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Reaction to Dr. R.D. Guerrero's presentation "The Impacts of Introduced Freshwater Fishes in the Philippines (1905 – 2013): A Review and Recommendations"

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Objectives of the RTD:

- Assess the impacts of introduced freshwater fishes in the Philippines
- Review the regulations on the importation of live aquatic species
- **Recommend strategies for the management of invasive alien fishes**
- Enhance public awareness and information on the impacts of introduced freshwater fishes.

Salient points of Dr. Guerrero's paper:

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- Highlights that not all introduced species had adverse impacts.
- Tilapia et al. have contributed heavily to the aquaculture and fisheries production in our inland waters.
- Aquaculture introductions had less adverse impacts compared to the ornamental introductions.
- Itemizes impacts - attributed to several species
- Presence of regulations on species importations, monitoring and control, adoption of mitigation measures and prevention of possible escapes of potentially invasive species, which need stricter enforcement.

Assess the impacts of introduced freshwater fishes in the Philippines

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- Tilapia, catfish, gouramis and pangasius have contributed to aquaculture as well as fisheries production.
- Species with **beneficial economic impacts**.
- Emphasizing that NOT all introduced species are bad!
- However…..

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Assess the impacts of introduced freshwater fishes in the Philippines

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Impacts may be economic, sociological or ecological

- Only a few introduced fish species have **on record** provided beneficial economic impacts.
- Of the 30 fishes introduced for aquaculture, only a handful are contributing to food fish production.
- Some of them have now been reported as invasive
- One may ask “Economically beneficial to most or to a handful of businessmen?”
- Prudence in introducing alien species must be exercised.

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Assess the impacts of introduced freshwater fishes in the Philippines

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Aquarium and ornamental trade are sources of invasive species in aquatic ecosystems (**Padilla and Williams, 2004**).

- A third of the world's worst aquatic invasive species are aquarium or ornamental species
- Aquarium trade will never be environmentally sustainable unless the consequences of escapees are considered
- Regulations to prevent unwanted species introductions from aquarium and ornamental sources currently lack authority
- A white list of native or safe alternative aquarium and ornamental species will help prevent unwanted introductions

Assess the impacts of introduced freshwater fishes in the Philippines

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'introductions for ornamental purposes have been more problematic than those for aquaculture."

- Aquaculture and the ornamental industry are the major pathways for freshwater fish introductions
- More introductions via aquaculture? – aquaculture introductions have more documentation and are mostly via government
- In reality, there have been more species moved around for the ornamental industry than for aquaculture.
- True for most countries

Assess the impacts of introduced freshwater fishes in the Philippines

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The "**absence of evidence is not evidence of absence**".
if we don't know that something exists, it doesn't mean that it doesn't

Impact studies on introduced alien species in the Philippines are lacking, hence we really do not know if impacts exists.

Socio-Economic impacts can easily be assessed but Ecological impacts do have a lag time in showing themselves.

Assess the impacts of introduced freshwater fishes in the Philippines

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- **Defining and quantifying impacts are difficult**
- Invasion science shifted from impacts of particular species to **cumulative impacts on ecosystems**, revealing that effects of introduction can be many and varied
- e.g. Predatory flatworm invasive to the UK, reduces native earthworms AND affects food supply for birds, soil becomes less porous, increased waterlogging, affects conditions for plants, makes habitat less suitable for moles (Simberloff et al., 2013).

Assess the impacts of introduced freshwater fishes in the Philippines

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Evaluation of IAS impact should include economic, ecological and sociological (Simberloff et al., 2013)

Japanese tiger prawn – invasive in Mediterranean (extinction of native species of prawn) however welcomed by local fishermen (extra income)

Invasion of pine trees in southern hemisphere, reduces quality of litter, depletes soil biodiversity but support timber industries benefiting local economies.

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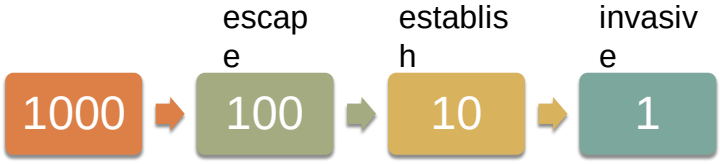
10% rule (Williamson, 1996)



Justifies why risk assessment prior to introduction is essential.

Species Invasion

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Invasion Curve

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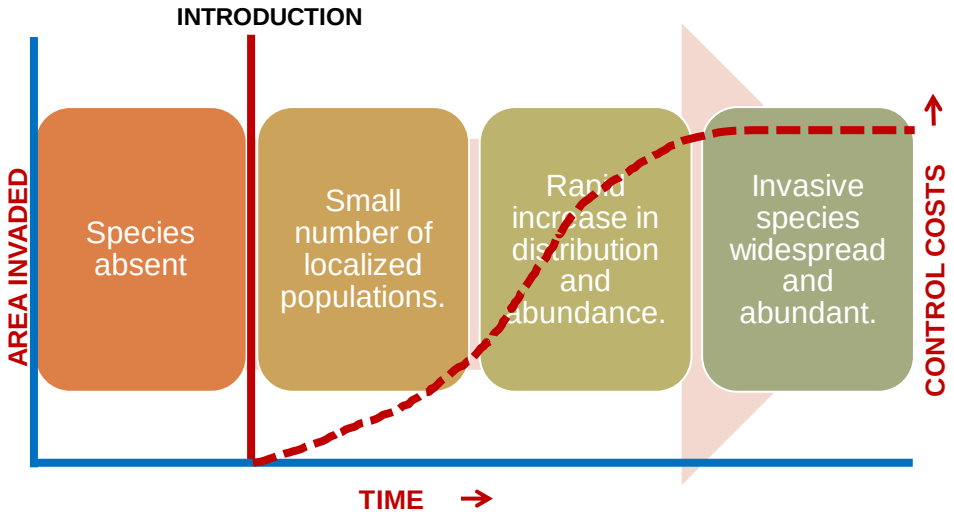

Invasion Curve

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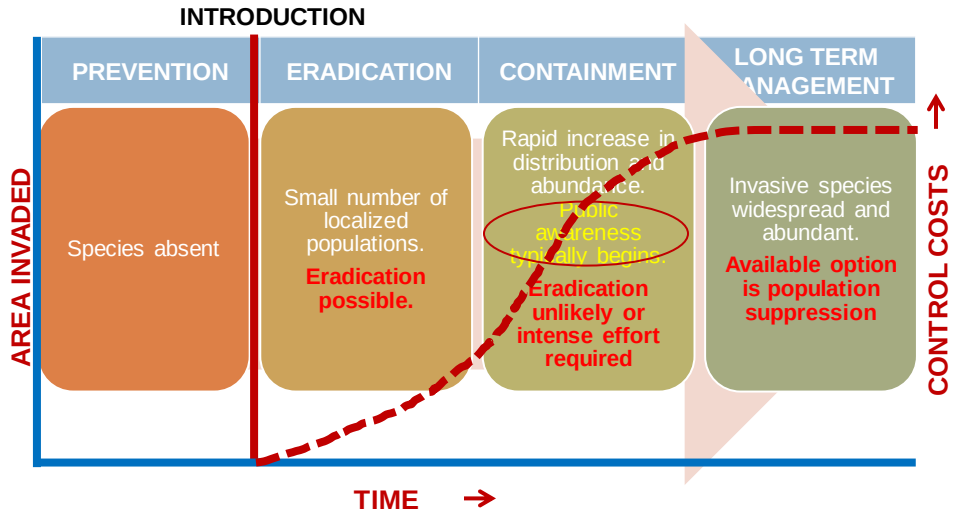

Knifefish

Chitala sp. (knifefish)

- Invaded Laguna de Bay
- Highly aggressive and carnivorous
- Diet: fishes (>60%), shrimps(~18%) and mollusks (~18%)
- Impacts livelihood of capture fishermen and aquaculture production
- Comprises 40.4% of major catch; daily landing of 10,000 kg
- Economic valuation: for every kg of knifefish produced: losing 7 kg of native fishes at a cost of P1,050.00
- Pathways: escape from ornamental fish farm/ aquarium; deliberate release by hobbyists
- Initiative: Gov't buys at P20/kg to help fishermen & for eradication

BFAR, 2014

Review the regulations on the importation of live aquatic species

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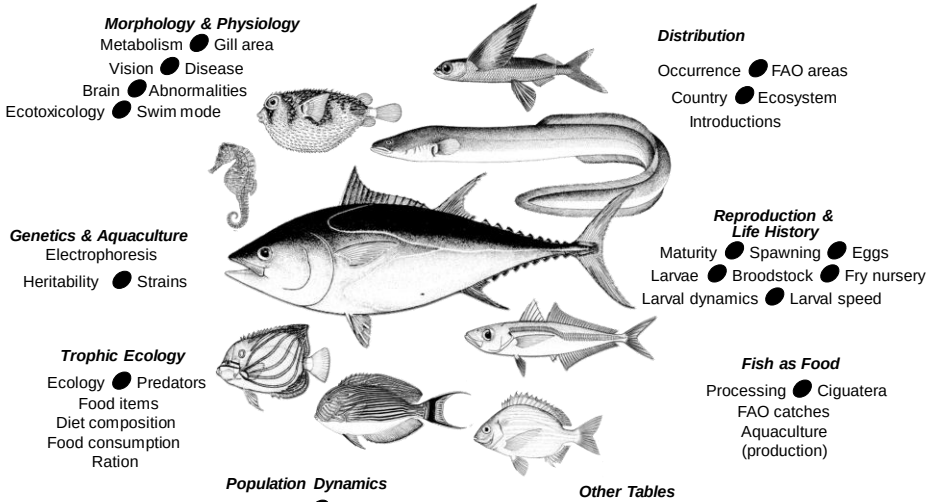
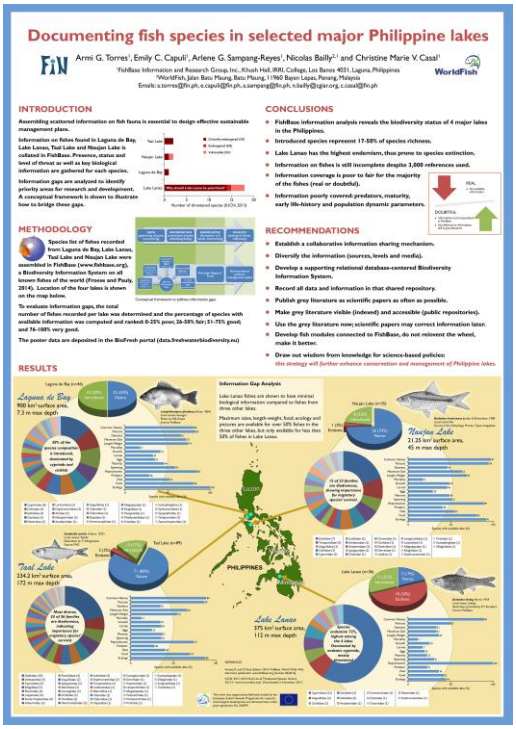
- Strictly implement existing regulations on species importations, monitoring and control, adoption of mitigation measures and prevention of possible escapes of potentially invasive species
- Be more proactive instead of reactive
- Think about the invasion curve
- Do risk assessment prior to importation
- What is the threshold between economic benefits and adverse ecological impact? What is an acceptable risk?
- Ensure immediate response upon establishment of localized populations of IAS.

Information in FishBase





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Documenting fish species in selected major Philippine lakes
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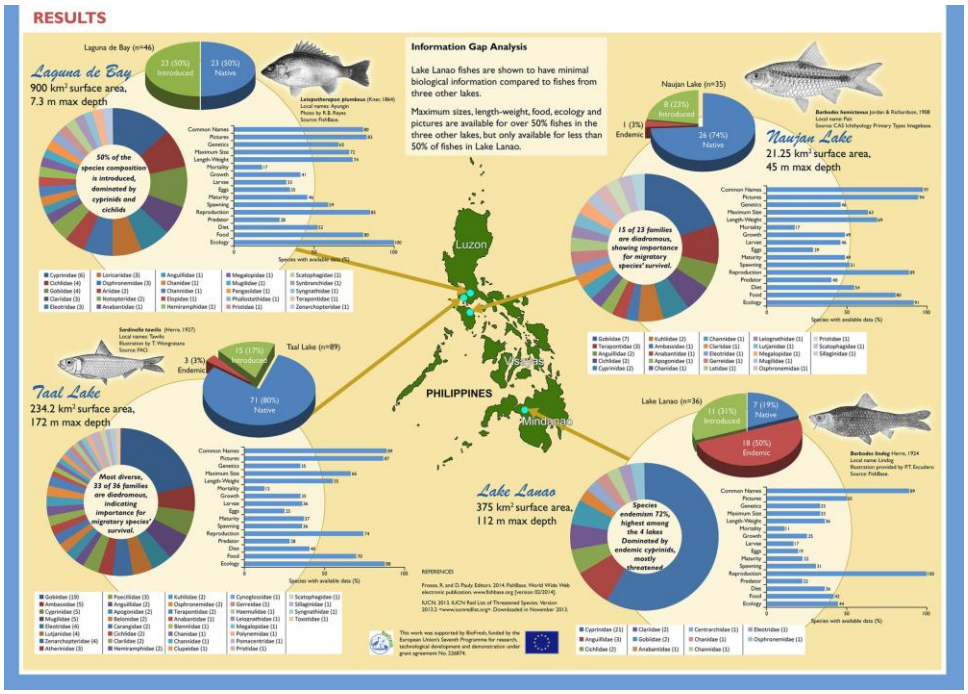
INTRODUCTION
Assembling scattered information on fish fauna is essential to design effective sustainable management plans.
Information on fishes found in Laguna de Bay, Lake Lanao, Taal Lake and Naujan Lake is collated in FishBase. Presence, status and level of threat as well as key biological information are gathered for each species.
Information gaps are analyzed to identify priority areas for research and development. A conceptual framework is shown to illustrate how to bridge these gaps.
Taal Lake
Naujan Lake
Laguna de Bay
Lake Lanao
Critically endangered (CR)
Endangered (EN)
Vulnerable (VU)
Why should Lake Lanao be prioritized?
Number of threatened species (IUCN, 2013)
METHODOLOGY
Species list of fishes recorded from Laguna de Bay, Lake Lanao, Taal Lake and Naujan Lake were assembled in FishBase (www.fishbase.org), a Biodiversity Information System on all known fishes of the world (Froese and Pauly, 2014). Location of the four lakes is shown on the map below.
To evaluate information gaps, the total number of fishes recorded per lake was determined and the percentage of species with available information was computed and ranked: 0-25% poor, 26-50% fair; 51-75% good; and 76-100% very good.
The poster data are deposited in the BioFresh portal (data.freshwaterbiodiversity.eu)
DATA (gathering of parts, researching)
INFORMATION (connection of parts, absorbing, doing)
KNOWLEDGE (formation of a whole, interacting)
WISDOM (joining of whole, reflecting)
Decision Support Tools
Science-based policies, management plans
Conceptual framework to address information gaps.
CONCLUSIONS
FishBase information analysis reveals the biodiversity status of 4 major lakes in the Philippines.
Introduced species represent 17-50% of species richness.
Lake Lanao has the highest endemism, thus prone to species extinction.
Information on fishes is still incomplete despite 3,000 references used.
Information coverage is poor to fair for the majority of the fishes (real or doubtful).
Information poorly covered: predators, maturity, early life-history and population dynamic parameters.
REAL
No available information
DOUBTFUL
Information not incorporated in FishBase
No reference or information still in grey literature
RECOMMENDATIONS
Establish a collaborative information sharing mechanism.
Diversify the information (sources, levels and media).
Develop a supporting relational database-centered Biodiversity Information System.
Record all data and information in that shared repository.
Publish grey literature as scientific papers as often as possible.
Make grey literature visible (indexed) and accessible (public repositories).
Use the grey literature now; scientific papers may correct information later.
Develop fish modules connected to FishBase, do not reinvent the wheel, make it better.
Draw out wisdom from knowledge for science-based policies:



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Sieves of the Invasiveness Tool

All Fish Species

↓

Commercially utilized in the Ornamental or Aquaculture industry

↓

Have at least one reported establishment record

↓

Country level limitations

Non-indigenous

↓

with a natural climate similar to the country

Aquaculture and Aquarium Fishes Which May Establish Themselves in Philippines

[n = 127]

List of commercial aquaculture and aquarium fishes which match the environmental conditions in Philippines, and which have established themselves in at least one other country.

Refresh | FishBase name | Species | Family | Aquaculture | Aquarium | Max. length | Productivity | Other countries

Select: Philippines — Percent established: 21%

FishBase name	Species	Family	Aquaculture	Aquarium	Max length (cm)	Temp. (°C)	Climate zone	Productivity	Established in countries This	Established in countries Other
Mozambique tilapia	*Oreochromis mossambicus*	Cichlidae	commercial	commercial	39	17 - 35	tropical	Med.	Yes	110
Nile tilapia	*Oreochromis niloticus*	Cichlidae	commercial	never/rarely	60	14 - 33	tropical	Med.	Yes	67
Blue tilapia	*Oreochromis aureus*	Cichlidae	commercial	commercial	46	8 - 30	tropical	High	Yes	35
Redbreast tilapia	*Tilapia rendalli*	Cichlidae	commercial	commercial	45	24 - 28	tropical	Med.	No	28
Green swordtail	*Xiphophorus hellerii*	Poeciliidae	never/rarely	highly commercial	14	22 - 28	tropical	High	No	28
Redbelly tilapia	*Tilapia zillii*	Cichlidae	commercial	commercial	40	11 - 36	tropical	Med.	Yes	24
Longfin tilapia	*Oreochromis macrochir*	Cichlidae	commercial	never/rarely	43	18 - 35	tropical	High	No	20
Southern platyfish	*Xiphophorus maculatus*	Poeciliidae	never/rarely	commercial	4	18 - 25	tropical	High	No	17
Jaguar guapote	*Parachromis managuensis*	Cichlidae	commercial	commercial	55	25 - 36	tropical	Med.	Yes	12
Giant gourami	*Osphronemus goramy*	Osphronemidae	commercial	commercial	70	20 - 30	tropical	Med.	Yes	11
Three spot gourami	*Trichopodus trichopterus*	Osphronemidae	commercial	highly commercial	15	22 - 28	tropical	High	Yes	9
Peacock cichlid	*Cichla ocellaris*	Cichlidae	commercial	commercial	74	24 - 27	tropical	High	No	9
Cachama	*Colossoma macropomum*	Serrasalmidae	commercial	public aquariums	108	22 - 28	tropical	Med.	Yes	8
Snakeskin gourami	*Trichopodus pectoralis*	Osphronemidae	commercial	never/rarely	25	23 - 28	tropical	Med.	Yes	8
Convict cichlid	*Amatitlania nigrofasciata*	Cichlidae	never/rarely	highly commercial	10	20 - 36	tropical	High	Yes	7

Why aquaculture and ornamental sieve

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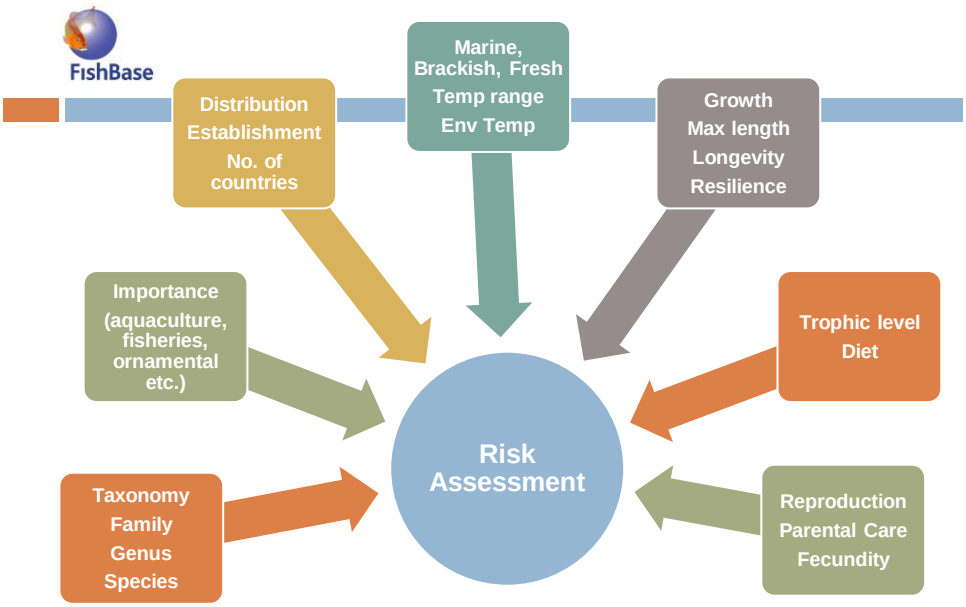
They are always brought in in high numbers, higher chance of establishing in wild

They have been selected for hardiness and suitability to receiving country

They are also the major reasons for introduction

More often than not, they are cultured in natural waters (outdoor fish pens, etc.)

High chance of escaping into the wild in a typhoon-prone country like the Philippines.



Data available for almost 32,700 species

Assess the impacts of introduced freshwater fishes in the Philippines

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We should do more impact studies on invasive species to have a more holistic view.

What we can safely say right now is that **there is very little evidence of invasive species impacts from introduced aquatic fishes in the Philippines because they have not been well studied**.

Recommend strategies for the management of invasive alien fishes

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Risk Assessment – prior to importation, introduction to natural waters

Early Detection – monitoring of areas near aquaculture (food and ornamental species)

Rapid Response – implement a planned response prior to a species' importation and introduction

Invasion Curve

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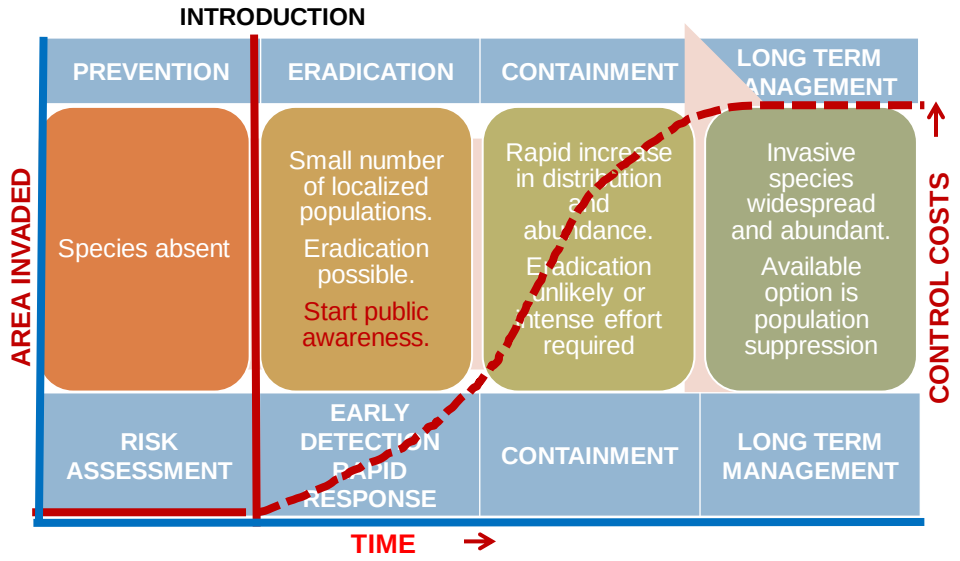

Early Detection and Rapid Response

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Early Detection allows cost-effective removal (Harris and Timmins, 2009) – early extirpation of non-native plants in NZ costs an average 40 times less than later attempts.

Rapid response e.g. prompt removal is ecologically less risky than later interventions (Caut et al, 2009) – a long standing IAS may already have strong interspecific relations within the invaded community.

Eradicating alien species

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Success of eradication:

1) absence of the eradicated species;
2) recovery of the ecosystem; and
3) absence of surprise effects.

Some eradications have been accompanied by unexpected population explosions of seemingly harmless (or undetected) introduced species, previously suppressed by the eradicated alien species (Courchamp et al., 2011).

These unexpected chain reactions are sometimes referred to as "surprise effects".

Recommend strategies for the management of invasive alien fishes

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IAS usually go undetected until the population explodes.

We only learn about them when:

- impacts have been felt,
- it has spread
- it becomes difficult to contain

No regular monitoring of ecosystems

Government agencies can not be everywhere

Recommend strategies for the management of invasive alien fishes

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- Citizen Science can be utilized
- Citizen scientists can be tapped to report new entrants to ecosystems
- Information can be mapped to show non-native species distribution
- Without knowledge on non-native species distribution, effective containment can not happen
- Information can contribute to plans for IAS containment

IAS Containment

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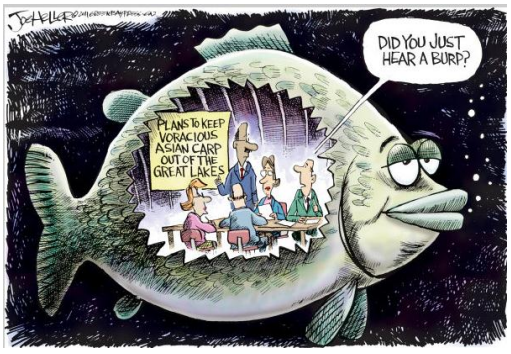
Chances for successful containment of invasive species are relatively good for species in freshwater habitats as fish spread is limited to specific water catchment area.



Enhance public awareness and information on the impacts of introduced freshwater fishes.

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Communication Education and Public Awareness (CEPA) on invasive alien species – in partnership with media and other agencies, newspaper and TV ads, incorporation in school curricula, etc.

Educate responsible pet owners/fish farmers in partnership with the aquaculture and ornamental industry, BFAR, DENR and other groups.

Encourage a responsible aquaculture and ornamental industry – reporting escapes in facilities immediately.

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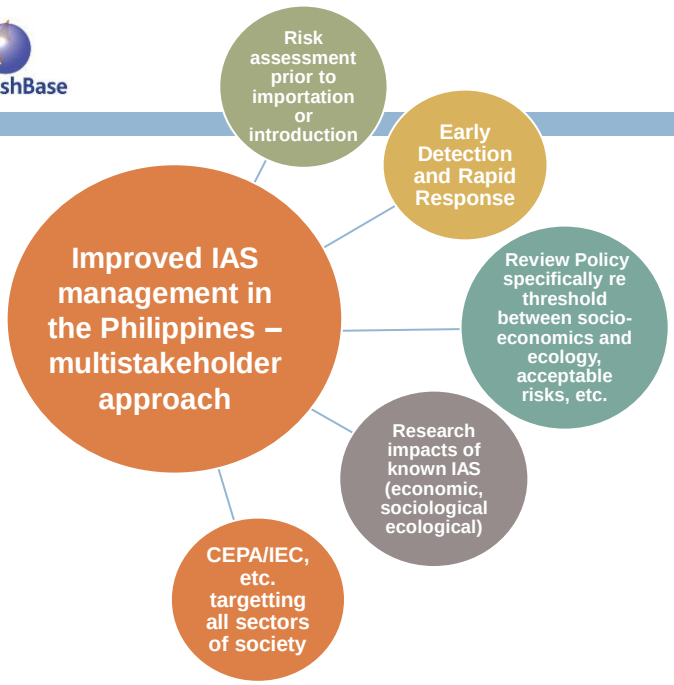

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Maraming Salamat

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