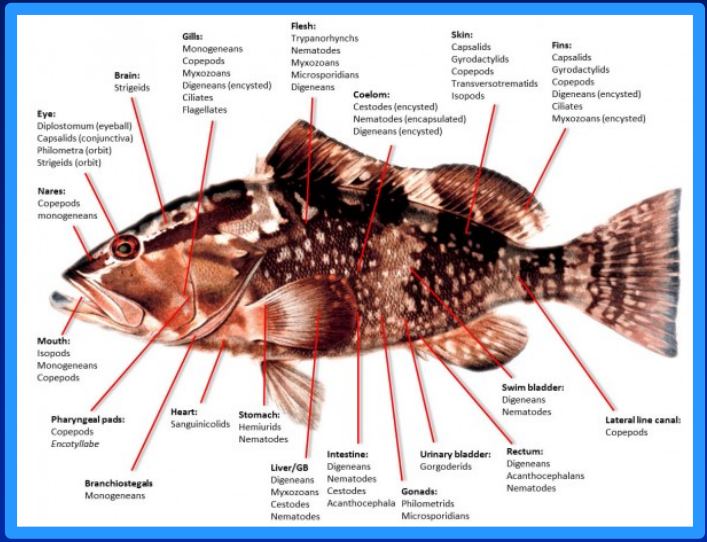
- Myoviridae
- Siphoviridae
- Podoviridae
- Tectiviridae
- Leviviridae
- Inoviridae
- Microviridae
- Multiple hits
- Unknown

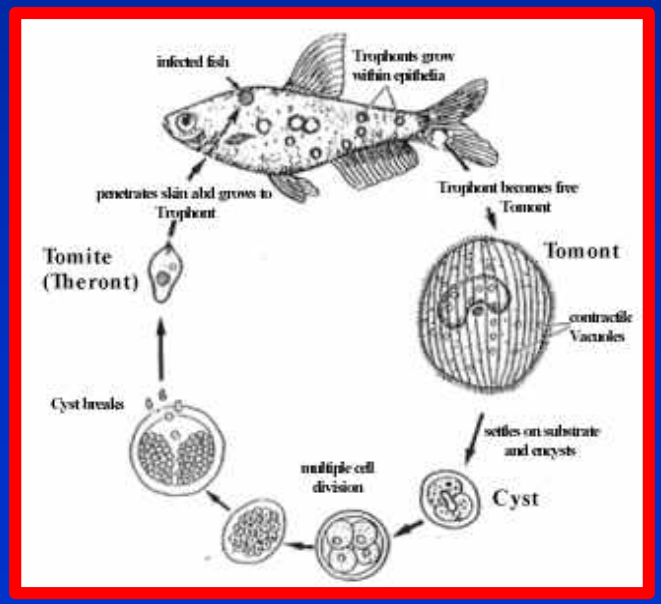
Samuel Minot, Rohini Sinha, Jun Chen, et al. 2011 The Human Gut Virome:Inter-individual variation and dynamic response to diet.
10.1101/gr.122705.111
Access the most recent version at doi:
published online August 31, 2011
Genome Res.

c

Taylor LH, Latham SM, Woolhouse ME. 2001. . Risk factors for human disease emergence. Philos Trans R Soc Lond B Biol Sci. 2001 Jul 29;356(1411):983-9.

A FISHY EXAMPLE…”no fish is an island”





All organisms are a diverse palette of microhabitats, all of which are ripe for the exploiting for the cost of a few specialized adaptations.

TODAY BONY FISH SPECIES ARE ESTIMATED AT APPROX 28,000

IF: we make an conjecture;

each fish has 3 distinct species of parasites = 84,000 species of parasites

From our studies of humans we know that (fish parasite) number is very conservative where there are over 1,400 bacterial and viral pathogens identified in us (not including multicelular parasties!)

SOURCE: **Dr. Alistair Dove.** DEEP SEA NEWS: NO FISH IS AN ISLAND 03/19/2012
http://deepseanews.com/2012/03/no-fish-is-an-island/

A FISHY EXAMPLE…”no fish is an island”

The state of our degree of understanding of fish parasites

“Canada has the best studied freshwater parasites in the world, so we were amazed when we found 47 species which is four times more species of (diplostomoid) flukes in a few fish from the St. Lawrence than were previously known in all fishes across the whole country”. (Dr Sean Locke, Concordia University in Montreal, Quebec)

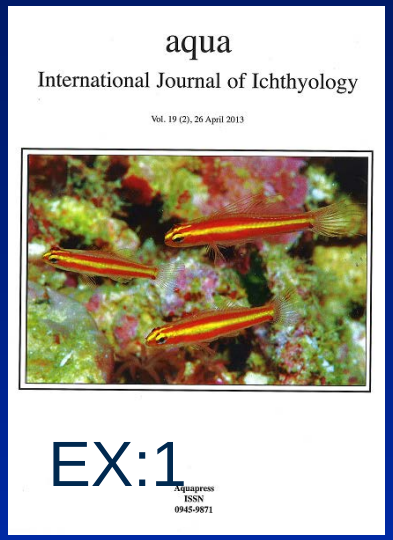
The prevailing view has been that only a small number of generalist species infect all sorts of different fish. But Locke and his colleagues used DNA barcoding to show for the first time that this was not the case. The parasites found in most tissues- including muscle, gills, brains and internal organs- specialized on one or a few closely related fishes, the researchers found. In contrast, the lenses (eyes being more immunosupressed) of fish were home to five species of non-specialized flukes that thrived in many different fish species and even frogs. The (immunosupressed) eye as a biome- is a better habitat for parasite infestation.

IMAGE: Adam Chamness

Sean A. Locke, J. Daniel Mclaughlin, David J. Marcogliese. **DNA barcodes show cryptic diversity and a potential physiological basis for host specificity among Diplostomoidea (Platyhelminthes: Digenea) parasitizing freshwater fishes in the St. Lawrence River, Canada**. *Molecular Ecology*, 2010

SCIENCE DAILY 2010:
http://www.sciencedaily.com/releases/2010/06/100622074824.htm http://www.practicalfishkeeping.co.uk/content.php?sid=2992

HOW FAST DO NEW SPECIES COME TO MARKET?
"IMPORT FIRST AND ASK QUESTIONS LATER"



Gerald R. Allen, William M. Brooks and Mark V. Erdmann: ***Eviota pamae,* a new species of coral reef goby (Gobiidae) from Indonesian seas,** pp. 79-84 aqua **Volume 19, Issue 2 - 26 April 2013**

For most species there is no force driving wholesale investigation of the life history of ***any*** imported ornamental species. Many "new species to trade " are imported well prior to any documentation

EXAMPLES:(3)

EX1) To the left is the April 2013 publication identifying a new coral reef goby *Eviota pamae*.

I was able to contact a California wholesaler (9/24/13) who had " seen this newly identified species, in shipments with a similar related species *Eviota pellucida* for sale for a year or two".

EX2) The image middle left is from 2011 of LIVE AQUARIA's specimen "one of the rarest reef basslets ever documented in the aquarium hobby, the flathead perch" for sale for $4,999 (some selling for $8000).
Read more:
http://reefbuilders.com/2011/08/30/flathead-perch-liveaquaria/#ixzz2gNzwB2mQ

3) The image below at left is of an undescribed species (9/2013) of dragonett; "We have seen them trickling into the trade the past few months this year, where they have been commanding a higher price as far as dragonets normally fetch."
Read more: http://reefbuilders.com/2013/09/20/ruby-red-dragonets/#ixzz2gOICRubh

This illustrates that we will import ornamentals BEFORE we know anything substantial about a species at any level. (RISK ASSEMSSMENT?)

(Tom's) Golden rule of ORNAMENTALORGS life history documentation

There is no pressure for documentation for parasite / interactions and their pathways / vectors for imports as a rule. All investigations are driven by "shared economic interests".

TGR: **UNLESS** a species (it's parasites) ;

1)are a human pathogen transfer risk (our health), or

2) are a risk to agriculture, livestock, fisheries (our food)

then there is no existing economic pressures to document life history including parasite interactions & their life histories.

This is because the interest is driven by "shared economic interest in our health and food" garnering attention, generating capital and direction, and promoting research to these ends.

>implication; for most imported ornamentals there is no substantial background that could be used in risk assessment analysis

EXS: ZOONOTIC AND REVERSE ZOONOTIC EXCHANGES

WHERE DO 75% OF NEW HUMAN DISEASES COME FROM?
ZOONOSIS = ("opportuninties of exposure" to animals)

75% of emerging diseases are zoonotic in origin, meaning that human exposure to animals is the primary source of emerging human disease (CDC). This does not mean that "fido" is necessarilly carrying a bug that can kill you (unless Fido is a civet cat).

INCREASING SPECIES CONTACT INCREASES RISK OF ZOONOTIC EXHANGES

H5N1 "BIRD FLU"

Since 1991 more than 120 outbreaks have been documented.(CDC/NCZVED)

"MAD COW" DISEASE

PSITTACOSIS

BURCELLOSIS VAR.

TOXOPLASMOSIS

MARBURG VIRUS

MONKEY POX"

Tularemia / lymphocytic choriomeningitis

SARS

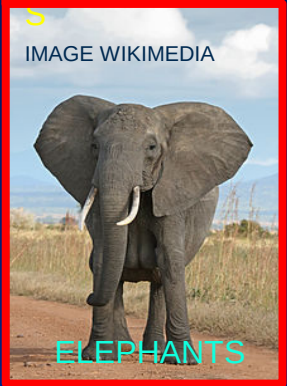
Taylor LH, Latham SM, Woolhouse MEJ. Risk factors for human disease emergence. Philos Trans R Soc Lond B Biol Sci. 2001;356:983–9.
http://www.freewebs.com/alexlees/Wildlife_paper%5B1%5D.pdf

IT GOES BOTH WAYS!

REVERSE ZOONOSIS

FROM HUMANS TO ANIMALS

TUBERCULOSIS



H3N2 virus / H1N1 virus

H1N1 virus

This is true for not only close mammalian relatives, but for unrelated taxa like corals.

MRSA / MSSA

INFLUENZA / metapneumovirus

Serratia marcescens

Kaur, et al (2008). Descriptive epidemiology of fatal respiratory outbreaks and detection of a human-related metapneumovirus in wild chimpanzees at Mahale Mountains National Park, Western Tanzania. *American Journal of Primatology, 70* (8), 755-765

Yu, H., Zhou, et al. (2009). Further evidence for infection of pigs with human-like H1N1 influenza viruses in China *Virus Research, 140* (1-2), 85-90

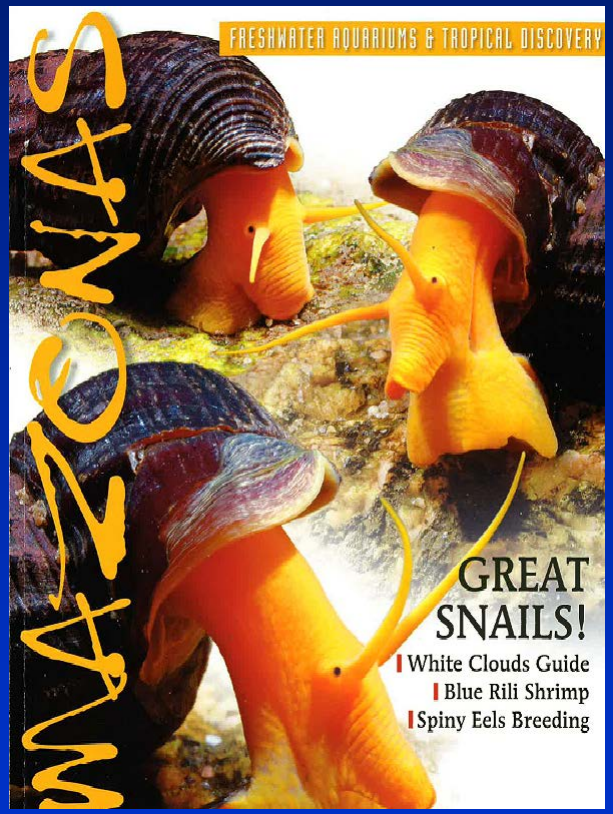
Hower S et al. (2013). Clonally related methicillin-resistant Staphylococcus aureus isolated from short-finned pilot whales (Globicephala macrorhynchus), human volunteers, and a bayfront cetacean rehabilitation facility. Microb Ecol. 2013 May;65(4):1024-38

WHERE DO 75% OF NEW HUMAN DISEASES COME FROM?

ZOONOSIS = (exposure to animals)

Ornamental aquarium snails and risk of *Schistosomiasis*

Tylomelania sp. snail



Eric S Loker. 2005. Research on the Molluscan Intermediate Hosts for Schistosomiasis What are the Priorities? Presented to the scientific working group on Shistosomiasis WHO 11 14-16, 2005.

NO OVERSIGHT !

As this recent AMAZONAS magazine shows, various species of snails that are imported from SE Asia (Mekong river), Africa, South America where human parasites thrive, where snails are 1 of the obligate hosts in human parasite life cycles

Among human parasitic diseases, a snail parasite, Schistosomiasis ranks second behind malaria in terms of socio-economic and public health importance in tropical and subtropical areas. The disease is endemic in 74-76 developing countries. And Florida has a habitable environment for human varities.

"Because schistosomes by necessity follow the snails, we must not ignore the snails as they will ultimately dictate where in the world schistosomiasis can occur .." (Eric S. Loker CDC pers comm)

Schistosomiasis life cycle

The three main species infecting humans;

Schistosoma haematobium,

S. japonicum, and

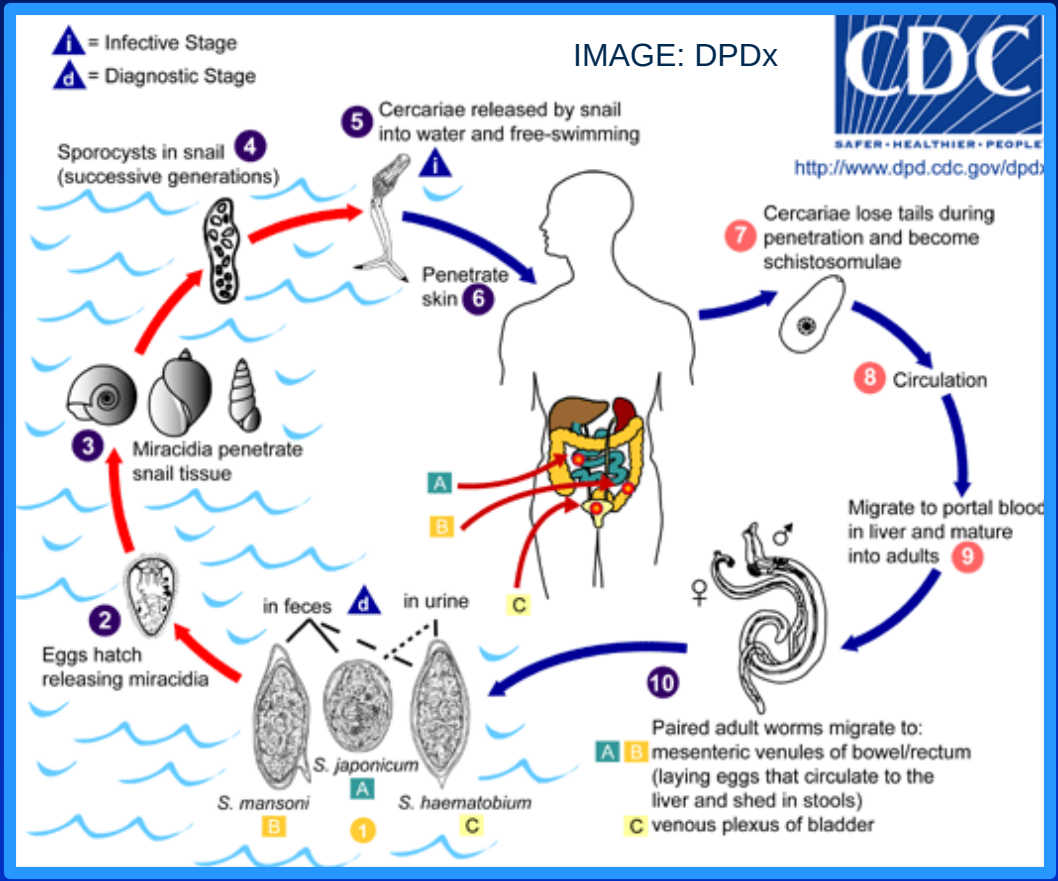
S. mansoni.

Two other species, more localized geographically, are

S. mekongi and

S. intercalatum.

In addition, other species of schistosomes, which parasitize birds and mammals, can cause cercarial dermatitis in humans.



" Human contact with water is necessary for infection by schistosomes. Various animals, such as dogs, cats, rodents, pigs, horse and goats, serve as reservoirs for *S. japonicum*, and dogs for *S. mekongi* ". (CDC)

INFO:
http://www.cdc.gov/parasites/schistosomiasis/biology.html

Q: WHAT DRIVES RESEARCH OF PARASITES AND IMPACTS?
A: "shared economic interest"

The documentation of the previous examples of zoonosis and reverse zoonosis were driven by the "shared economic interest " (concern) previously mentioned (our health and food).

The interconnections for human exposure are the best documented with the most levels of detail recently illustrating a very complex interconnection between us and our biomes, viromes, and fungomes.

What we are learning is that such global exposure to so many taxa is the predominant mechanism for disease emergence in us.

"75% of emerging diseases are zoonotic in origin, meaning that human exposure to animals is the primary source of emerging human disease" (CDC)

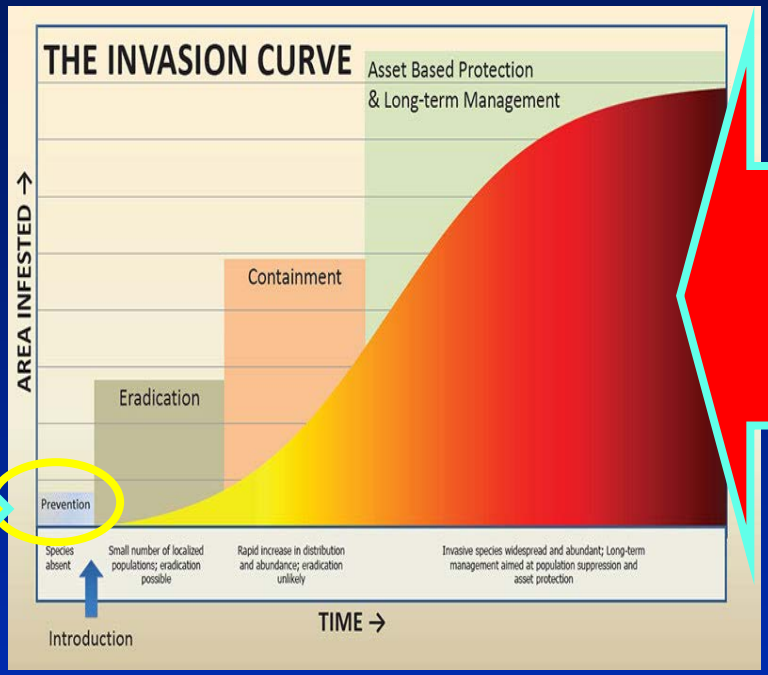
However due to a lack of "shared economic interest" there is no similar level of wholesale investigation into disease emergence in the ornamental trade to understand the risks even though the levels of exposure are the same (if not more).

BECAUSE OF “Tom’s golden rule”;

WE SPEND OUR TIME HERE

PROACTIVE ACTION

invasive (in humans / food) species are acted upon using precautionary strategies (VIA THE CDC) acting via strategic **PREVENTION**



TIME TO PREVENT!

EX: current Ebola outbreak in Africa

REACTIVE ACTION

invasive (not in humans) species are dealt with in a reactionary model when impacts are evident post invasion creating “shared economic interest” and (re)action (anything but PREVENTION)

TIME TO (RE)ACT!

EX:

The lionfish is a classic example; it’s life history was lacking substance PRIOR to the invasion. The invasion impacts generated “shared economic interest” and (re) ACTION

The continued sale of other *Pterois sp. post impact documenteation* shows that we have no real intention for PREVENTION even when ecosystem level impacts are documented

Q: PATHOGEN TRANSFERS – how distant can taxa be and how far reaching are the pathogen connections?

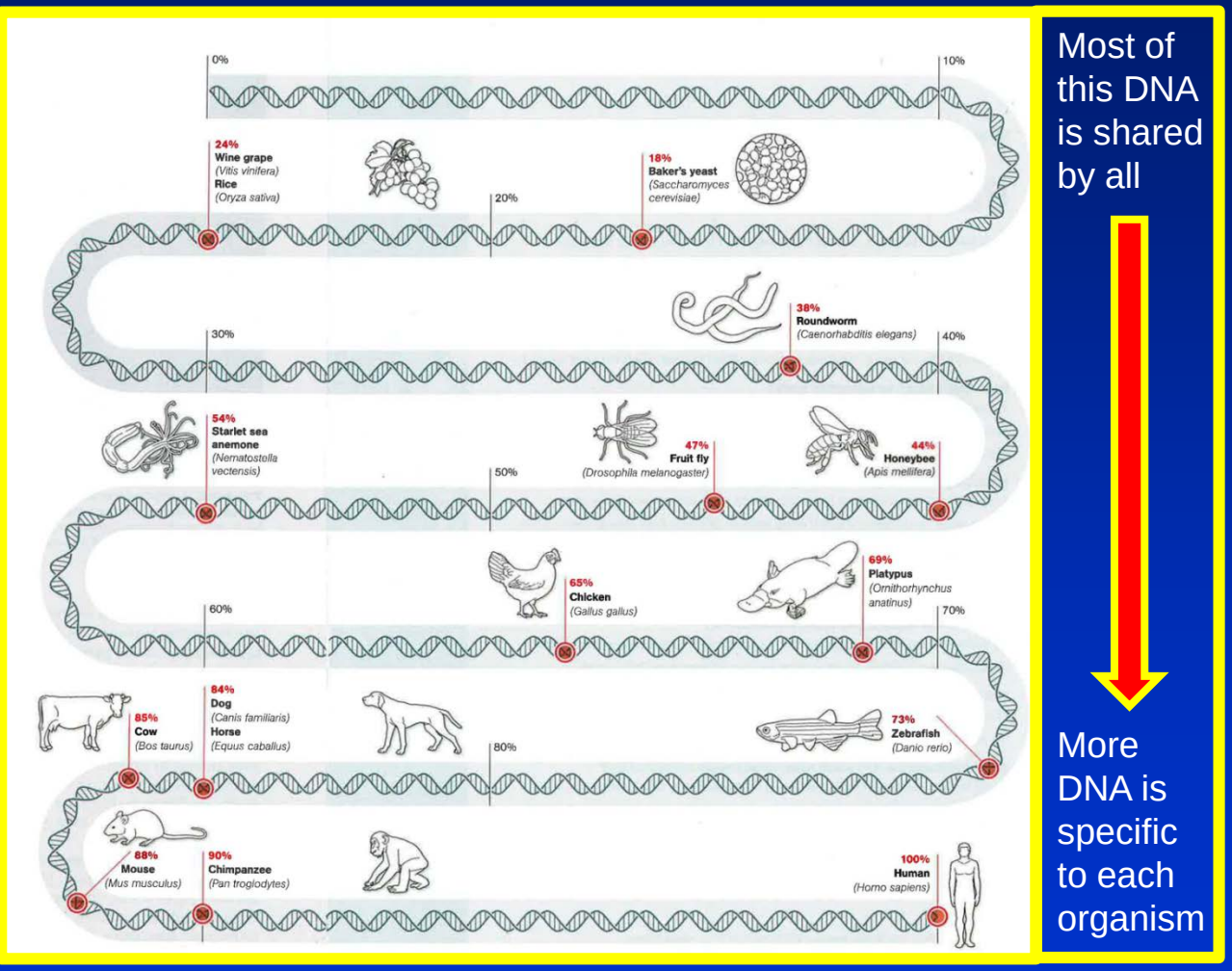
HOW DISTANT CAN TAXA BE TO CROSS INFECT PATHOGENS?

This DIAGRAM shows the “ shared genetic overlap ” between all life and humans along the phyllogenetic tree.

Some genes code for protein systems that are fundamental with most life forms (shared).

At (lower) phyllogenetic levels (upper left of this chart) a wider range of taxa can be compromised by information swapping pathogens

It gets more specific (closer relatedness) as you go to the bottom right



SOURCE:: NATIONAL GEOGRAPHIC July 2013, “the case of the missing ancestor” by Jamie Shreeve

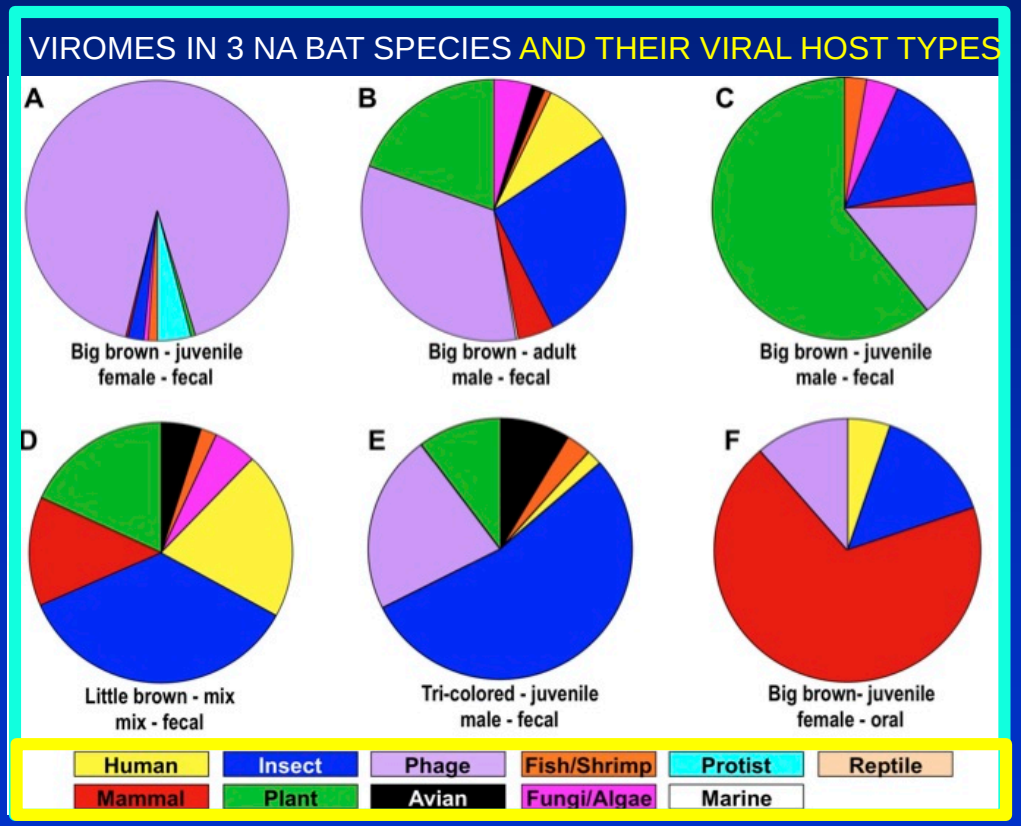
Q: *HOW DISTANT CAN TAXA BE TO BE CROSS INFECTED WITH (VIRAL) PATHOGENS?*

A: (EX: in 3 species of N. American bats) = all major vertebrate groups, a number of invertebrate groups, plants and fungi, as well as terrestrial and marine organism viroids are represented

Here we see how taxonomically far VIROME cross exposure can be in one (of the best studied) examples. This is due to bats being the singular most significant human pathogen vector / asymptomatic carrier (reservoir).

This illustrates another aspect of "opportunities of exposure" – all are histories of our exposure so it is easy to understand a bat having viral exposure to a cicada (and carrying some of it's virome) but that extends to the plants the cicada ate (and it's virome – now we are two levels deep).

The perplexing question is how does a marine VIROME host enter the food chain of a bat and get incorporated?



SOURCE:

http://www.ncbi.nlm.nih.gov/pubmed/20926577

Donaldson EF, Haskew AN, Gates JE, Huynh J, Moore CJ, Frieman MB. Metagenomic analysis of the viromes of three North American bat species: viral diversity among different bat species that share a common habitat. J Virol. 2010 Dec;84(24):13004-18. doi: 10.1128/JVI.01255-10. Epub 2010 Oct 6.

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3318625/

OPEN FILTRATION SYSTEMS PROVIDE GLOBAL "OPPORTUNITIES OF EXPOSURE "

The same exposure mechanisms and risks must also be in play with ornamentals.

EX: Pet wholesaler stock tank.

This image is of a system that included crustaceans and fish with 18 species from 3 Oceans and 4 seas exposed via "open filtration" systems!

yellow tang
purple tang
sohal tang
Atlantic blue tang
powder blue
powder brown
sailfin tang
naso tang
tomini tang
brown tang
flame angel
blue face angel
maculosus Angel
French angel
grey angel
fire shrimp
Picasso trigger
asfur Angel

exposed to all in system

How many different systems will an individual fish see before being exposed to others in ones fish tank prior to release?

Such "globally exposed" released ornamentals are a pathogen vector risk to natives including threatened and endangered, and commercial species. AGAIN: no "shared economic concern" to document.

EX: ANTIBIOTIC RESISTANCE ALREADY DOCUMENTED IN ORNAMENTAL FISHES IN TRADE IN FLORIDA COLOMBIA AND SINGAPORE

32 species of Tropical fish from Florida, Colombia, and Singapore were evaluated in Portland Oregon using kidney samples to evaluated for pathogens (Bacteria), as well as antibiotic resistance to 9 antibiotics.

64 Bacterial colonies were isolated including those in the genera Aeromonas, Pseudomonas, Staphylococcus.

A number of these bacterial were determined to cause disease in both fish and humans.

Some were found to be resistant to a number of antibiotics including 77% tested to tetracycline to 16% tested to cefotaxime.

High level resistance was found for some antibiotics that are rarely used.

They also noted that " *A number of common bacterial isolates from ornamental fish also possess zoonotic potential* ".

(meaning this could spread to humans)

This is useful for understanding potential zoonosis in future.

"..we appear to set ourselves up for some pretty serious problems with the industry" (Tim Miller-Morgan- author)

This is of signifcant concern to the CDC:

http://www.cdc.gov/ncezid/pdf/ncezid-accomplishments-2013.pdf

CAN WE GET A DISEASE FROM OUR FISH?

Rose S, Hill R, Bermudez LE, Miller-Morgan T. **Imported ornamental fish are colonized with antibiotic-resistant bacteria.** J Fish Dis. 2013 Jun;36(6):533-42. doi: 10.1111/jfd.12044. Epub 2013 Jan 7.

EX: RECENT PATHOGEN VECTOR RISK DOCUEMNTATION; *P. monodon* WSSV to commercially important native Panaeid shrimps

Recently documented **(GO GSARP!)**

population incursions of the invasive species of *P. monodon* into the WNA and GOM carry with them the risk of a number of pathogens they are susceptible to (EX) white spot syndrome virus (WSSV) with the likelihood of *P. monodon* acting as vector / nidus to commercially important panaeid shrimps.

WSSV exposure risk?

SOURCE Fuller, Pam L., et al. "Invasion of Asian tiger shrimp, Penaeus monodon Fabricius, 1798, in the western north Atlantic and Gulf of Mexico." Aquatic Invasions 9.1 (2014): 59-70.

LIONFISH / OPEN FILTRATION SYSTEMS AND IMPLICATIONS TO POLICY

The now stymied HB 1069 and SB 1336 did take into consideration by not importing Pacific lionfish there would be a reduction in the possibility of pathogen transfers within imported lionfish from future released lionfish. That by only allowing Atlantic lionfish in trade, we reduce that risk.

But in reality – the lionfish is likely to be housed with other marine fish that were imported and exposed in open filtrations systems to all other individuals at different points at different lines of trade prior to purchase. These secondarily expose the (Atlantic sourced) lionfish to their exposure history (in trade).

And as discussed earlier the release pressures for lionfish (boredom, not willing to euthanize, their now (larger) size at maturity) mean the release pressures are still in play and the pathogen transfer risk is a continuing threat to native wildlife.

Understanding that the animal trade is the largest component of emerging diseases in humans, the same exposure mechanisms are in play for the hordes of undocumented imported species with possibly global exposure, some bound for eventual release. Had any American chestnuts lately?

HOW DOES THIS AFFECT RISK ASSESSMENTS

The interrelationships (obligate and otherwise) within a organism's biome and between organisms (biomes) and interactions with others in their habitats, are as numerous and poorly understood as the implications of their understudied capabilities, interactions.

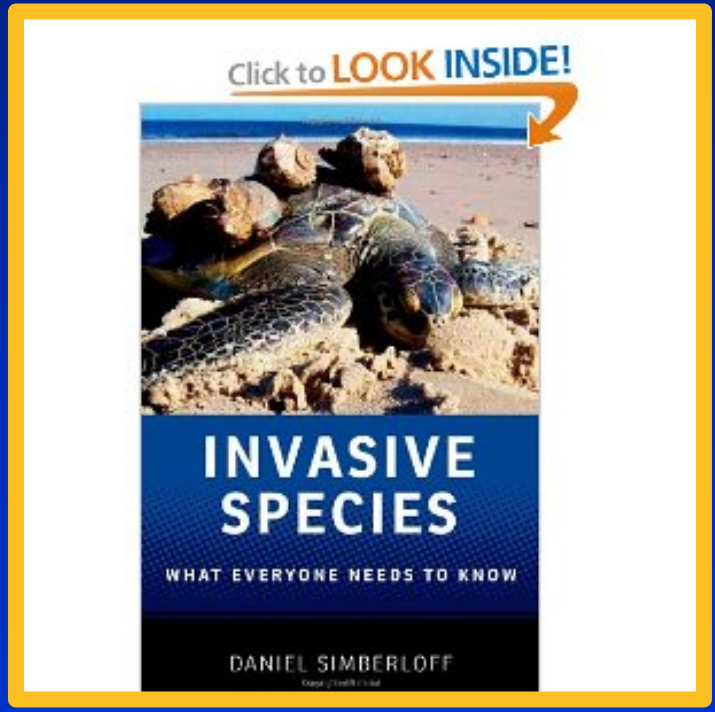
RISK ASSESSMENTS ARE (today) are based on often inadequate life histories peppered with near total lack of understanding of intrinsic organismic biomes, and their interactions with(in) others and the environment. Such microbial interactions above being difficult to identify and evaluate occur with every released organism and can be more deleterious and less mitigateable than "the organisms" effects post release. (EXAMPLE: American Chestnut Blight).

SYSTEMATIC RISK ASSESSMENTS
not to be relied upon as end all be all alternative

The problem is outlined In a 2013 book "INVASIVE SPECIES: WHAT EVERYONE NEEDS TO KNOW" written by Daniel Simberloff, contributer to over 500 invasive species publications.

Dr. Simberloff (p160,161):

"One immediately spots the difficulty of ….risk assessment(s). The procedure consists of a series of guesses. The guesses may be educated guesses if the assessors are experts…however they are still guesses. An accurate quantified statement such as "there is a probability X of a risk of magnitude Y" is simply impossible….accurate quantitative risk assessments for invasions are currently extremely difficult if not impossible, so this requirement is difficult or impossible for a nation to fulfill."



YOU SURVIVED!