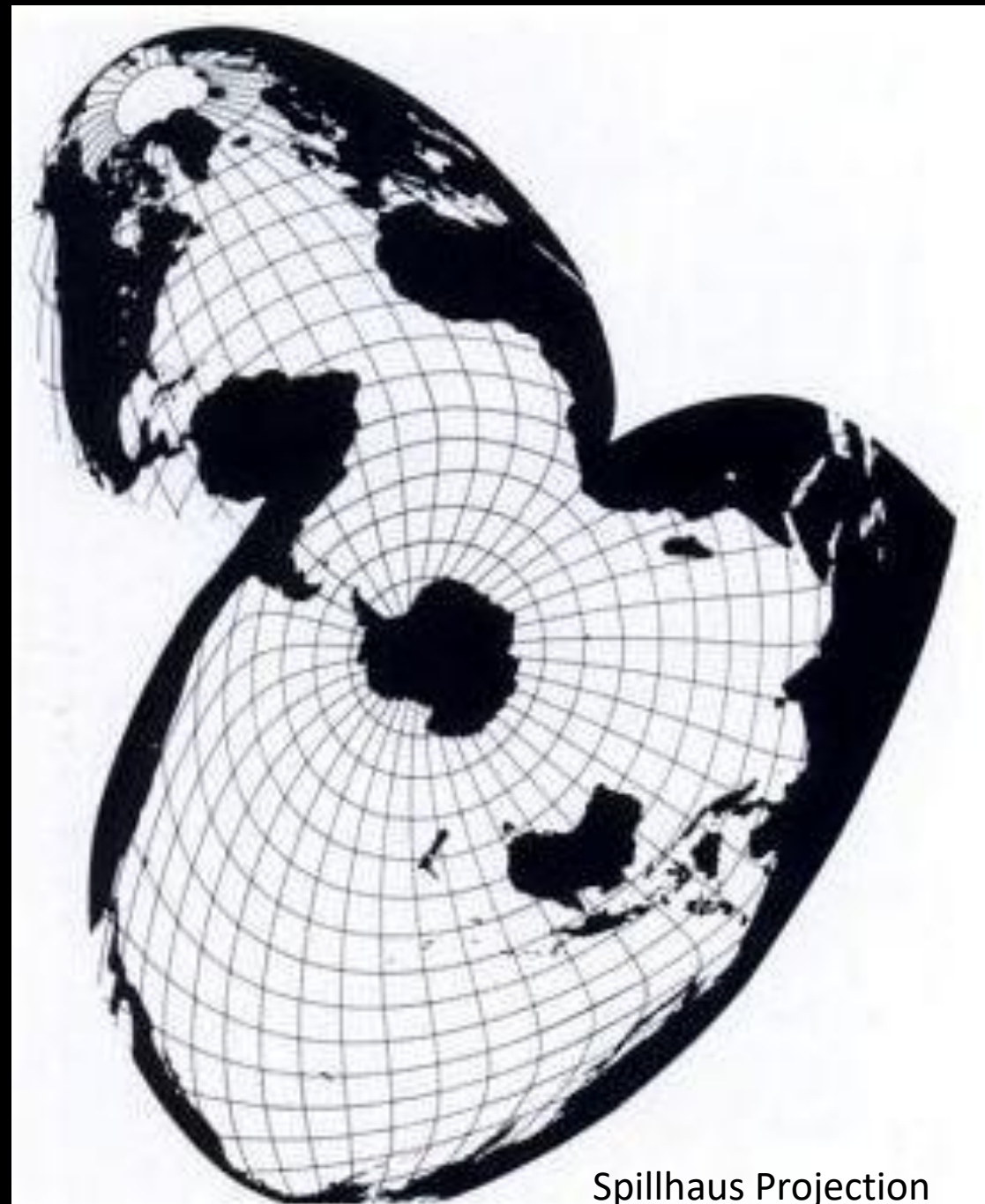


Combating Antibiotic- Resistant Bacteria in Aquatic Livestock Production

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Spillhaus Projection

Assuming NO Abx (or little use)

~~Alternatives:~~ Appropriate first responses:

- Biosecurity for primary pathogens
- Environment control/modification for species
- Vx for expected and economically important
- Clinical Dx for distinction of etiologies
- Passive immunity for contrary infections
- Discontinue/alternate Disinfectants

Globally:

17 industrialized species of aquatic livestock

~40 countries w/ significant activity

Major progress in marine/estuarine spp.

Aquatic livestock + wild > ½ beef + pork + poultry

Aquatic livestock growing twice population growth

1 billion use fish as main source of animal protein

3 billion get > 20% animal protein from fish

Current Abx Use Scenario:

Approved Abx available

- US has three FDA approved for food fish
- Unapproved to ornamentals (low regulatory)
- Japan has ~29 single or combinations
- Chile has ~17 available
- Some countries using Abx banned in US
- Integrated production-feces to production water

Current Abx Resistance Landscape:

- 90% seafood consumed in US is imported
50/50 ratio farmed/wild (\$17.4 Billion 2012)
NOAA reported on 23+ spp imported in 2012
 - ~27% shrimps; 13% Salmon; 11% tuna, etc
30 countries > \$100 million fisheries products
- Evaluated under FDA Seafood Processor HACCAP

Abx Resistance Success story:

- Norway Salmon Farms late 1970's
 - Medicated feeds became ineffective
 - Vaccines developed w/ Norwegian Vet. Inst.
 - Second wave of diseases brought different vaccines
- Presently -
 - Norwegians utilize 50,000 kg/yr for sick people
 - Salmon farms utilize 1,000 kg/yr for diseased fish
 - Biomass on Salmon farms is twice humans!

Table 1

Some examples of preservatives and Antibiotics to which resistance has been reported

- Benzalkonium Chloride
- Benzisothiazolone
- Benzoic acid
- Chloroallyltriazine-azoniadamantane
- Chloramine
- Chlorhexidine
- Chlorophenol
- Dibromodicyanobutane
- Dimethyldithiocarbamate
- Dimethoxy dimethyl hydantoin
- Formaldehyde
- Glutaraldehyde
- Hexahydrotrienthyl triazine
- Hydrogen peroxide
- Imidazolidinyl urea
- Iodine
- Mercuric salts
- Methylenebischlorophenol
- Methylchloro/methyl-isothiazolone
- Methyl paraben
- Phenylmercuric acetate
- Propyl paraben
- Povidone iodine
- Quaternary ammonium compounds
- Sorbic acid
- Tetrahydrothiadiazinone
- Trifluoromethyl dichloro-cabanilide

USA:

Major species (CCF, RBT, ASL, TLP)

VFD since 2006 for Aquaflor. OTC & ~~RMT~~

1 Health Authority but 3 Federal Agencies regulate

3 categories of livestock (farmed, conserv., pet fish)

Inadequate disease reporting thru DNR's, hobbyists

Few states with active aquatic livestock regulations

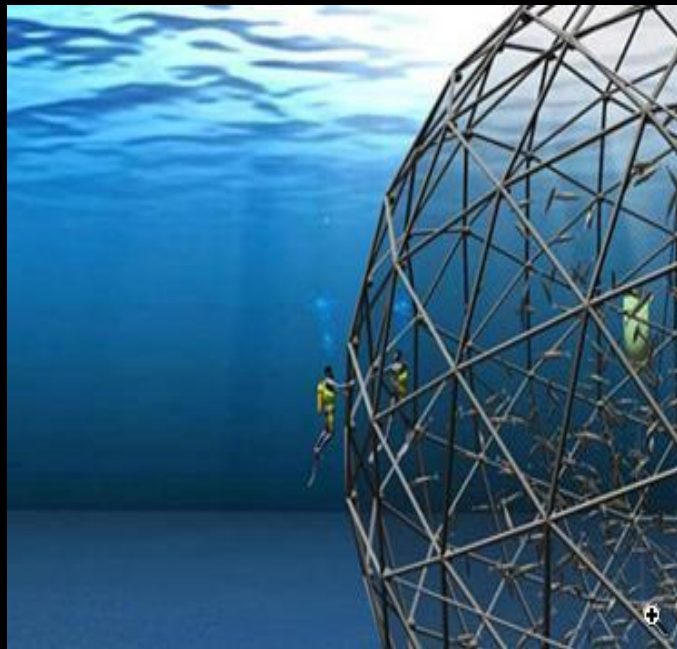


ROUT FARMING IN IDAHO

<https://ustfa.org/>

ATFISH FARMING ON MISSISSIPPI DELT

Snap-shot of majority of USA Aquatic Livestock Facilities



<http://thefutureofthings.com/6281-robotic-fish-cages/>

www.coastalwatershedinstitute.org

FLORIDA TROPICAL FISH FARM

http://www.ftffa.com/content/fish_farming_in_fl.php



- **Assuming NO Abx (or little use)**

~~Alternatives:~~ Appropriate first responses:

- **Biosecurity for primary pathogens**
- **Environment control/modification for species**
- **Vx for expected and economically important**
- **Clinical Dx for distinction of etiologies**
- **Passive immunity for contrary infections**
- **Immunostimulants for innate mobilization**
- **Control of biotope populations**
- **Discontinue/alternate some Disinfectants**

Thank you!