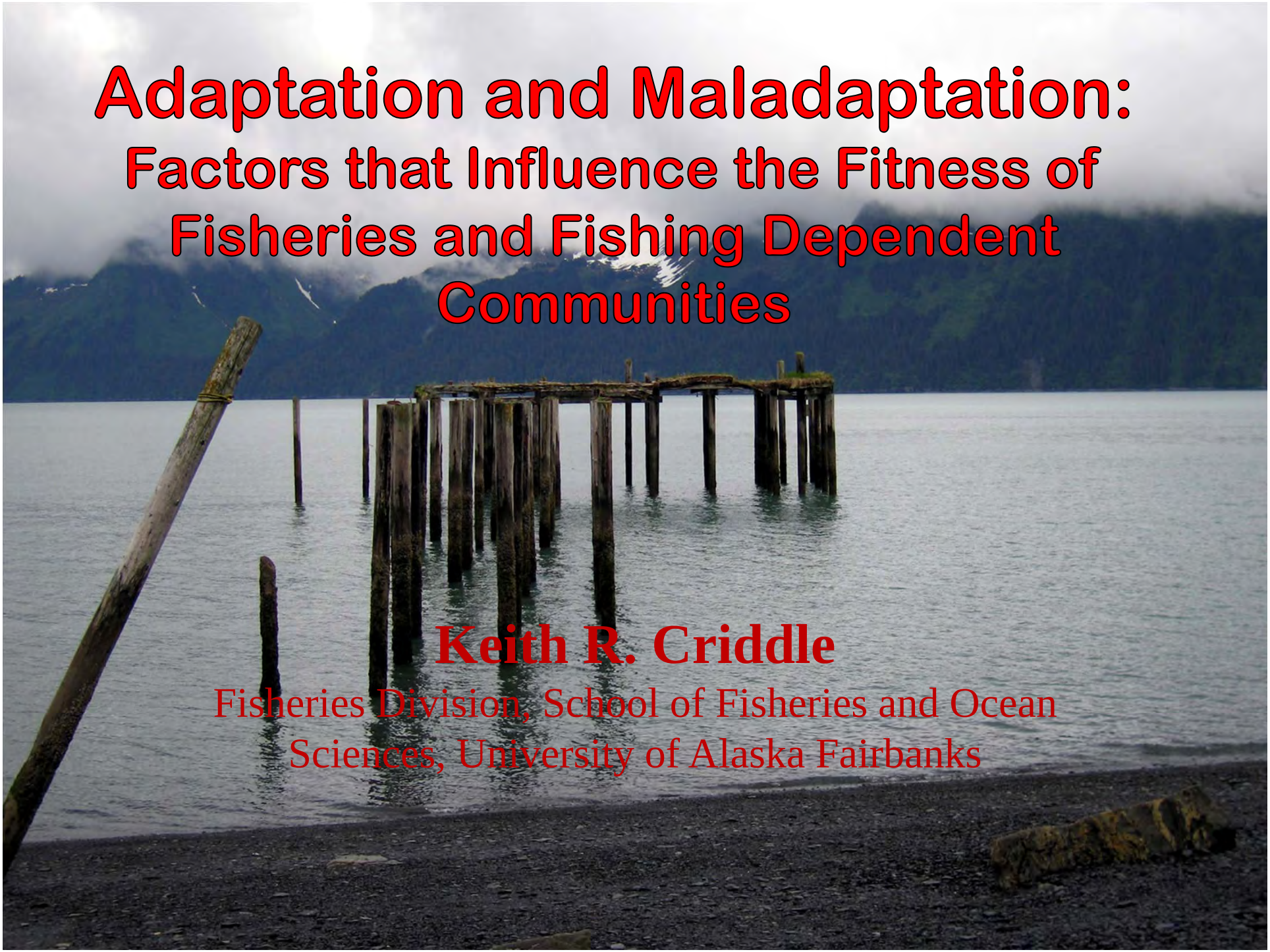


Adaptation and Maladaptation:
Factors that Influence the Fitness of Fisheries and Fishing Dependent Communities

Keith R. Criddle

Fisheries Division, School of Fisheries and Ocean Sciences, University of Alaska Fairbanks

How to Crash a Socio-Ecological System

Fail to solve the common-pool resource dilemma

- Ignorance—Failure to understand limits of biophysical system.
- Incompetence—Failure to stay within those limits.
- Ineptitude—Failure to prevent race-for-fish.

How to Crash a Socio-Ecological System

Fail to adapt to nonstationarities, e.g.,

- Environmental and Ecological change
- Demographic change
- Technological change
- Changes in social preferences
- Changes in input and output prices

Low frequency dynamics are often indistinguishable from nonstationarities.

How to Crash a Socio-Ecological System

Face a shock that exceeds critical thresholds in the biophysical, social, or economic systems, e.g.,

- Critical depensation
- Loss of keystone
  industry or
  infrastructure

Alaskan Fisheries: Successes or Failures?

Although most of Alaska's fisheries have been successful from a biological perspective, at one time or another, nearly all of Alaska's fisheries have courted economic disaster.

Alaska's Salmon Fisheries

- Following statehood in 1959, Alaska banned the use of salmon traps to disrupt the monopsony power of the salmon canneries.
- A rush of new entrants led to congestion on the fishing grounds and made it difficult for fishery managers to control catches.

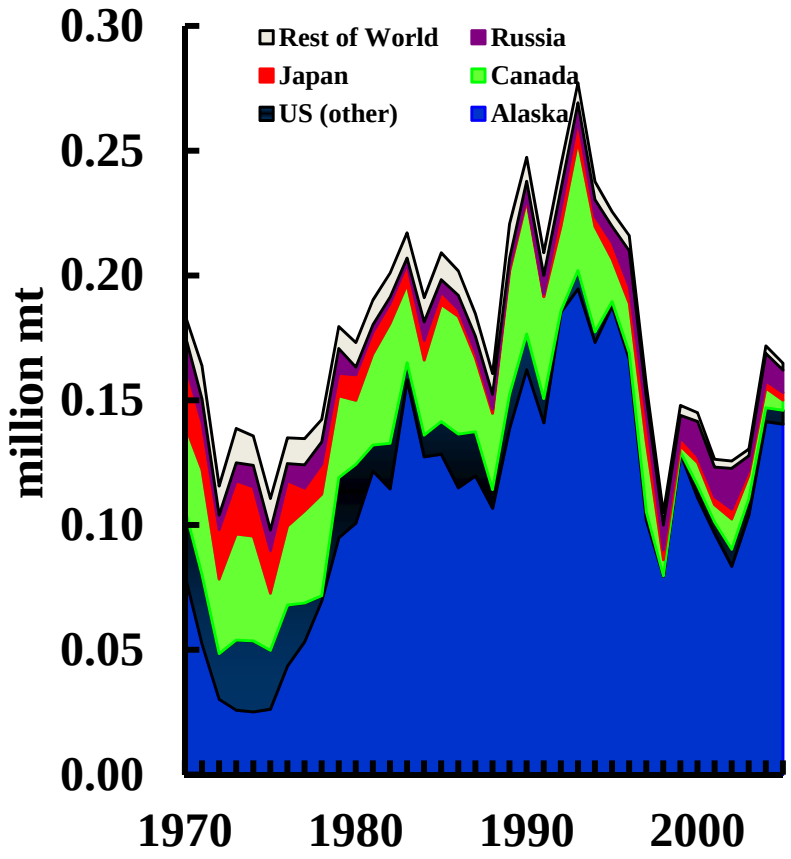
Alaska's Salmon Fisheries

In 1972, Alaska passed the Limited Entry Act.

Limited entry capped the number of boats, but failed to prevent continued escalation of fishing power and associated pathologies of the race-for-fish.

Alaska's Salmon Fisheries

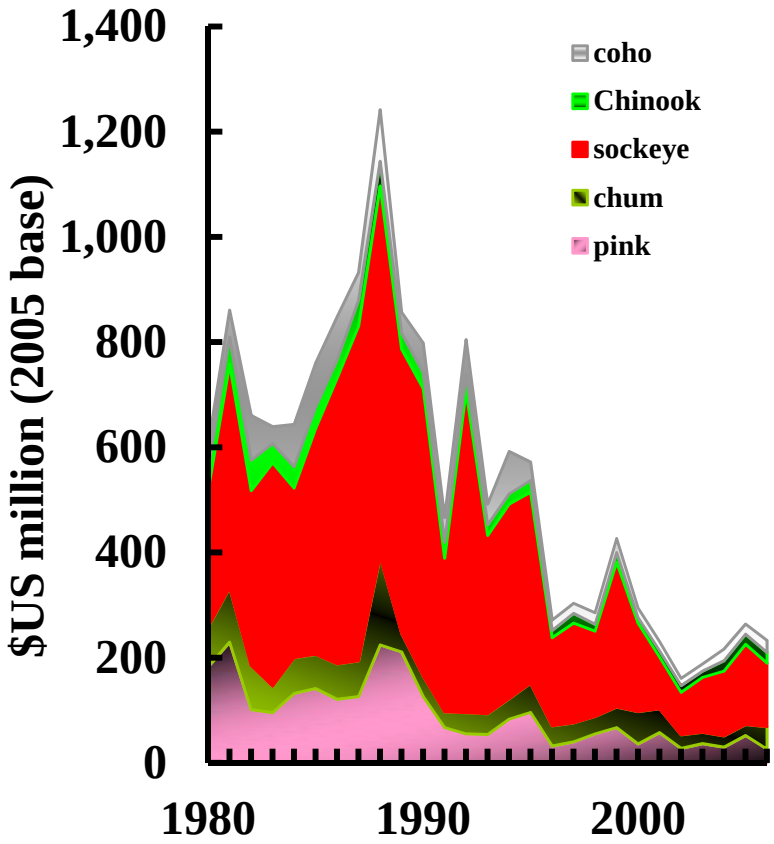
Buoyed by strong prices caused by declines in salmon production in other regions, Alaskan salmon fishery exvessel revenues and the price of limited entry permits soared through the mid-1980s.



World production of Chinook, coho, sockeye, and steelhead.

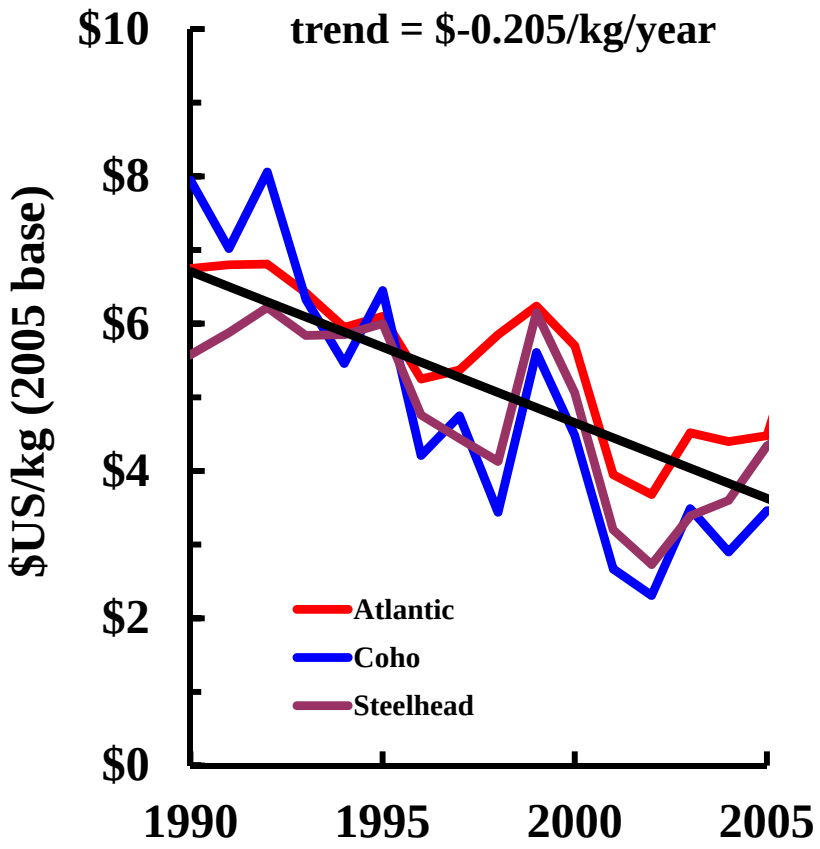
Alaska's Salmon Fisheries

By the early 1990s, high volumes of salmon from Norway, Chile, the UK, and Canada began to depress Alaskan exvessel prices and revenues.



Alaska's Salmon Fisheries

Aquaculture production increased because technological innovation caused production costs to decline more rapidly than the production-induced decreases in product prices.



FOB Chilean export prices.

Alaska's Salmon Fisheries

The collapse of exvessel prices created social and economic turmoil in salmon fishing communities because it reduced annual revenues to about one-fifth their peak level and at the same time reduced the asset value of limited entry permits to well below their outstanding loan value, bankrupting many salmon fishers.

Alaska's Salmon Fisheries

These effects were particularly pronounced in rural communities that went from controlling 50% of the limited entry permits in the late 1970s to controlling only 44% by 2005.

Salmon Management in Alaska

While Alaska's salmon management has been a biological success (or fortunate result of a favorable environment), it has been an abject economic failure.

Salmon Management in Alaska

- The race-for-fish resulted in individually sensible but collectively irrational excess investment in harvesting and processing capacity
- The overcapitalized Alaskan fishery is unable to effectively compete against substitute suppliers who operate under economic incentives that reward adoption of cost minimizing technologies.
- To those unfamiliar with the spendthrift incentives of the race-for-fish, it begs comprehension to learn that Alaska's salmon capture fisheries fail to generate rents comparable to those generated in salmon aquaculture, where feed and smolt costs alone are over $1.50/kg round weight.

Salmon Management in Alaska

- Adoption of harvest and management strategies that foster a race-for-fish led to unsustainable investment in processing capacity and infrastructure in remote communities.
- Contraction of revenues has resulted in closure of processing facilities in communities with small or highly variable runs, or runs of low-value species.
- The loss of wage income and tax receipts has compromised the economic viability of these communities.

Salmon Management in Alaska

While limited entry may have increased the resilience of ecological and governance systems, it is unclear if it increased or decreased the resilience of social and economic systems vis a vis the status quo ante.

Alaska's Halibut Fishery

1880 Commercial fishery begins

1923 Halibut Commission formed

1976 MSFCMA enacted

1982 Authority to allocate catch delegated to NPFMC

1991 Canada implements IVQs

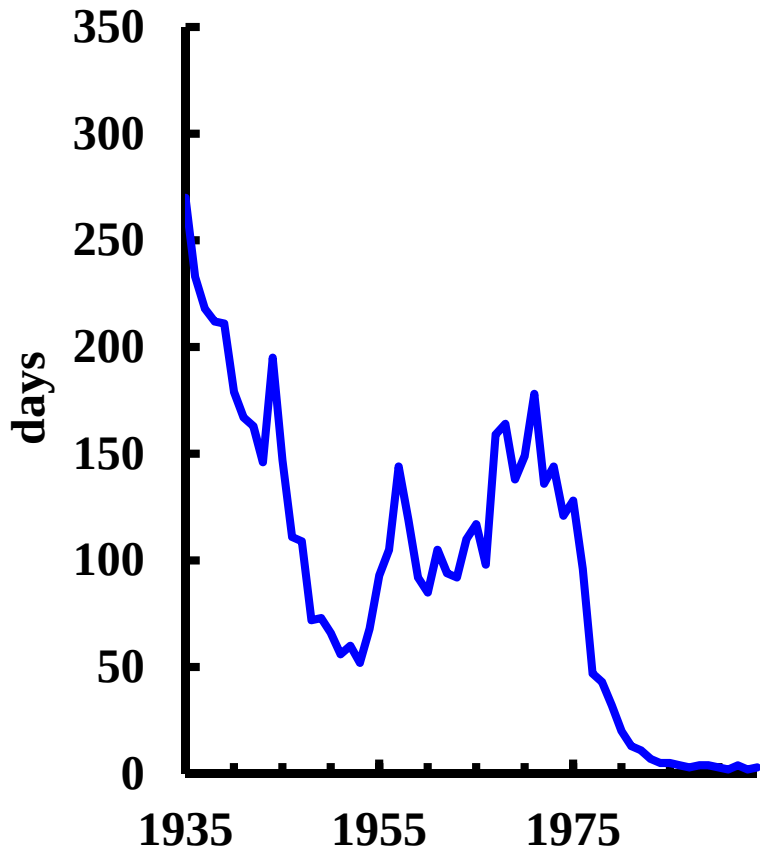
1995 Alaska implements IFQs

Alaska's Halibut Fishery: Pre-IFQ

- Under the Halibut Convention, abundance steadily increased through the 1950s before declining in the 1960s and early 1970s.
- The stock decline was driven, in part, by foreign catches outside US and Canadian territorial seas.
- The stock was rebuilt in the wake of extended jurisdiction and catches rebounded.

Alaska's Halibut Fishery : Pre-IFQ

Recovery of the halibut stock and protection from foreign competition stimulated a rapid increase in the number of fishing vessels and led to shortened seasons.



Alaska's Halibut Fishery

The heated race for fish reduced quality and suppressed market development, prevented rationalization of capital investments, decreased safety, and increased the likelihood that catch limits would be exceeded

Alaska's Halibut IFQ Program

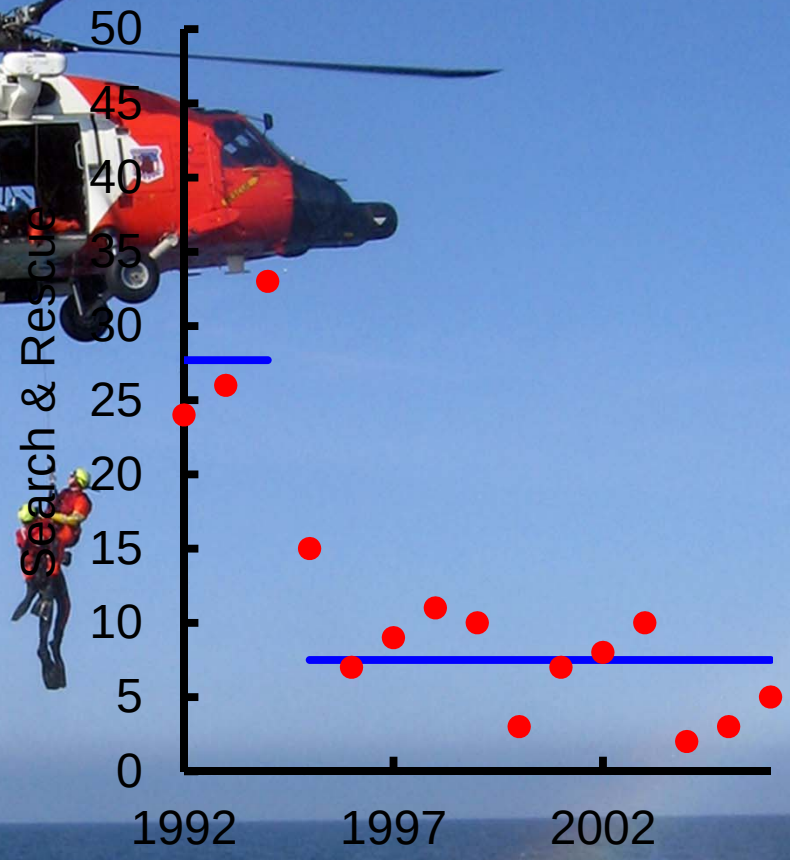
- Permanent allocation of shares of TAC to individual vessel owners
- Market-based transfer of quota shares between fishermen
- Limits on consolidation of quota shares
- Limits on transfer of quota shares between vessel classes
- Limits on leasing

Alaska's Halibut Fishery: Post-IFQ

- The fishery has reorganized to deliver high-quality fresh product throughout a protracted season.
- Average exvessel price (Alaska) increased $0.53/kg; about $11 million per year in exvessel revenue.
- Fishermen received ~92% of this increase.
- Processors received ~8% of this increase.
- The distribution of benefits from this program has influenced the structure of all subsequent programs in Alaska.

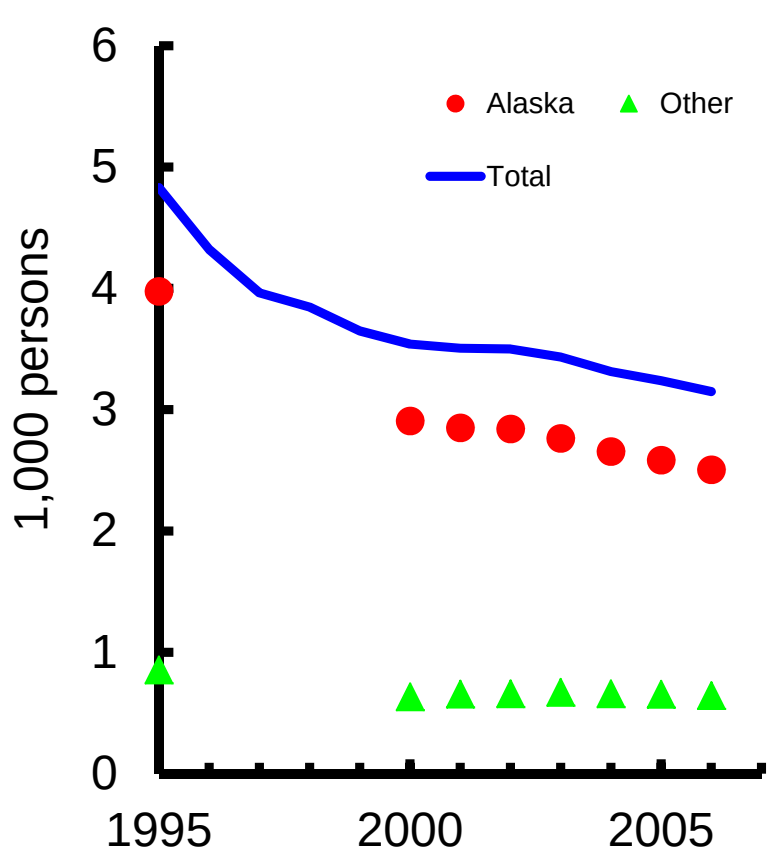
Alaska's Halibut Fishery: Post-IFQ

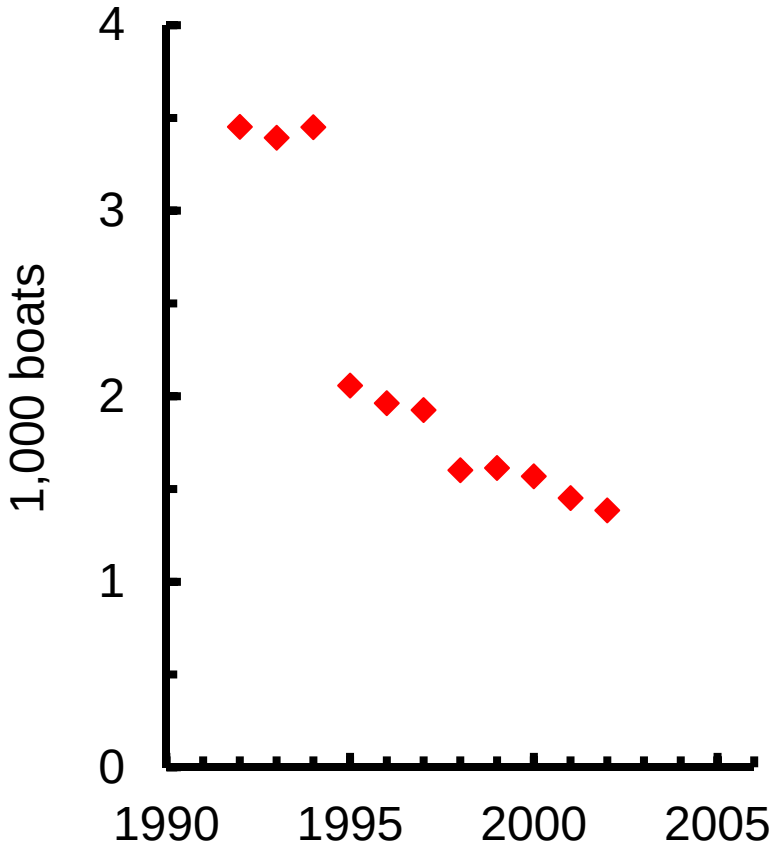
Safety at sea has improved.



Alaska's Halibut Fishery: Post-IFQ

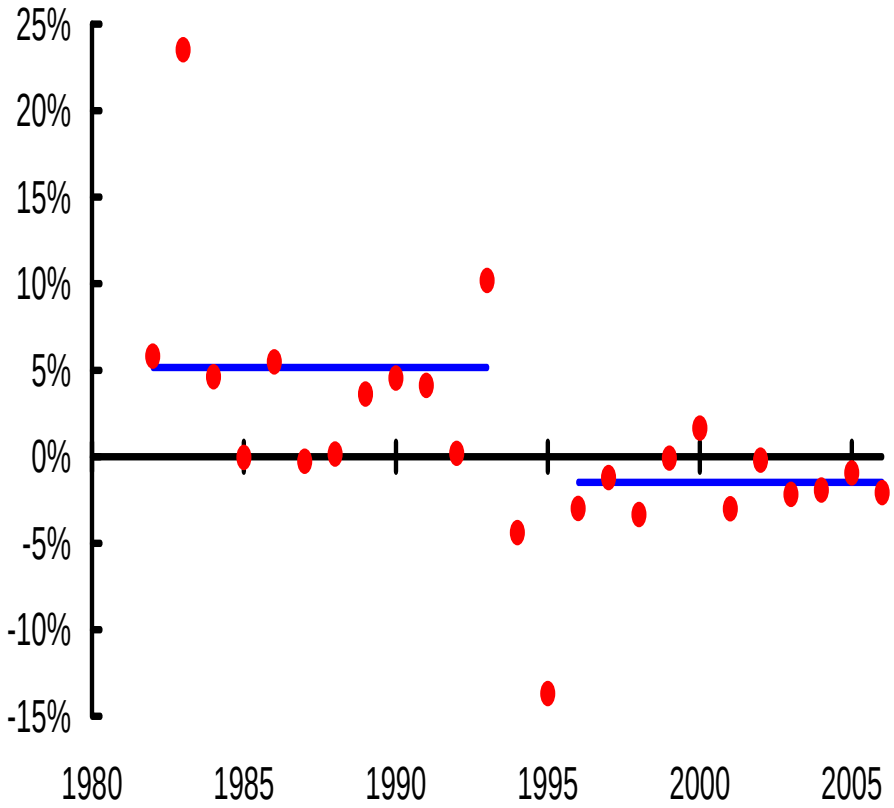
The number of permit holders and active fishing vessels has declined.





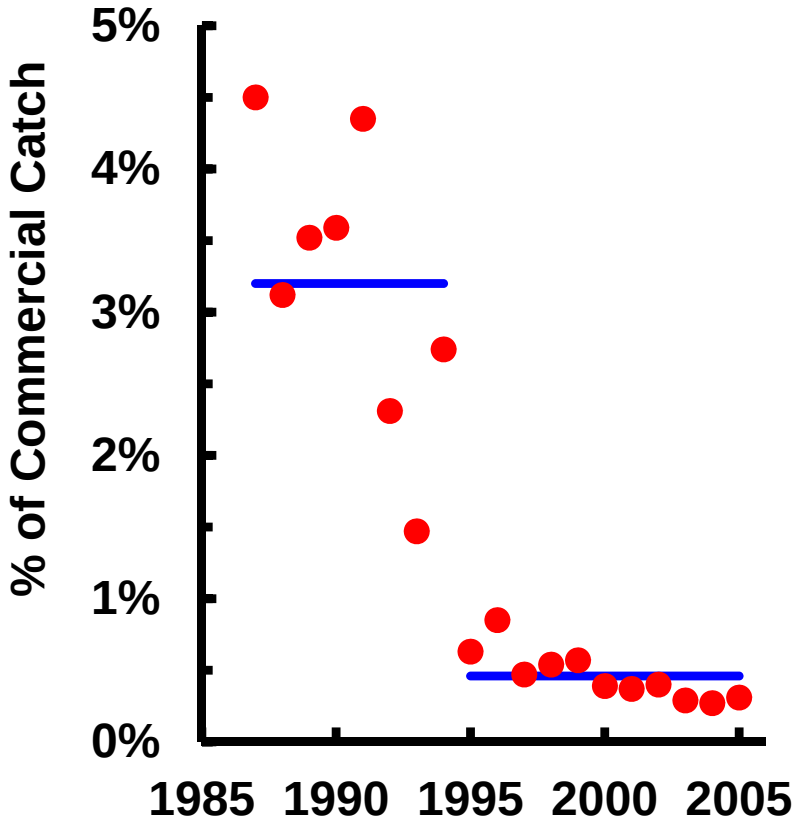
Alaska's Halibut Fishery: Post-IFQ

Management of annual catch limits has become more precise.



Alaska's Halibut Fishery: Post-IFQ

Ghostfishing and bycatch losses have been reduced.



Ghostfishing losses.

Alaska's Halibut Fishery: Post-IFQ

- Quota shares held by rural Alaskans increased from 14.6% in 1995 to 22.1% in 2006, but the growth has been concentrated in larger rural communities and masks losses in smaller communities.
- Pre-IFQ halibut processors lost market share and revenues as fishers bypassed traditional supply chains through contracts with niche processors and wholesalers.

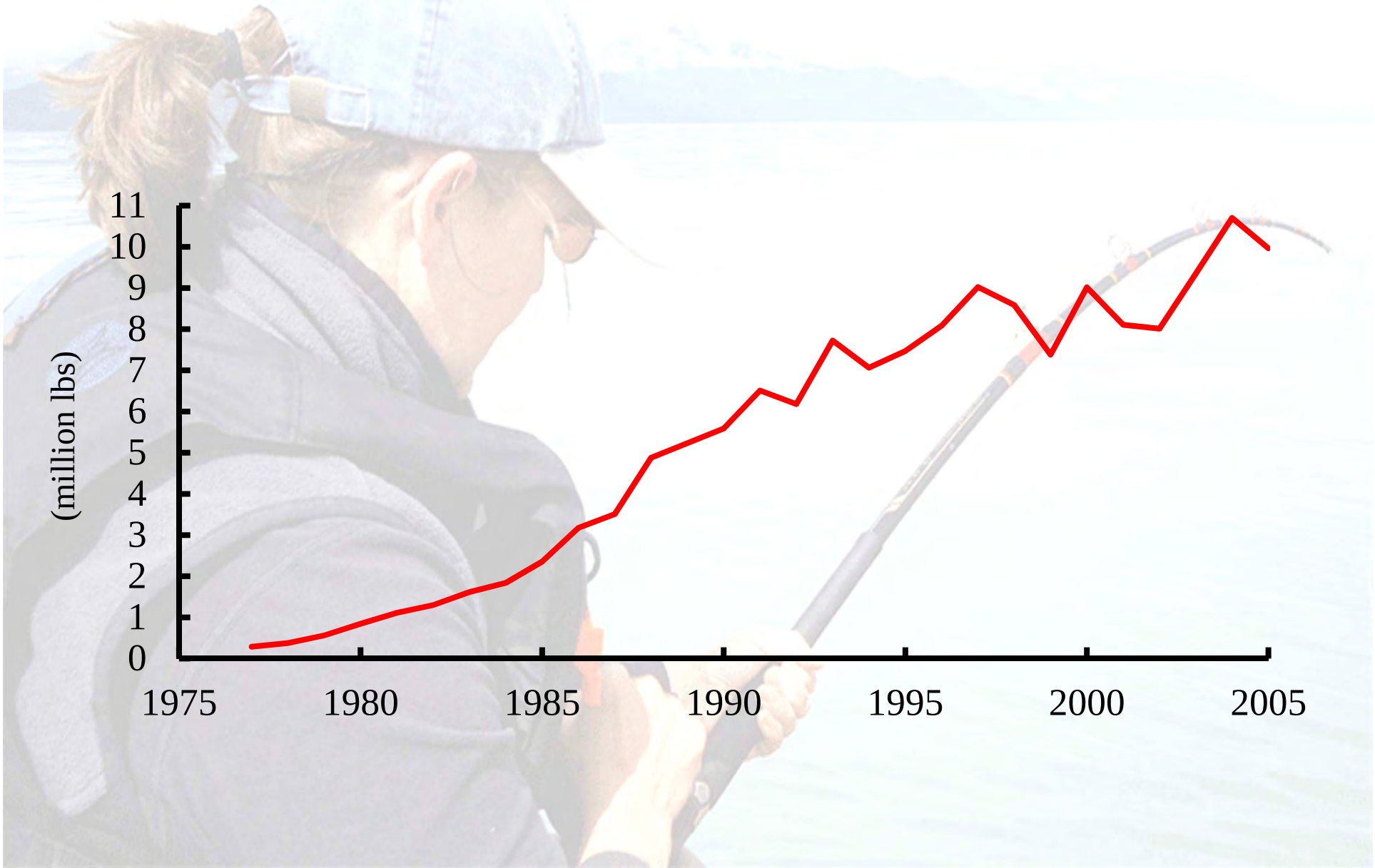
Alaska's Halibut Fishery: Post-IFQ

Some elements of this fishery became increasingly resilient under a market-based IFQ management strategy, while other historic participants lost due to market opportunities to cash in their halibut shares, and social resilience has been reduced for some fishermen and fishery-dependent communities.

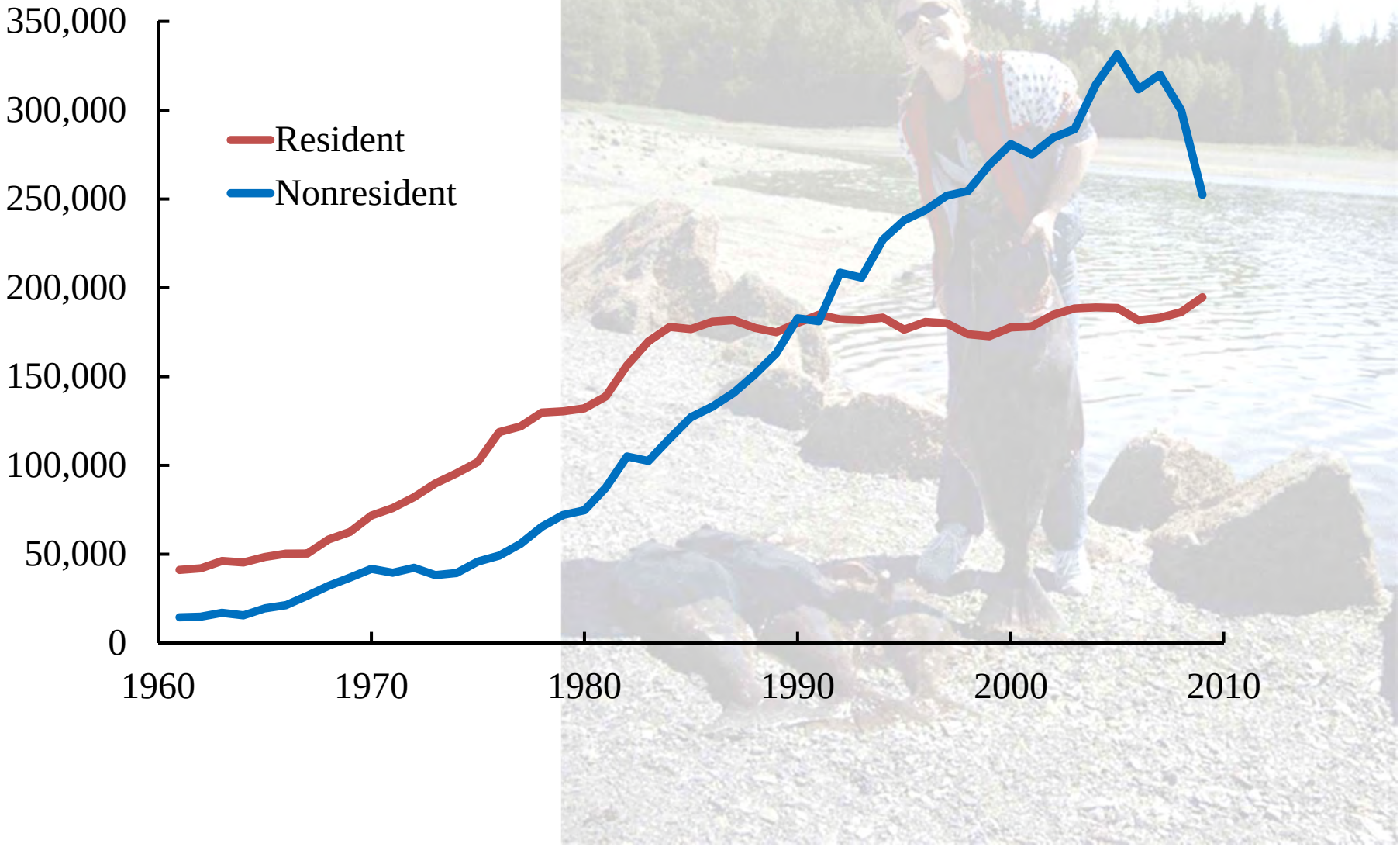
Alaska's Halibut Fishery: Preemption by the Charter Sector

- Expansion of the charter sector catches reduces the quantity of fish available to individual commercial fishers in any given year and thus reduces their revenues.
- Expansion of charter sector catches also reduces the wealth of IFQ holders because the asset value of the IFQ is a function of current and expected future catches.

Sport Catches of Halibut

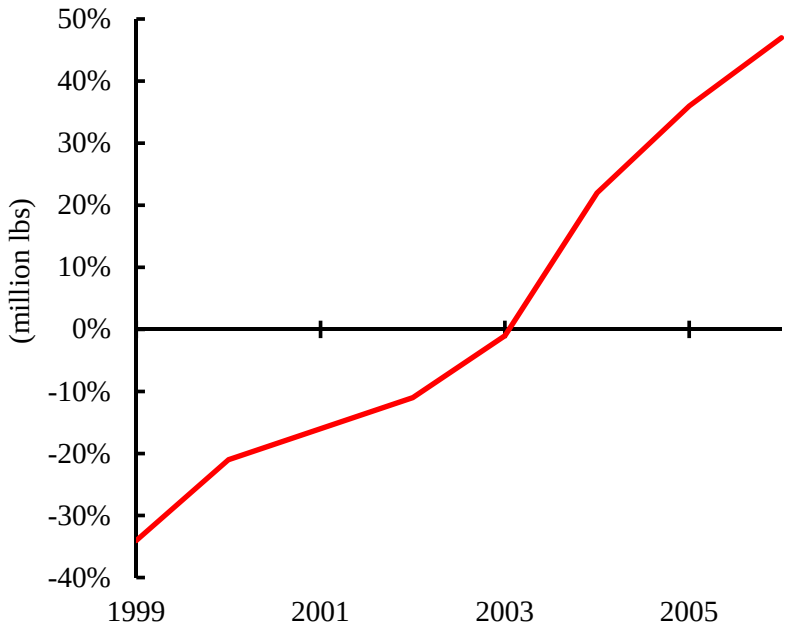


Sportfishing License Sales



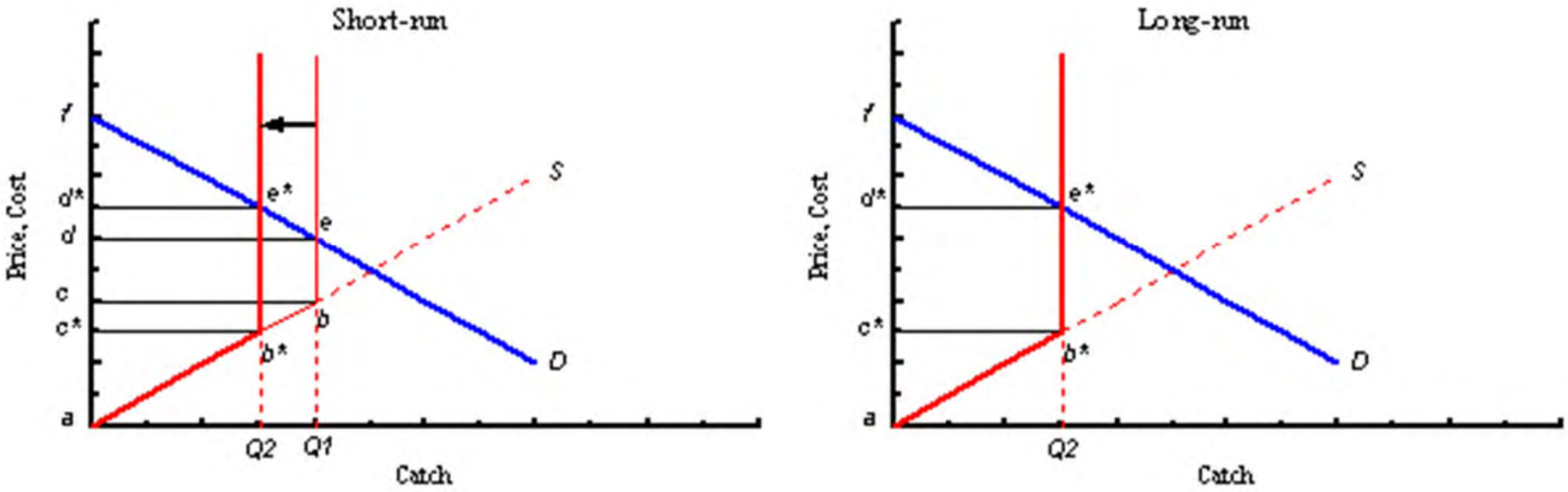
Deviations for Charter-Sector GHLs

Area 2C



Area 3A

IFQ commercial fishery & open-access charter fishery with increasing demand for sportfishing



Balancing Benefits of Commercial and Sport Fishing

$$\text{Max}\left(NB\right) = \sum_{t=0}^{T} \delta^{t} \left(NB_{c,t} + NB_{s,t}\right)$$

$$\textit{subject to:} \quad h_{c,t} + h_{s,t} = f\left(x_{t}\right)$$

The optimal solution equates marginal (incremental) net benefits across uses.

Balancing Benefits of Commercial and Sport Fishing

- The overall optimal solution is suboptimal from the myopic perspective of each user group.
- Consequently, stakeholders will contest specific allocation decisions if political processes are used to effect the allocation.
- Changes in output prices, input prices, recreation participation rates, etc., change the optimal allocation.
- Because prices and participation rates are constantly changing, political allocation processes are unlikely to keep pace.

Alaska's Halibut Fisheries

- Before 1995, the management paradigm put biological sustainability at risk and incentivized unsustainable investment in harvesting capacity.
- Adoption of IFQs improved biological and economic sustainability in the commercial sector.
- Expansion of the charter sector has been accommodated through uncompensated reallocation from the commercial sector but could be accommodated through market transactions.
- Much of the value gained by the commercial sector through IFQs is now being lost to a charter sector that dissipates the value to excess capital investment.

Pollock in the Eastern Bering Sea

- Pre-1976 – Foreign fishing
- 1976-1985—Foreign fishing replaced by joint ventures
- 1985-1990—Joint ventures replaced by fully domestic

Pollock in the Eastern Bering Sea

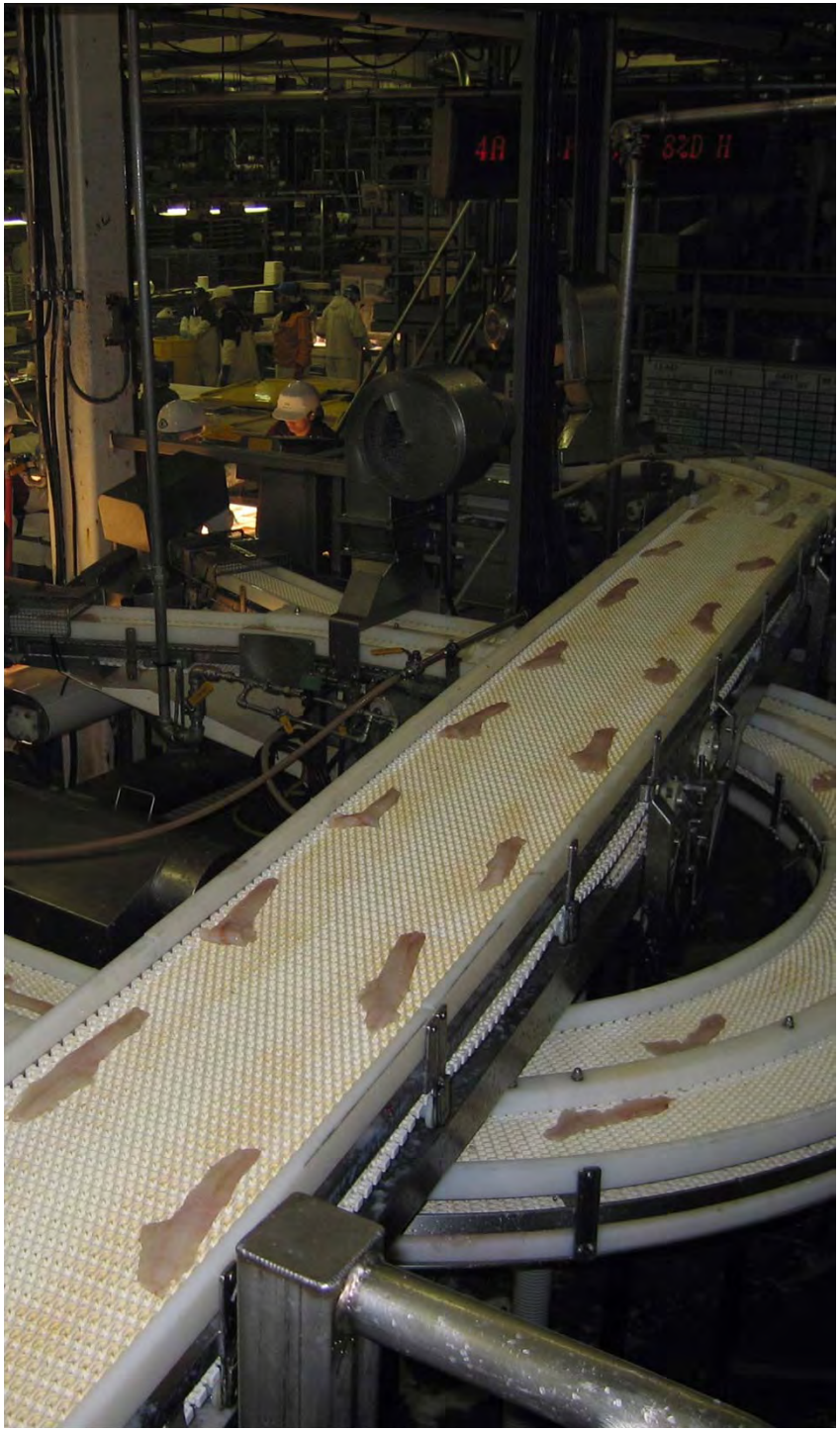
- 1991-1995—cycle of bankruptcy and recapitalization due to excess harvesting and processing capacity. Inshore-Offshore allocation wars, season compression.
- 1996—Moratorium on entry
- 1998—American Fisheries Act (AFA).

Pollock in the Eastern Bering Sea: AFA

- Established permanent allocation to each sector with permanent moratorium on entry—usable as collateral
- $75 million to retire 9 of 29 catcher-processors
- Explicit authority for companies within each sector to negotiate sub-allocations
- Market-based transfer of sub-allocations within each sector
- CDQ and high seas catcher boat quotas could be leased to any sector

Pollock in the Eastern Bering Sea: AFA

- Increased product recovery rate by ~150%.
- Increased production of high value product forms.
- Increased economic returns.
- Reduced bycatch.
- Improved management precision.



Pollock in the Eastern Bering Sea: AFA

- Helped industry accommodate changes in fishing seasons and areas required to meet ecological concerns.
- Provided the resources needed to modernize vessels and processing equipment

Pollock in Eastern Bering Sea: CDQs

The CDQ entities are allocated 10% of all TACs and PSC caps for BSAI groundfish targets.

CDQ entities earn revenues from leasing or fishing their quotas and as profit from their ownership stakes in the inshore and at-sea sector.

Pollock in the Eastern Bering Sea

- The AFA shifted bargaining power of from processors to fishing vessel owners.
- The AFA increased the resilience of governance and economic systems but created an imperative for devising analogous governance and management strategies for all other BSAI and GOA groundfish fisheries as a protection against the spillover of redundant capacity.

Pollock in the Eastern Bering Sea

- Variation in the distribution of pollock as well as the need to avoid salmon bycatch have led the fleet to fish at increased distances from port.
- When combined with high fuel prices, the need to fish at long distances from port could cause the inshore sector to underharvest its allocation.
- Thus, while the AFA Act has increased the economic resilience of the pollock fishery as a whole, prohibitions against inter-sector quota transfers reduce potential revenues.

Musings

- Sustainable resource management consists of practices which ensure that the expected flows of use, option, and nonuse benefits provided by the resource are not degraded through time.
- Choices of **which** combination of benefits to sustain are inseparable from choices of **who** will receive those benefits.

Musings

- The fitness of fisheries and fishery dependent communities depends on characteristics of social, economic, and legal systems that determine who is allowed to fish and how fishing takes place as well as attributes of the stock.
- The unique legal foundations, culture, and traditions of each nation or state affect the range of viable alternative fishery governance structures.

Musings

- There are tradeoffs between economic efficiencies gained through management measures such as single species IFQs and heightened exposure to factors that affect individual stocks, associated product markets, etc.
- In contrast, generalist fleets trade reduced economic efficiency and possible losses of management precision for reduced exposure to losses associated with variations in the abundance or value of any one species.

Musings

- Durable individual entitlements to shares of the allowable catch increase profitability that helps fishermen adapt to modest adverse changes in stock abundance, exvessel prices, and input costs but their fragility to larger perturbations is increased.
- While catch shares increase choice and therefore resilience from the perspective of individuals, catch shares can increase or decrease the resilience of fishery dependent communities.