Aquaculture, wild fisheries, and consumption of omega-3 fatty acids

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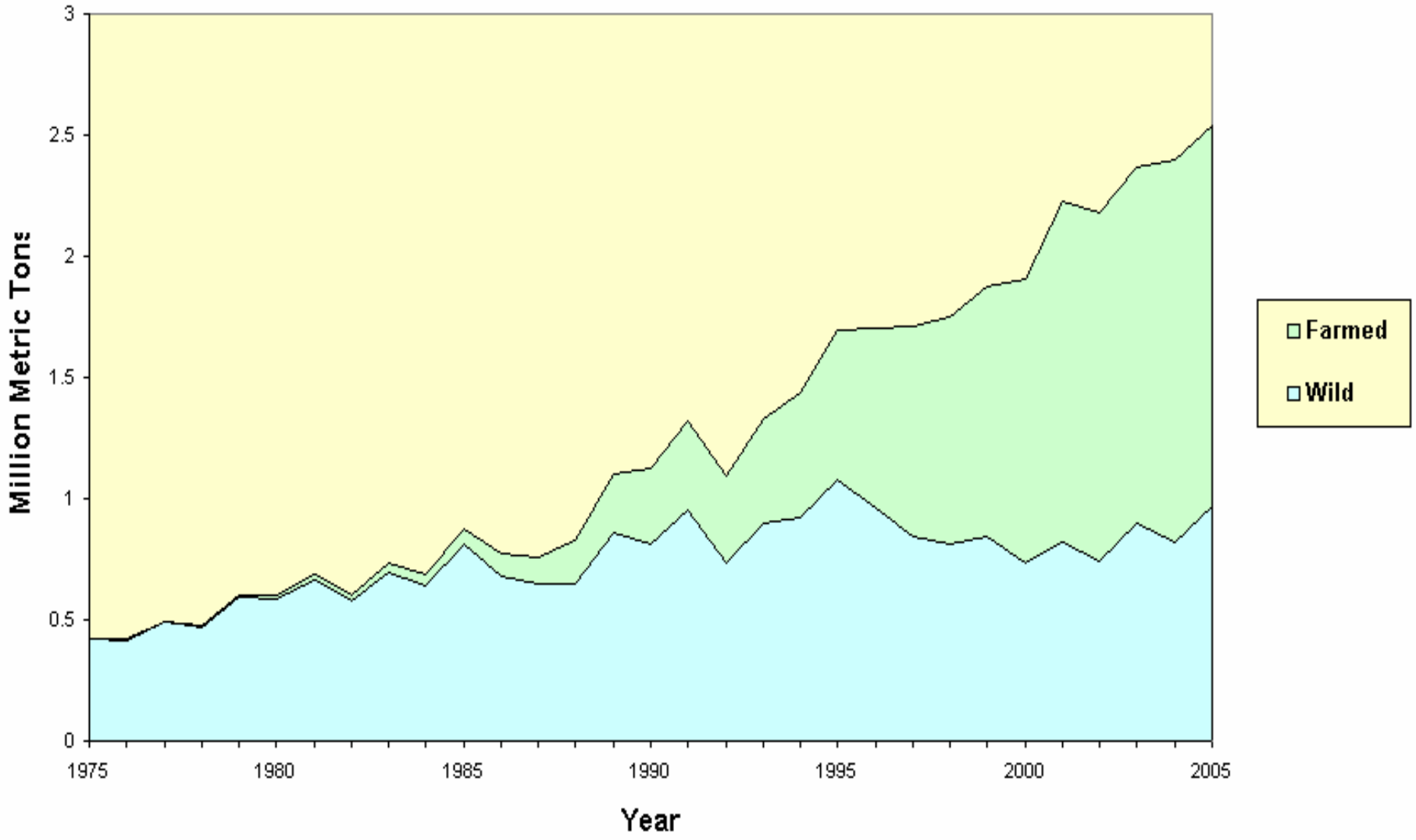
ENVIRONMENTAL DEFENSE
finding the ways that work

Fish farming is an increasingly important source of seafood

- About 43% of all fish directly consumed by people worldwide in 2004 were farmed, up from 9% in 1980 (FAO 2006).

Global Production Farmed and Wild Salmon



EPA+DHA in selected wild fish

Species	EPA (g)	DHA (g)	EPA+DHA / 3.5 oz portion	EPA+DHA / 8 oz portion
mackerel, Atlantic	0.90	1.40	2.30	5.22
salmon, chinook	1.01	0.94	1.95	4.43
salmon, canned	0.56	0.76	1.33	3.01
tuna, canned white	0.23	0.63	0.86	1.96
striped bass	0.17	0.59	0.75	1.71
shrimp	0.26	0.22	0.48	1.09
pollock (whitefish)	0.15	0.22	0.37	0.84
crab, blue	0.17	0.15	0.32	0.73
tuna, canned light	0.05	0.22	0.27	0.61
grouper	0.03	0.22	0.25	0.56
tuna, yellowfin (ahi)	0.04	0.18	0.22	0.49
flounder/sole	0.09	0.11	0.20	0.45
cod, Atlantic	0.06	0.12	0.18	0.42

Source: USDA Nutrient Database v. 18

EPA+DHA in selected farmed fish

Species	EPA (g)	DHA (g)	EPA+DHA / 3.5 oz portion	EPA+DHA / 8 oz portion
salmon, Atlantic	0.62	1.29	1.91	4.34
salmon, coho	0.39	0.82	1.21	2.74
trout, rainbow	0.26	0.67	0.93	2.11
oyster, Pacific	0.44	0.25	0.69	1.56
shrimp	0.26	0.22	0.48	1.09
mussel, blue	0.19	0.25	0.44	1.00
oyster, eastern	0.19	0.20	0.39	0.89
catfish	0.07	0.21	0.27	0.62
scallop	0.09	0.11	0.20	0.45
crawfish	0.12	0.03	0.14	0.33
clam	0.07	0.07	0.14	0.32
tilapia	0.01	0.08	0.09	0.20

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Optimal intake for reduced risk of coronary death/ total mortality

0.25 g /day
1.75 g /week

Mozaffarian and Rimm. 2006. *JAMA*

EPA+DHA in selected wild fish

Species	EPA (g)	DHA (g)	EPA+DHA / 3.5 oz portion	EPA+DHA / 8 oz portion
herring	0.88	0.88	1.76	5.27
mackerel, Atlantic	0.90	1.40	2.30	5.22
salmon, chinook	1.01	0.94	1.95	4.43
sardine	0.50	0.69	1.19	3.57
salmon, canned	0.56	0.76	1.33	3.01
tuna, canned white	0.23	0.63	0.86	1.96
shrimp	0.26	0.22	0.48	1.09
pollock (whitefish)	0.15	0.22	0.37	0.84
tuna, canned light	0.05	0.22	0.27	0.61
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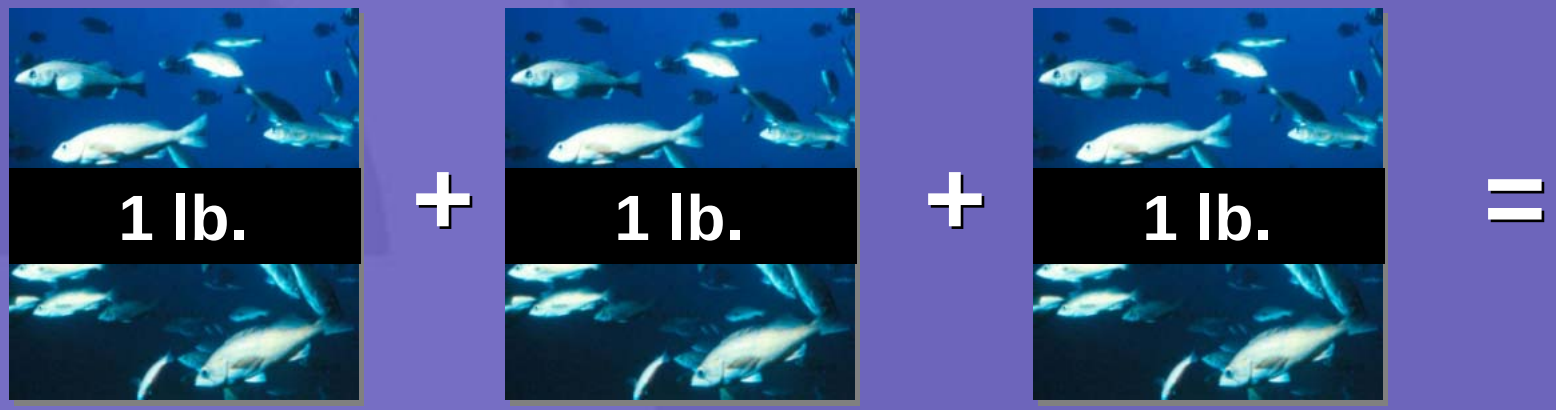
Fish meal and oil in fish diets*

	Fish meal (%)	Fish oil (%)
Salmon	35	25
Trout	30	17
Marine shrimp	23	2
Carp (fed)	5	1
Catfish	3	1
Mollusks	0	0

* Global average, 2003 (Tacon, 2006)

Feed: Net Loss of Fish



Producing one pound of farmed salmon requires roughly three to six pounds of wild caught fish

Reduction Fisheries: Sardines, anchovies, menhaden, and more

- Fish catches for “reduction” to fish meal and fish oil were three million metric tons in 1950.
- From mid-1980’s on, reduction catches have fluctuated from 20 – 30 million metric tons per year.

Proportion fish meal supplies used for fish farming

1988 -- 10%

1994 -- 17%

1997 -- 33%

1998 -- 43%

2002 – 42%

2003 – 46%

Challenges from aquaculture's dependence on wild fisheries

1. Finite quantities of small pelagic fish used in fish feed are available as aquaculture grows. Fish meal and fish oil prices are rising.
2. Demand for small pelagic fish for direct consumption will grow with human population and affluence, as well as rising prices for other fish.

3. Stocks of small pelagic fish critical food for marine predators, including commercially valuable fish.

Opportunities to replace fish meal and oil in aquaculture feeds

- Predatory fish such as salmon need certain omega-3 fatty acids and amino acids in their diets, but they don't need to come from fish.
- Substitutes for fish meal and oil
  - Soy and other grains
  - Seafood and poultry processing byproducts
  - Farmed marine worms, algae, and other organisms
- Developing alternatives to fish oil is especially challenging

Reducing farmed salmon's reliance on fish oil: Maintaining omega-3s

Feed treatment	Flesh EPA+DHA (% total FA)	Flesh EPA+DHA (% total FA)
100% fish oil (control)	12.4	10.7
25% linseed oil	9.1	9.9
50% linseed oil	7.8	8.9
75% linseed oil	6.1	9.1
100% linseed oil	4.4	8.9

* Following a 24 week "finishing diet" with 100% fish oil

Bell et al. 2004. *Lipids*

Conclusions

- Farming fish with substantial levels of EPA and DHA now generally requires substantial inputs of wild fisheries products in feeds.
  - Farming fish with such diets is not an alternative to fishing.
  - Farmed molluscs are a notable exception.
- Alternative fish diets which provide EPA and DHA are now in development. However, until they are in widespread use, aquaculture will not supplement capture fisheries as a major source of omega-3 fatty acids.