Technological Changes and the Impact on Fishing Capacity – Preliminary Findings in Hawaii Longline Fishery

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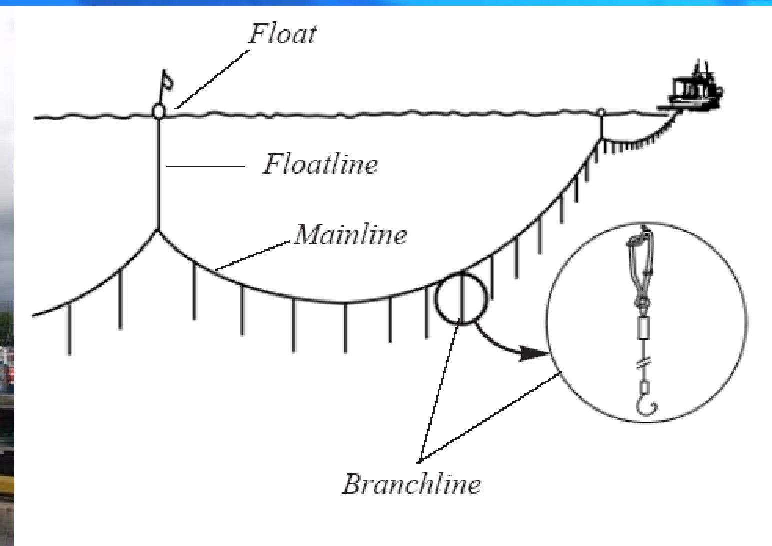
Acknowledgements

We would like to thank NMFS Office of Science and Technology for funding the project. We are especially grateful to Adam Griesemer and Jae-Cheon Lim for the field-work assistance.

Research Background

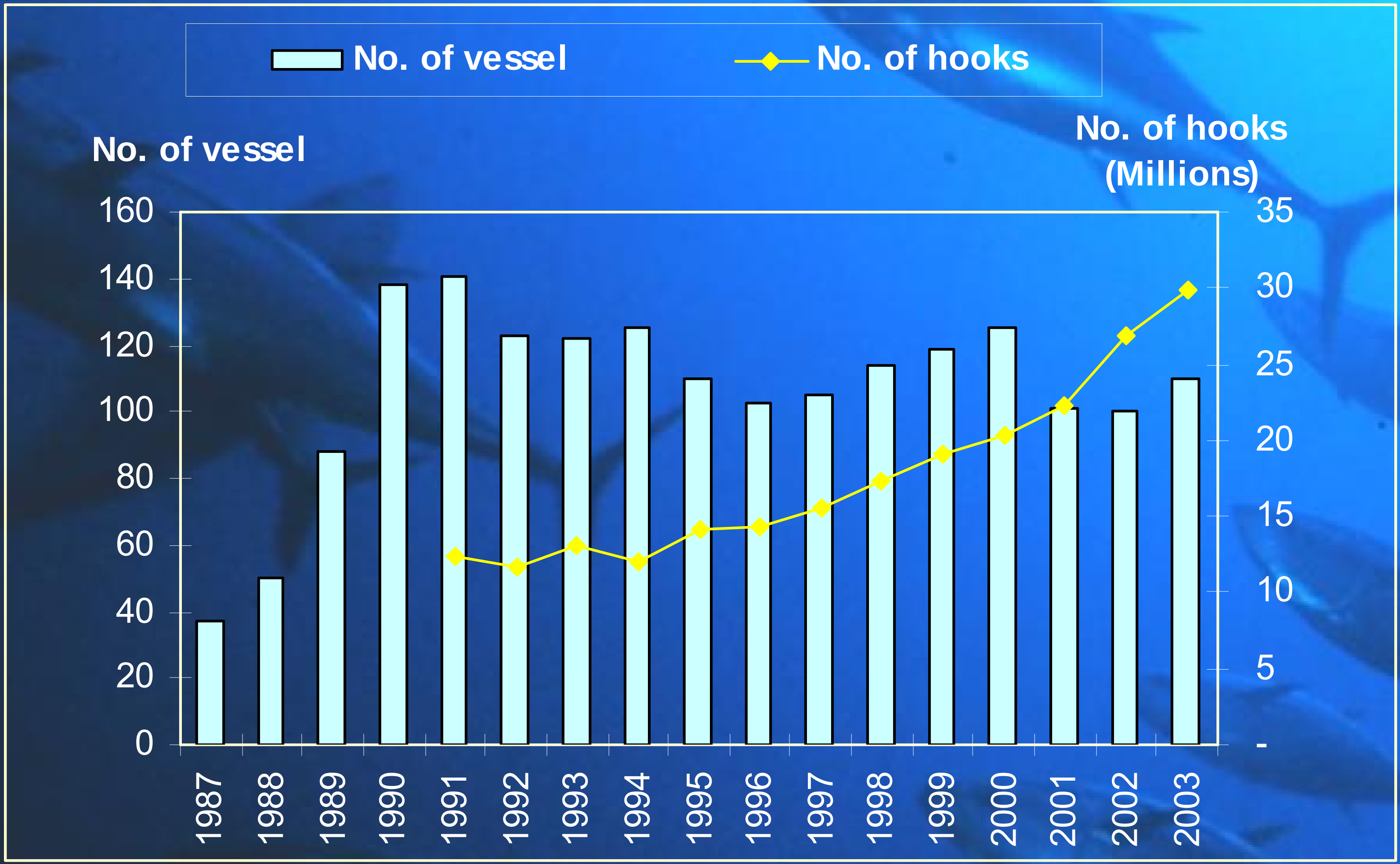
- ✓ Nominal measurement of fishing effort: number of vessels, vessel size, fishing days, etc
  - Biased performance measures on fishery industries
- ✓ Actual fishing power is enhanced by technology
  - 9% annual increase in the world fishing power by technology (Fitzpatrick 1995)
- ✓ In Hawaii
  - Observable changes in technology
  - Increase of fishing effort in the longline fishery, under the limited entry program

Longlining in Hawaii



Tuna (deep set) or swordfish (shallow set)

No. of Vessel & No. of Hooks of Hawaii Longline Fleet (1987-2003)



Research Objectives

- ✓ To assess current status & trends of fishing technologies in the Hawaii longline fishery
- ✓ To analyze the impact of fishing technological changes
  - To quantify the effects of technology on fishing capacity
  - To evaluate correlation between technology and fishing effort
- ✓ To anticipate technological changes in fisheries management

Theoretical Framework

- ✓ A standard approximation to the production function (a 1st order log Cobb–Douglas Functional), Kirkley et. al. 2001

$$\ln Y_{it} = \eta + \beta_E \ln E_{it} + \sum_k \gamma_{Kk} \ln K_{k,it} + \sum_j \delta_{Tj} T_{j,it} + \alpha_t t + \beta_s \ln S_t$$

Where

E: the variable inputs (effort) e.g., fishing days

K: the capital stock e.g., vessel length

T_E : embodied technology e.g., GPS, Satellite

t: time trend

S: fish stock

Research Methodology – Questionnaire design

- ✓ Fishing effort (E)
  - Monofilament gear type vs. Traditional gear (# number of hooks per set)
- ✓ Physical capital and human capital stock (K)
  - vessel length
  - captain’s education
  - captain’s fishing experiences
  - crew duration (the longest time stayed with the vessel)
- ✓ Technological changes (T_E) and time course (t)
  - GPS
  - Computer (HiPlot)
  - Satellite, etc.

Research Methodology – Fieldwork

- ✓ Person-to-person interview (2004-2005)
  - Owner operator
  - Hired captains (both owners & captain)

- ✓ Team members with different language background
  - English
  - Korean
  - Vietnamese

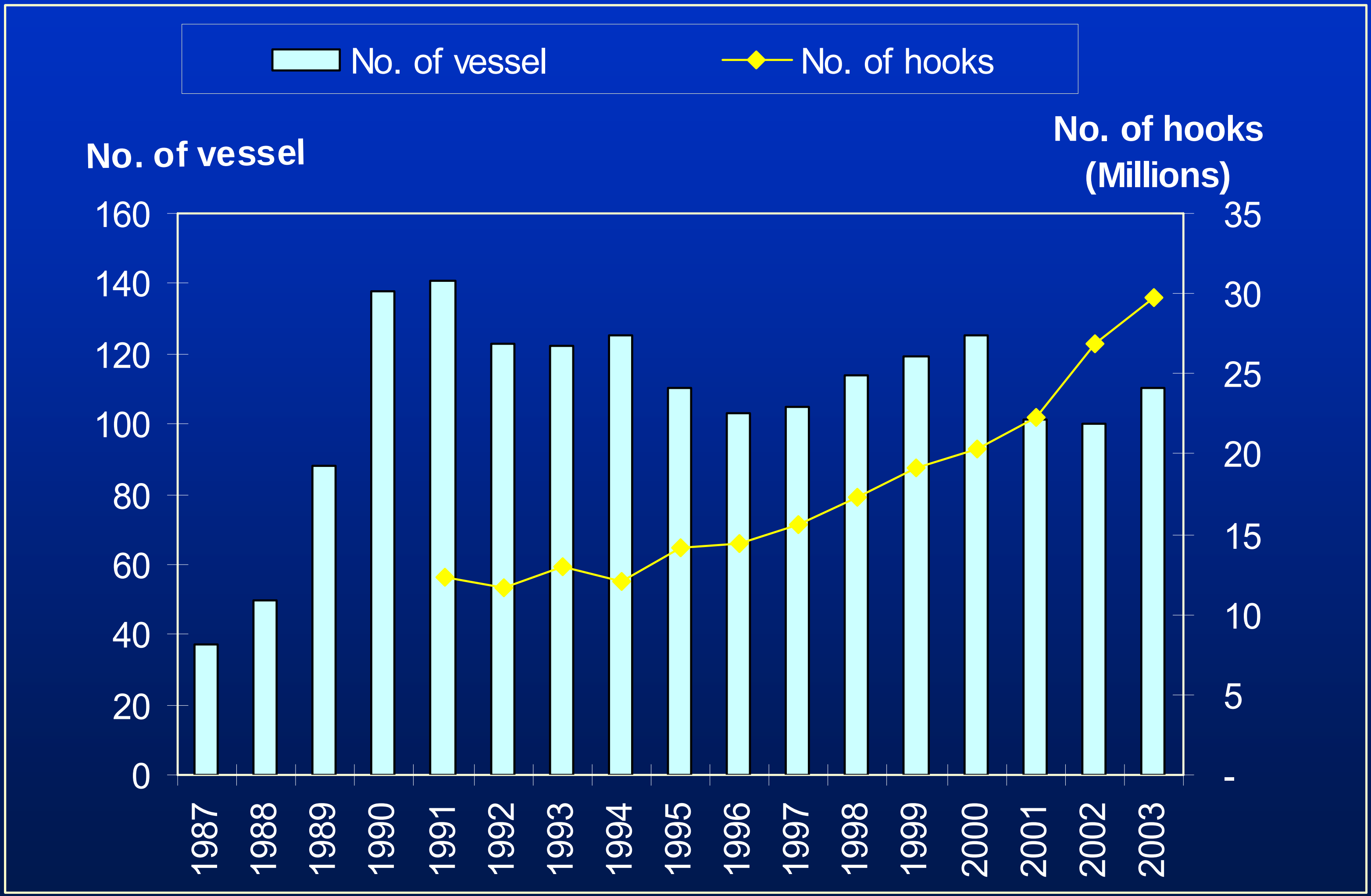
Fieldwork 2005

70% vessels surveyed (86/120)

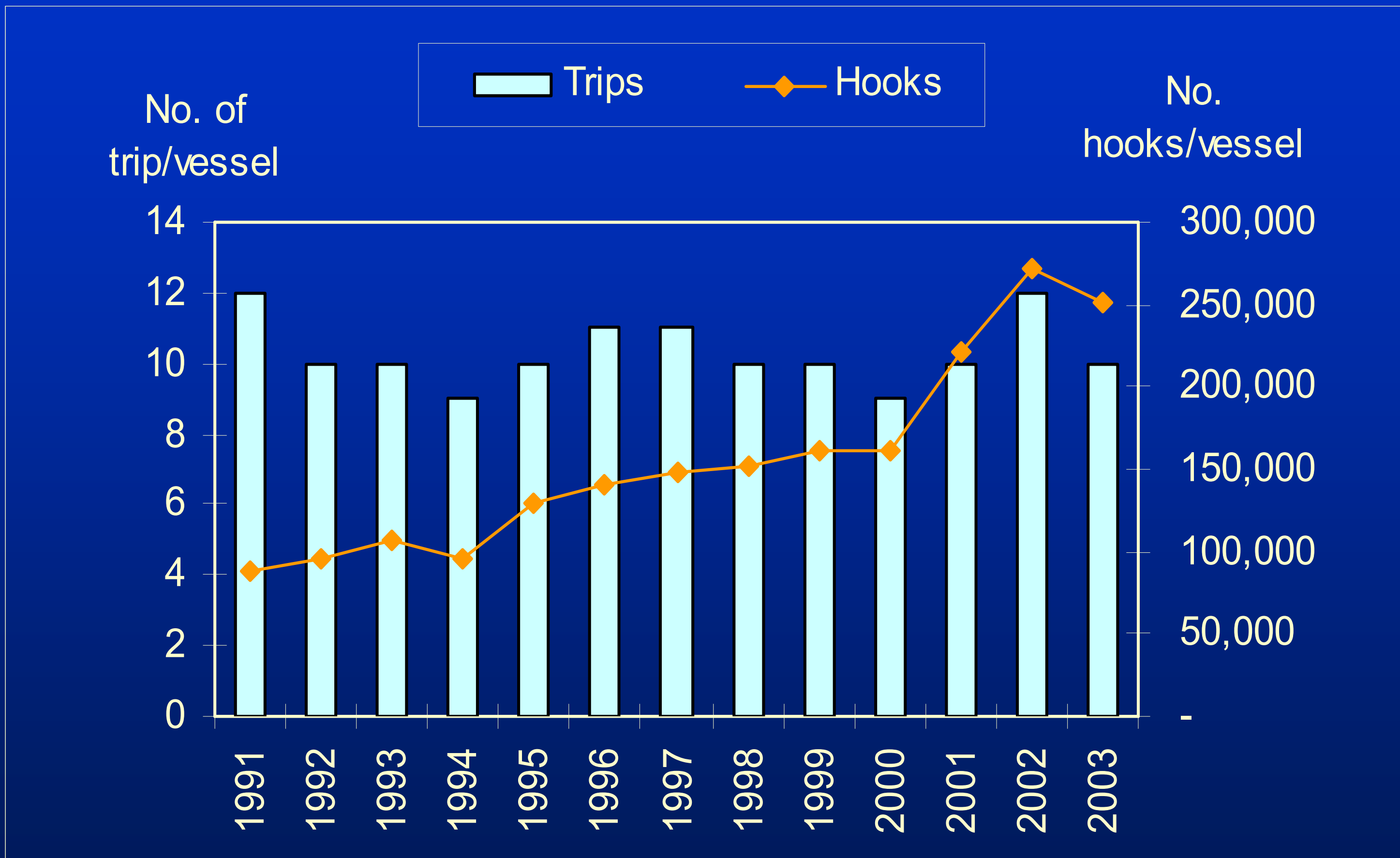
Preliminary Results

- ✓ Impact of technological changes on the fishing effort (increasing hooks)
- ✓ Trends of technological adoption in Hawaii longline fishery
- ✓ Factors that affect technological adoption

No. of Hooks vs. No. of Vessels
(Hawaii Longline, 1987-2003)



of Hooks and # of Trips per Vessel
(Hawaii Longline, 1991-2003)



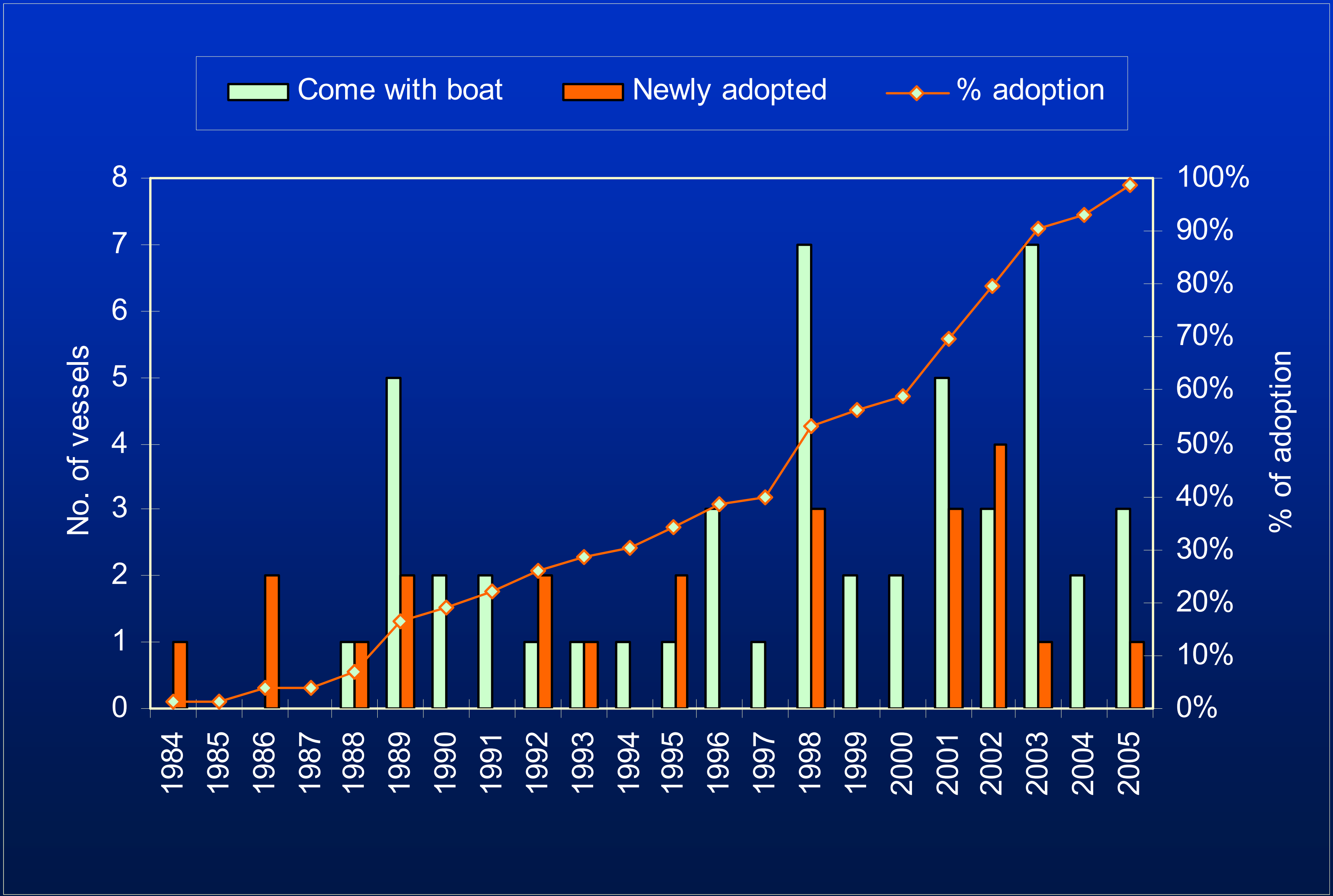
# of trip per vessel stable
# of hooks per vessel increased

Impacts of Technological Change on Fishing Effort (# of hooks)

- ✓ 2000-2003 swordfish closure
  - Swordfish-targeted trip used less hooks per set
  - Some vessels switched to target tuna

- ✓ Traditional basket vs. monofilament gear
  - Monofilament gear holds more hooks per set
  - Monofilament gear adopted gradually

Adoption Schedule for Monofilament Gear (99% adoption by 2005)



Impact of Monofilament on Fishing Effort (# of Hooks)

Model: $Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \varepsilon$

Y: Total number of hooks

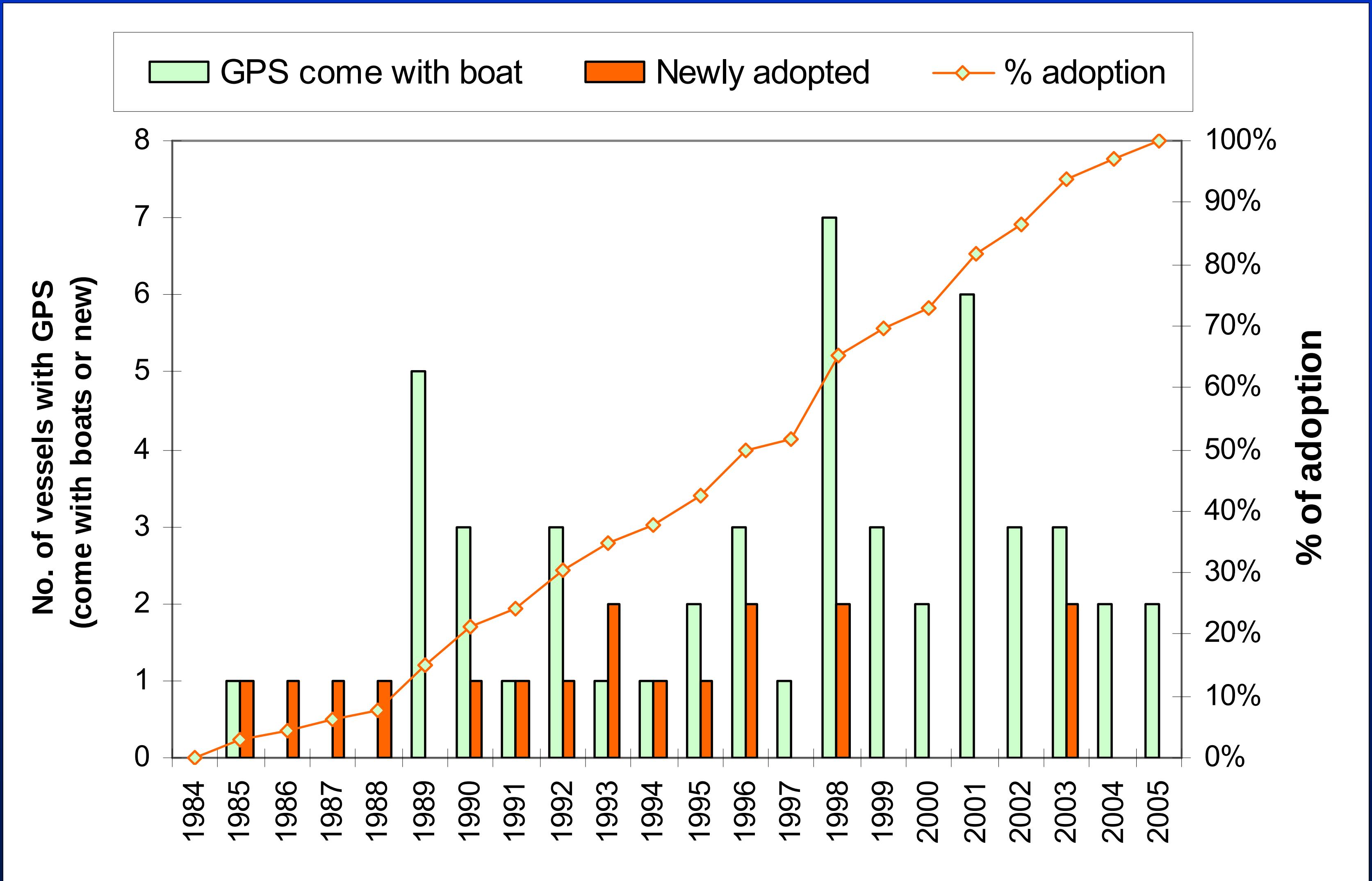
X1: Number of trips per vessels

X2: % of vessels used to monofilament

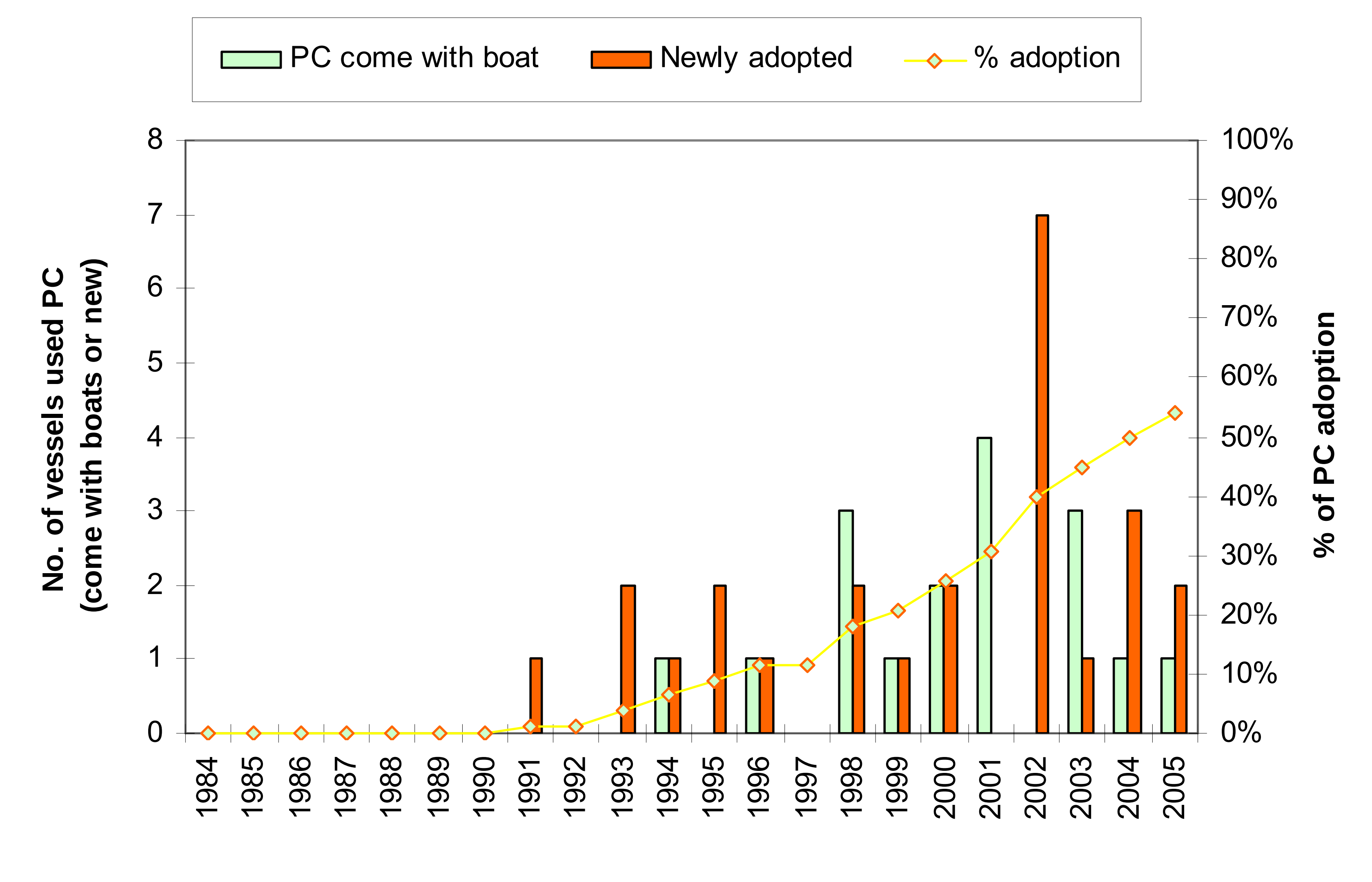
	Coefficient	t Stat	P-value
Intercept	20.31	5.34*	0.00
No. vessels (X_1)	0.1	3.82*	0.00
% vessels used monofilament (X_2)	0.39	22.23*	0.00

$R^2 = 97\%$

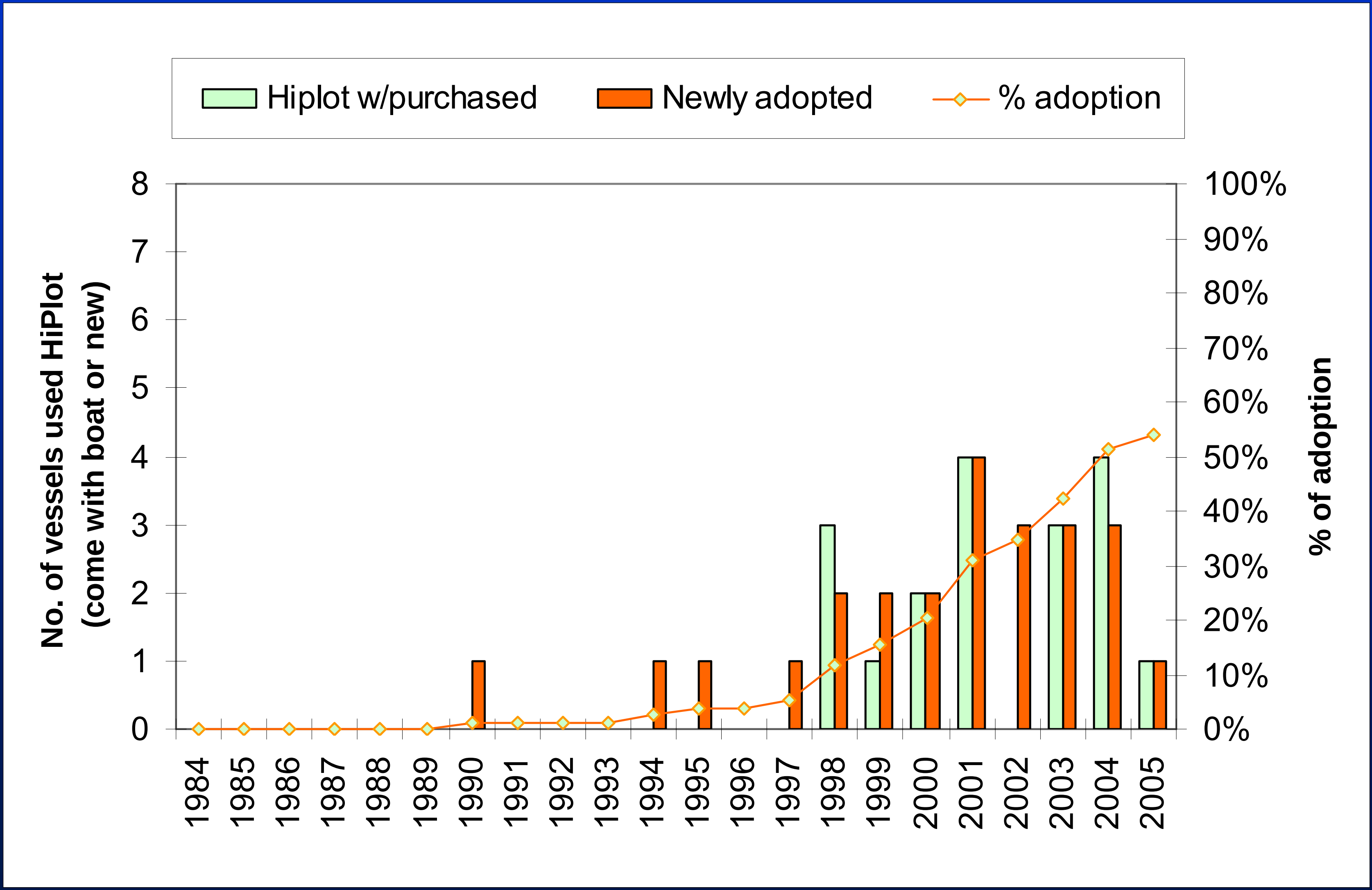
Adoption Schedule for GPS
(100% adoption by 2005)



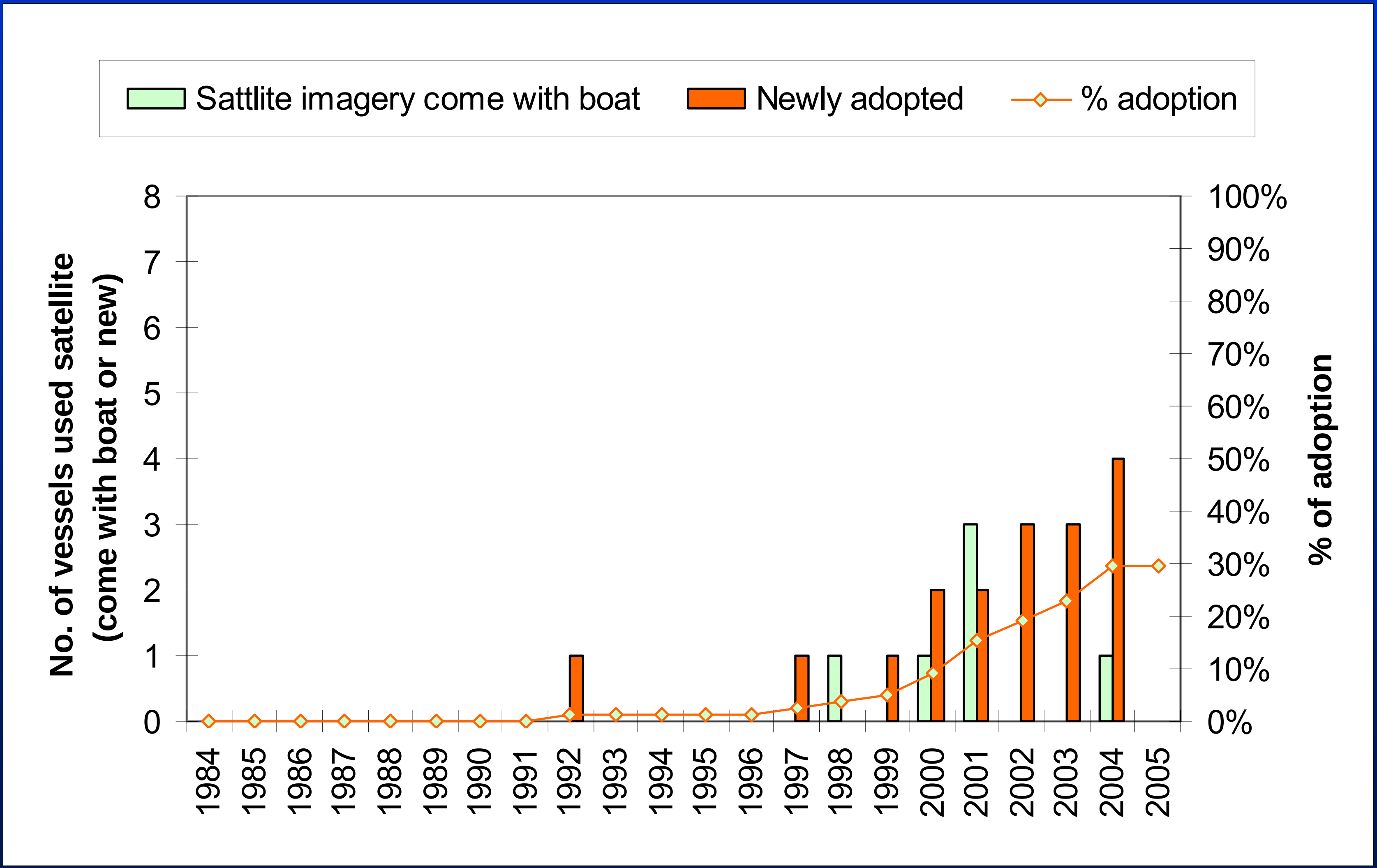
Adoption Schedule for PC
(58% adoption by 2005)



Adoption Schedule for HiPlot (with PC)
(50% adoption by 2005)



Adoption Schedule for Satellite Imagery
(36% adoption by 2005)



Factors Affecting Technological Adoption

- ✓ Availability of the technology
- ✓ Education
- ✓ Fishing experiences
- ✓ Ethnicity (fieldwork observation)

	Caucasian American	Korean American	Vietnamese American
Computer Use	92%	28%	40%
Fish finding software (HiPlot)	84%	24%	25%
Satellite imagery	59%	24%	15%

A Simple Technological Adoption Model

Model: $Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \varepsilon$

Y: Adoption of new technology - HiPlot

X1: Hawaii longline experience (yr)

X2: Ethnicity (Caucasian = 1)

	Coefficient	t Stat	P-value
Intercept	3.37	4.11	0.00
Fishing Experience (X_1)	-0.05	-1.75	0.08
Caucasion (X_2)	1.46	4.11	0.00

R^2 = 24%

On-going Research

- ✓ Fieldwork (completed)
- ✓ Further analysis
  - Understanding on technological adoption
  - Exploring the relationship between technological changes and fishing capacity
- ✓ Writing report and paper


THANK YOU!