WF4313/6413-Fisheries Management

Class 3

Announcements

MsState AFS Meeting

Date: *Wednesday, Sept. 12, 2018*

Place: Thompson Hall, Room 118

5:00 PM

Pizza and Drinks provided at all meetings

Questions?

Bradley Richardson

bmr380@msstate.edu

Dedicated to Strengthening the Fisheries Profession, Advancing Fisheries Science, & Conserving Fisheries Resources

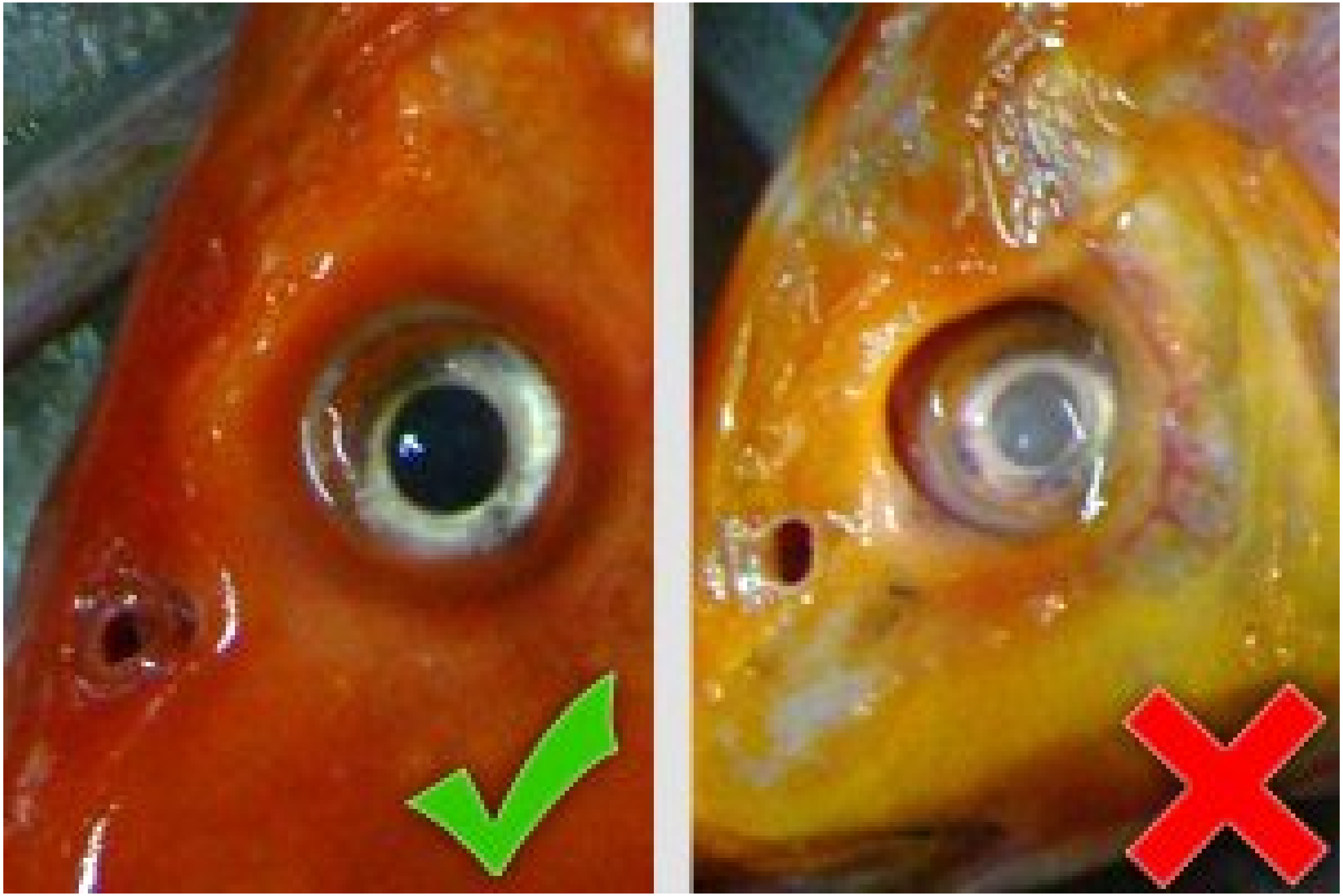
AMERICAN FISHERIES SOCIETY

MISSISSIPPI STATE UNIVERSITY STUDENT SUB-UNIT

Announcements

- Reminder to see website for content, links, and so on. https://mcolvin.github.io/WFA4313-Fisheries-Management/
- Lab information posted

How do you tell if fish is fresh?



Mohamed El Dahshan @eldahshan · Sep 1, 2018

Kuwaiti police has shut down a fish store that was sticking googly eyes on fish to make them appear more fresh than they are. :-) via Al Bayan newspaper, @bayan_kw. pic.twitter.com/CcPa73fDQh

Class Topics

1. Time periods in fisheries management
2. Population dynamics

NAVIGATION AND FLOOD CONTROL ERA

Authorizations

- Rivers and Harbors Act (1899)
  - Navigation
- Flood Control Act
  - Damming


Pre 1930s
Winnipeg
NORTH DAKOTA
MONTANA
MINNESOTA
Minneapolis
SOUTH DAKOTA
WISCON
HO
IOWA
EBRASKA
ILLIN
ates
Kansas City
UTAH
KANSAS
MISSOURI

Channelizing The River

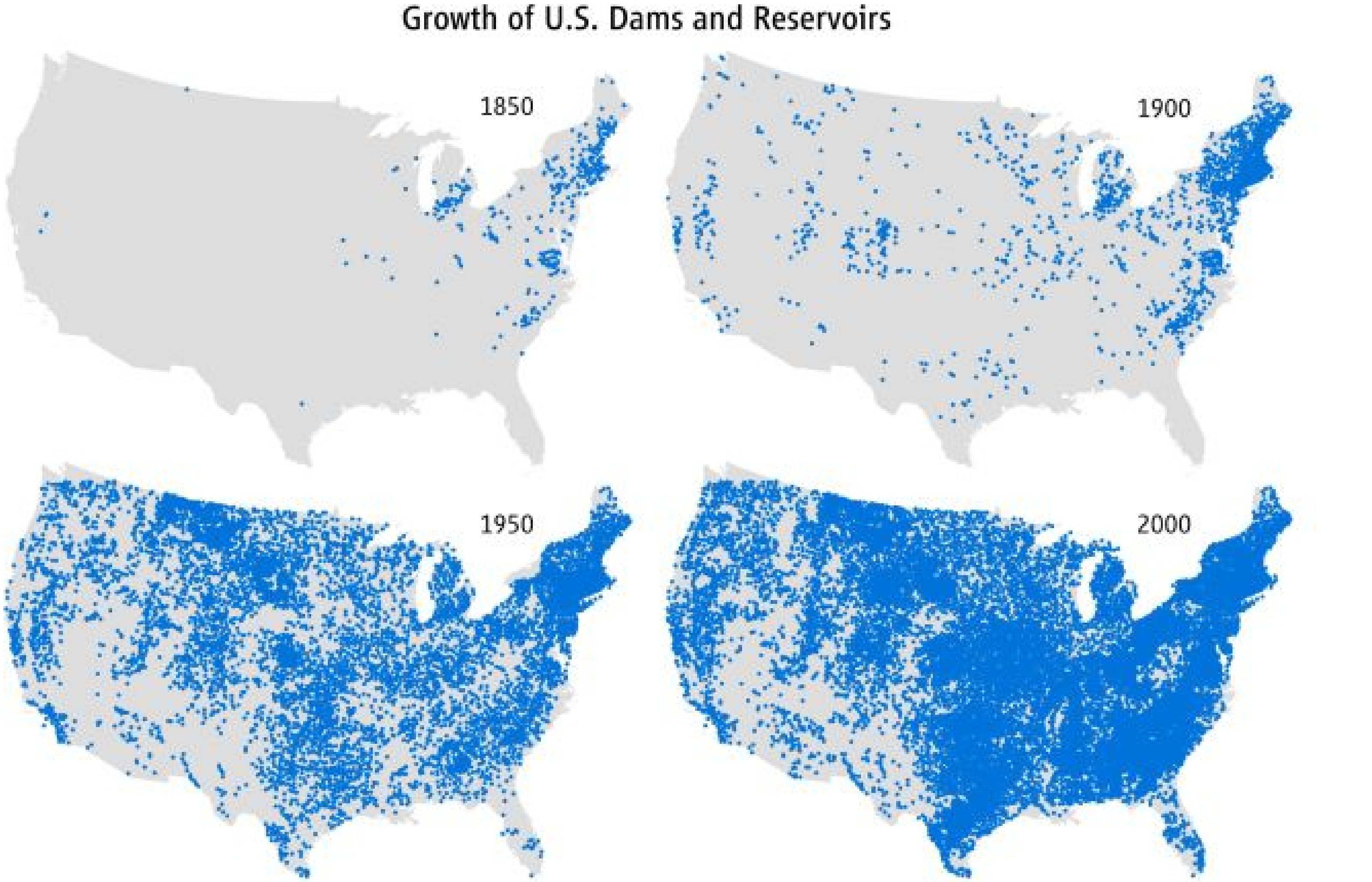
Wing Dike Construction at Indian Cave Bend, Nebraska, Missouri River, 10-1935, Source: USACE

Channelizing The River

Sourece:https://lh3.googleusercontent.com/CqCwB6CLbVPUjmpPjjM2aqNWIJktKuqYu_0ixajc5
GncUJWIFvaZpL431SWYwWWCwvVJSGEUHpDZIU7gGp9QEHCTjCWeWGBOclB6UePH31lYhA

Elevated Flows

Dam Era Early to Mid 1900s

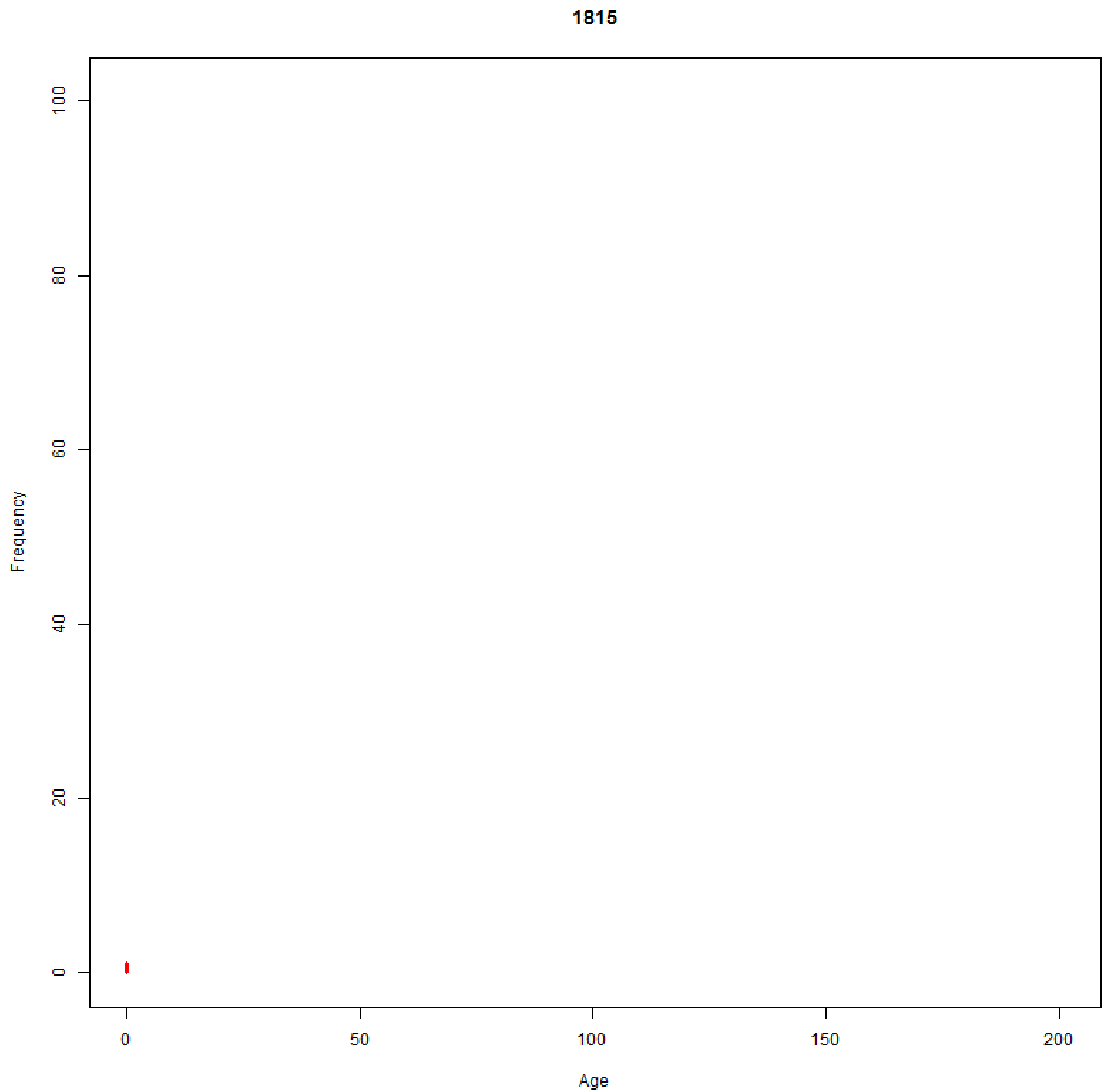


SOURCE: JAMES P. M. SYVITSKI ET AL., *PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY A* **369**, (2011)

1930s-1960s


Winnipeg
MONTANA
NORTH DAKOTA
SOUTH DAKOTA
MINNESOTA
Minneapolis
WISCON
HO
IOWA
NEBRASKA
ILLIN
United States
Kansas City
UTAH
COLORADO
KANSAS
MISSOURI
Fort Peck Dam & Lake
US Army Corps of Engineers

Additional Dams…

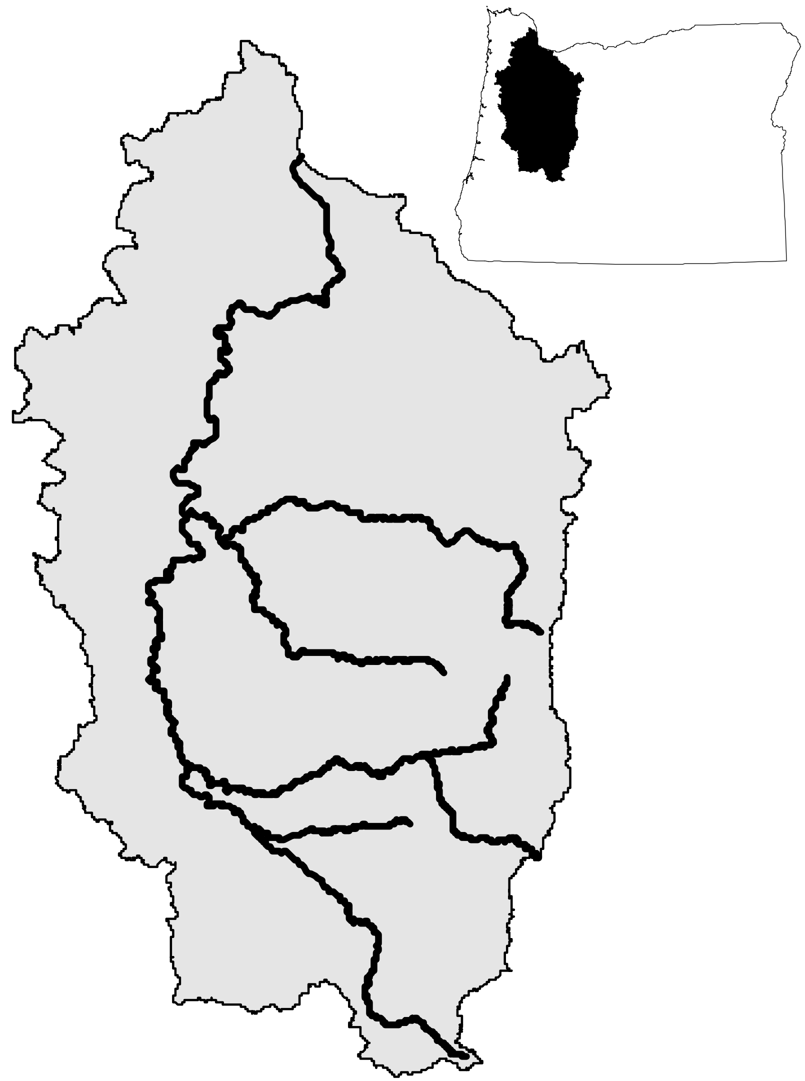


1815
Frequency
Age
0
20
40
60
80
100
0
50
100
150
200

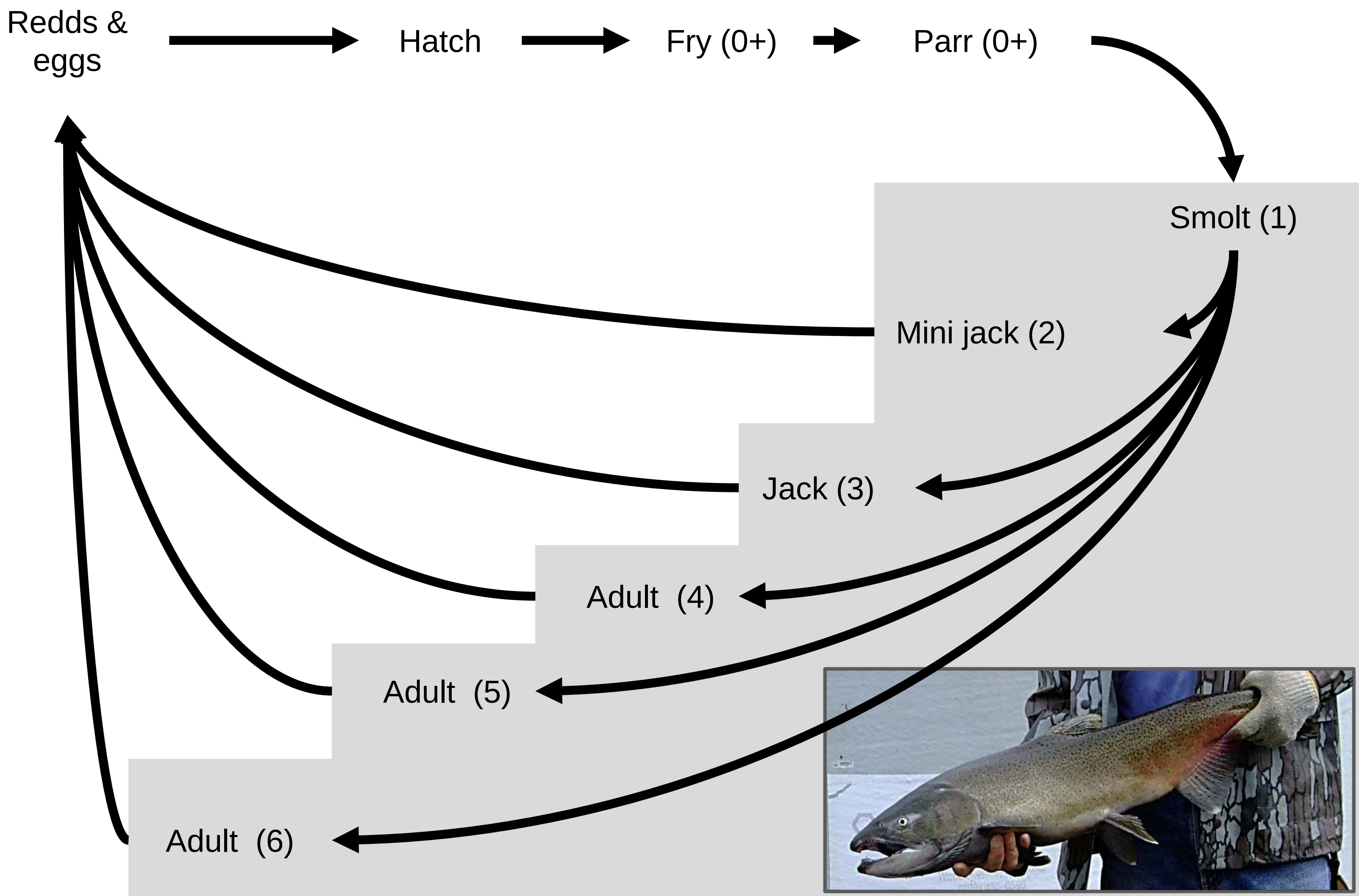
Willamette basin spring Chinook

Anadromous species of conservation need

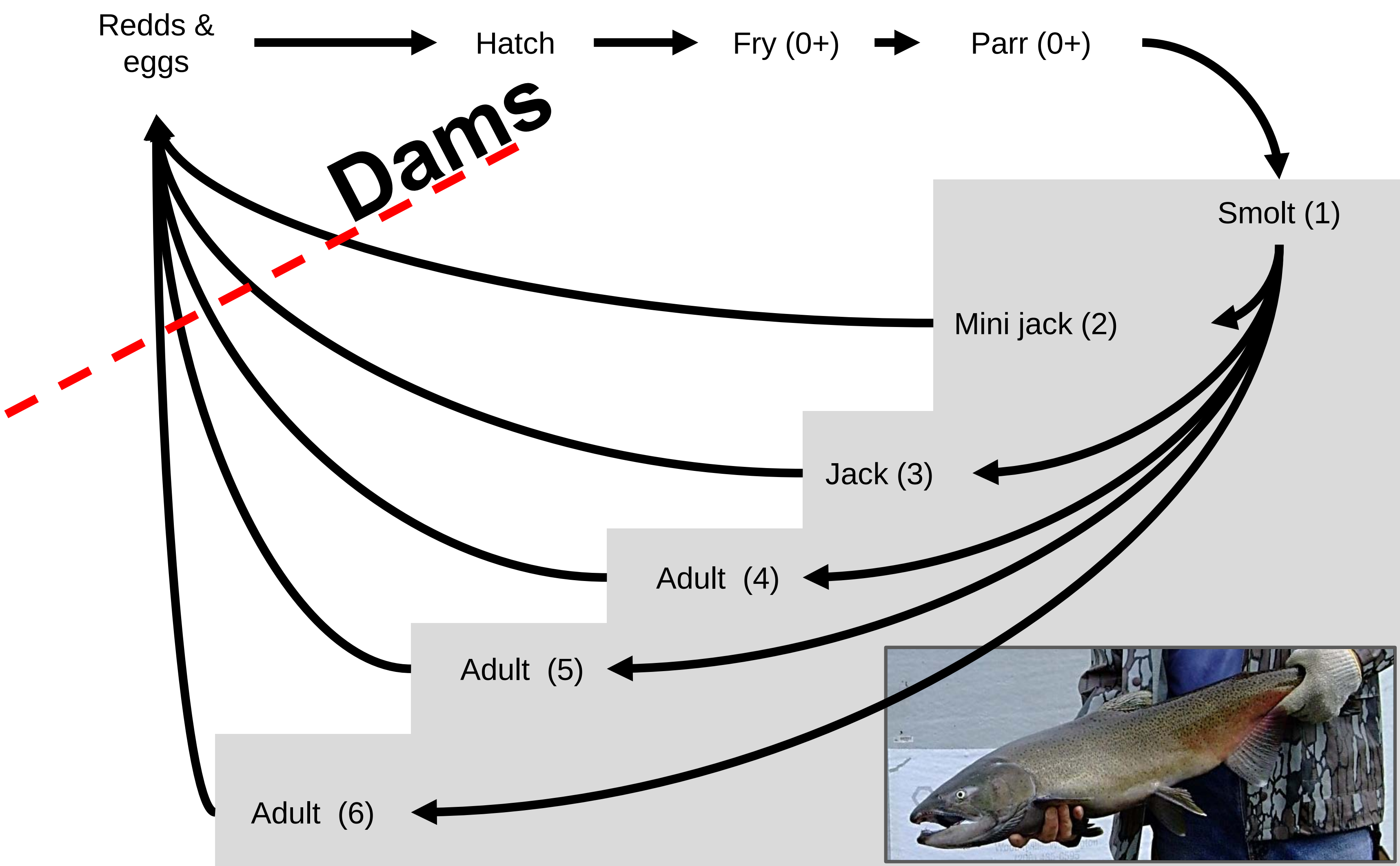
-Threatened status 1999
- Anthropogenic modifications



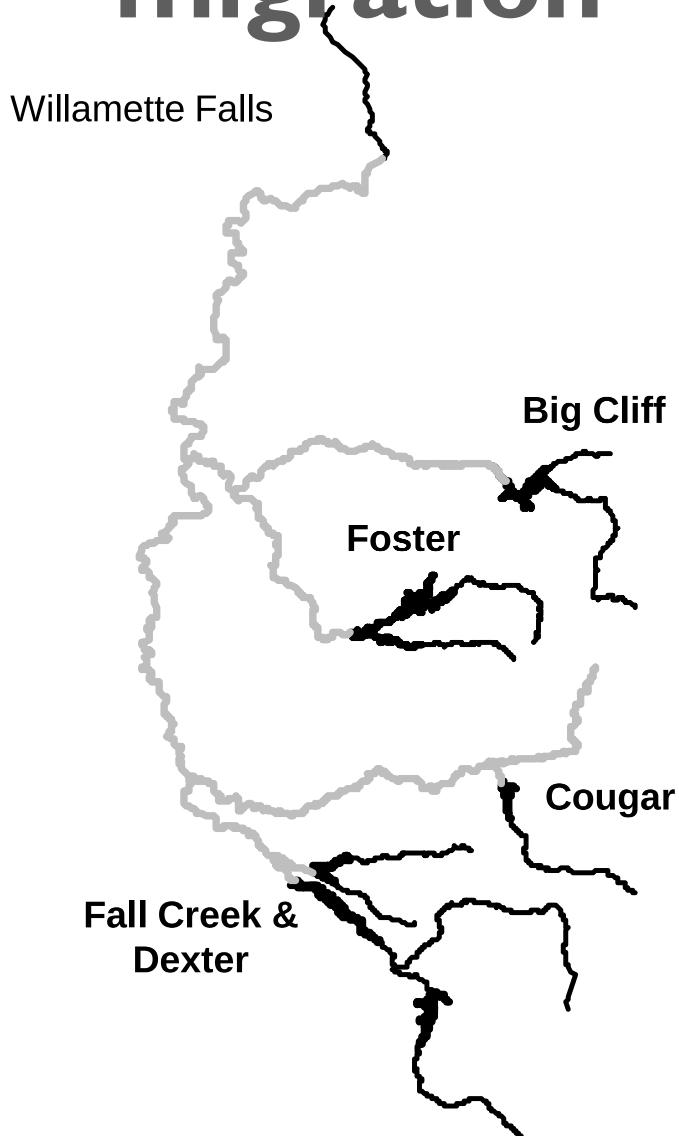
Spring Chinook life history



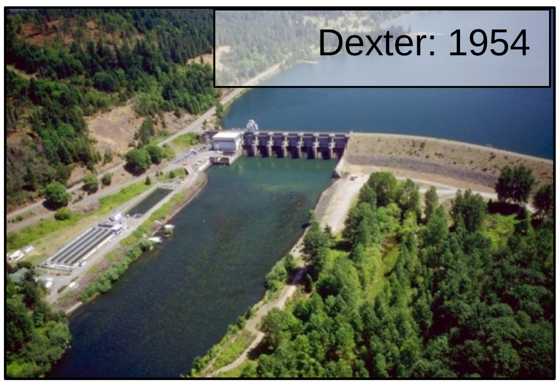
Spring Chinook life history



1950-60s Barriers to adult migration

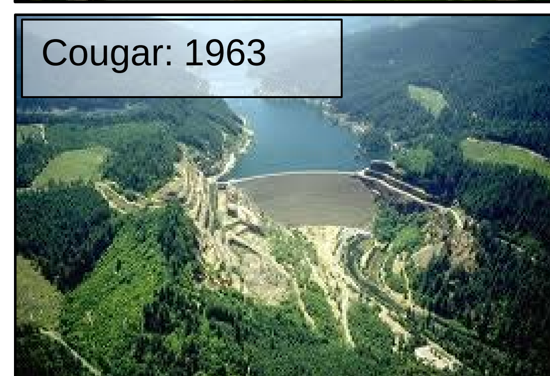



Big Cliff: 1953


Dexter: 1954

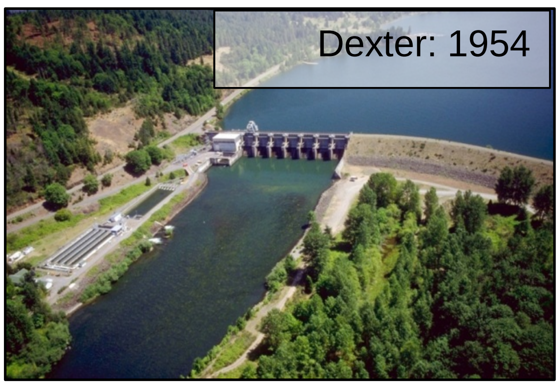

Foster: 1968

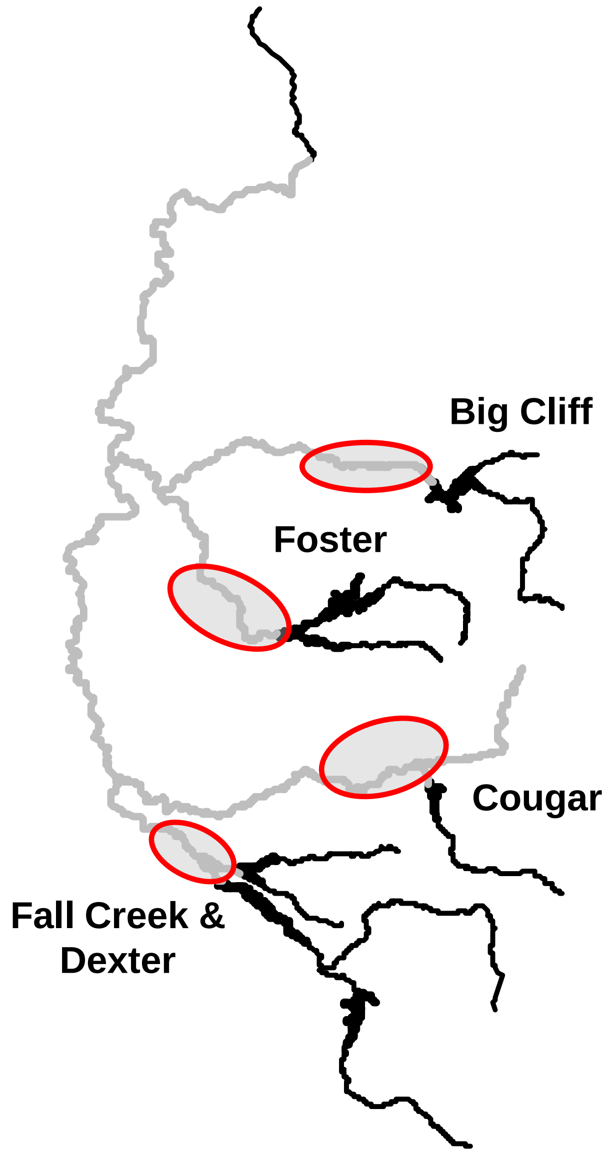

Fall Creek: 1966

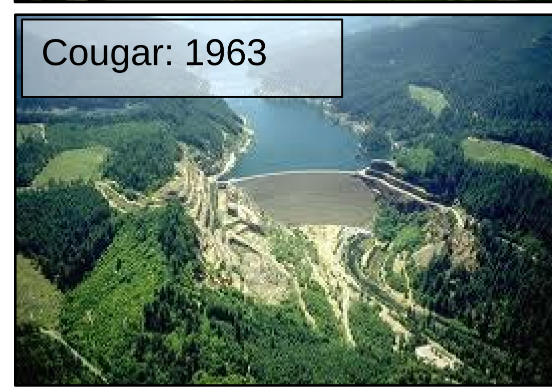

Cougar: 1963

www.nwd-wc.usace.army.mil

Limited natural reproduction







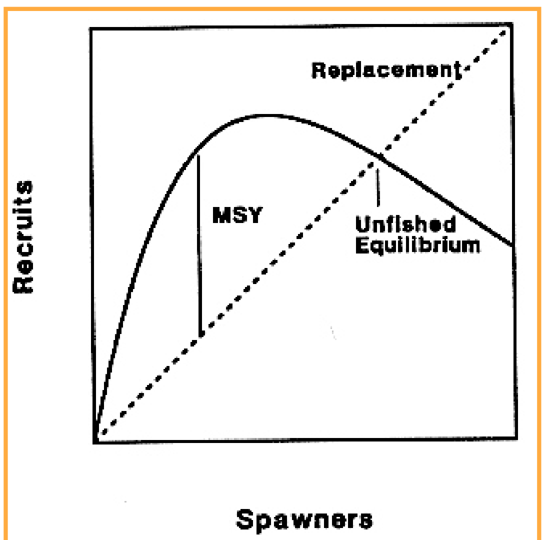
www.nwd-wc.usace.army.mil

Holistic era 1960s to present

- Look at the whole picture
- Need to manage
  - Fishing
  - Habitat
  - Nuisance species
  - Multiple species management

Maximum sustainable yield

- Allow some fish to grow before harvesting at a level to promote the greatest long term yield
- Ineffective due to dependencies on exploited forage
  - Bass eat bluegill, both are harvested (Forbes 1887)
  - Need to be managed together



An Epitaph for the Concept of Maximum Sustained Yield[1]

P. A. Larkin
Institute of Animal Resource Ecology, University of British Columbia Vancouver, British Columbia V6T 1W5

About 30 years ago, when I was a graduate student, the idea of managing fisheries for maximum sustained yield was just beginning to really catch on. Of course, the ideas had already been around for quite a while. Baranov (1918) was the first to combine information on growth and abundance to develop a catch equation, and Russell (1931) and famous "green book," the first version of his handbook (Ricker 1958); Fry (1947) developed the virtual population idea; and Schaefer (1954) proposed his method for estimating surplus production under nonequilibrium conditions. The literature crackled with new information and new ideas. The solidification of the concept of MSY, its application to

Optimum sustained yield

- Failures in management using MSY
  - ~75% of fisheries resources are fully or overexploited
  - Estimates of collapse of global fisheries by 2048
- Optimum sustained yield (OSY)
  - Broader goals and policies than fishery yield
- Integrated view of aquatic systems
- More holistic view

Nuisance fish considerations

- Sea lamprey control in Great Lakes

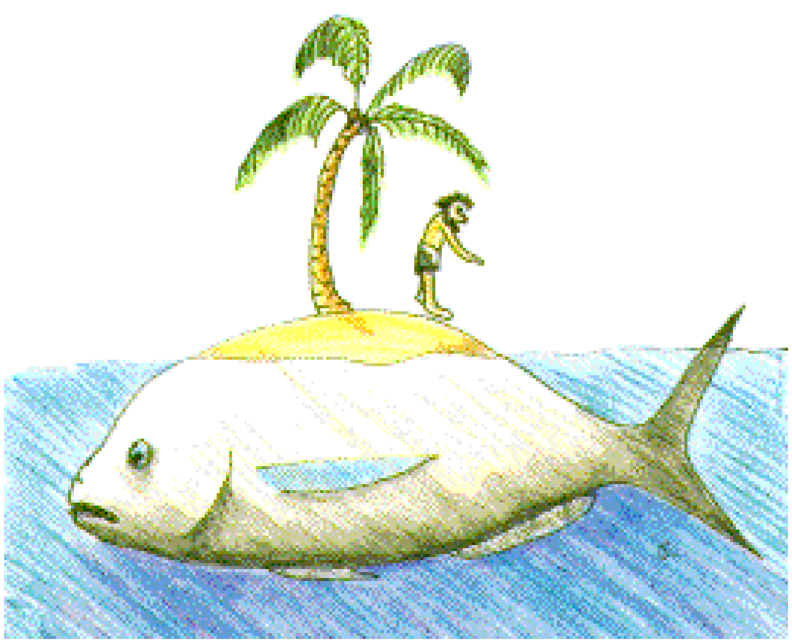



Push for holistic management

- Magnuson Stevens Act- National Standard
  - (1) Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the ***optimum yield*** from each fishery for the United States fishing industry.
  - (2) Conservation and management measures shall be based upon the best scientific information available.
  - (3) To the extent practicable, ***an individual stock of fish*** shall be managed as a unit throughout its range, and ***interrelated stocks*** of fish shall be managed as a unit or in close coordination.

“No fish is an island”

- Optimum sustained yield (OSY) attempts to integrate a broad range of goals not just fishery yield (biodiversity, function)



No fish
is an
Island

It signifies that all living organisms are linked together.
In the oceans, for example,
despite our great impact,
we are only one of many predators.
We must learn to behave responsibly in a realm
where we are the intruders.

Development of ECOPATH

- Mass balance
  - Conservation of mass

Coral Reefs (1984) 3: 1–11

P129 Coral Reefs

Model of a Coral Reef Ecosystem

I. The ECOPATH Model and Its Application to French Frigate Shoals

Jeffrey J. Polovina

Southwest Fisheries Center

Accepted 30 April 1984

Abstract. A simple sented which estima tion, and consumptic To use the model, the groups of similar sp groups, estimates of food consumption. T an ecosystem at Fren ern Hawaiian Islands estimates of the inpu mean annual biomas duction estimates fo eled are used to vali

The Strategy of Ecosystem Development

An understanding of ecological succession provides a basis for resolving man's conflict with nature.

Eugene P. Odum

The principles of ecological succession bear importantly on the relationships between man and nature. The framework of successional theory needs to be examined as a basis for resolving man's present environmental crisis. Most ideas pertaining to the development of ecological systems are based on descriptive data obtained by observing changes in biotic communities over long periods, or on highly theoretical assumptions; very few of the generally accepted hypotheses have been tested experimentally. Some of the confusion, vagueness, and lack of experimental work in this area stems from the tendency of ecologists to regard "succession" as a single straightforward idea; in actual fact, it entails an interacting complex of processes, some of which counteract one another.

As viewed here, ecological succession involves the development of ecosystems; it has many parallels in the developmental biology of organisms, and also in the development of human society. The ecosystem, or ecological system, is considered to be a unit of biological organization made up of all of the organisms in a given area (that is, "community") interacting with the physical environment so that a flow of energy leads to characteristic trophic structure and material cycles within the system. It is the purpose of this article to summarize, in the form of a tabular model, components and stages of development

The author is director of the Institute of Ecology, and Alumni Foundation Professor, at the University of Georgia, Athens. This article is based on a presidential address presented before the annual meeting of the Ecological Society of America at the University of Maryland, August 1966.

require more study, and those that have special relevance to human ecology.

Definition of Succession

Ecolo in term eters (of comm sonably dictable tion of commu munity- ical env the rate as to ho It culm in whic informa functio tained p In a wo as a sh same a evolutio sphere– or hom vironme maximu bations egy of trying t comple flicts w

Ecological Modelling, 61 (1992) 169–185
Elsevier Science Publishers B.V., Amsterdam

ECOPATH II — a software for balancing steady-state ecosystem models and calculating network characteristics *

V. Christensen and D. Pauly

International Center for Living Aquatic Resources Management (ICLARM), MC P.O. Box 1501, Makati, Metro Manila, Philippines

(Accepted 12 November 1991)

ABSTRACT

Christensen, V. and Pauly, D., 1992. ECOPATH II — A software for balancing steady-state ecosystem models and calculating network characteristics. *Ecol. Modelling*, 61: 169–185.

A holistic view of aquatic systems

$$B_i(P/B)_i\ EE_i = \sum (Q/B)_i DC_{ij} B_j + C_i + BA_i + NM_i,$$

- Heir to Odum
  - –24 attributes
- Ecosystem level functions

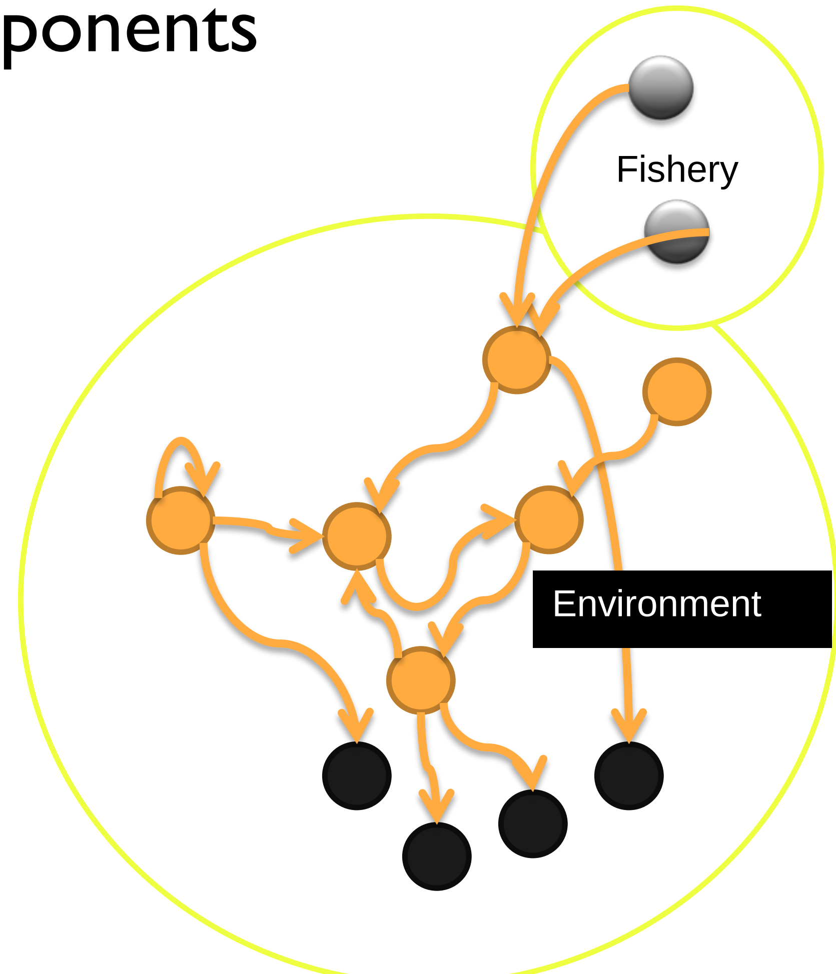
Attribute/function	Symbol	Unit	Odum attribute
1 Net primary production	P_p	g/m²/year	
2 Respiration	R	g/m²/year	
3 System size (sum of flows)	T	g/m²/year	
4 Primary production/respiration	P_p/R	–	
5 Deviation of P_p/R	*Teta*	–	1
6 Primary production/biomass	P_p/B	year	2
7 Biomass supported (a)	B/T	year	3
8 Biomass supported (b)	$B/(P_p+R)$	year	
9 Net production	$P_p - R$	g/m²/year	
10 Connectance	C	–	5
11 System omnivory index	SOI	–	5
12 Dominance of detritus	Dom.Det	–	5
13 System biomass (excl. detritus)	B	g/m²/year	
14 Flow diversity	H	–	8–9
15 Average organism size	B/P	year	13
16 Finn's cycling index	FCI	–	15
17 Predatory cycling index	PCI	–	
18 Nutrient regeneration	FCI – PCI	–	
19 Path length	PL	–	16
20 Straight-through path length	SPL	–	
21 Residence time	$B/(R+\mathrm{EXP})$	year	18
22 Nutrient conservation	O_{ex}	–	21
23 System overhead	O	–	
24 Schrödinger ratio	R/B	–	23
25 Information content of flows	I	bits	24
26 Energy-based ascendency	A	–	
27 Relative ascendency	A/C	%	
28 Emergy (Odum)-based ascendency	A_0	%	
29 Internal redundancy	Redund	%	
30 Exergy	EX	–	
31 Structural exergy	EX_{st}	–	

Use of ECOPATH

- 169 countries
- >7000 users
- NOAA top ten break through

ECOPATH Levels of organization

- Populations- biotic components
- Communities
  - –Consumers
  - –Primary Producers
  - –Detritus
- Ecosystem
  - –Fishery
  - –Environment
    - Forcing functions



Restoration & Conservation Era

- 163 Threatened & endangered fishes

U.S. Fish & Wildlife Service

Environmental Conservation Online System

Conserving the Nature of America

Enter Search Term(s): Search

ECOS > Species Reports > Species Search > Species Search Results

Species Search Results

163 Records

Here are all the species that match your criteria. Please click on the the Scientific Name to find out more about the particular species.

Inverted Common Name	Scientific Name	Where Listed	Lead Region	Listing Status
Bocaccio	*Sebastes paucispinis*	Puget Sound-Georgia Basin DPS — See 50 CFR 224.101	NMFS	E
Catfish, Yaqui	*Ictalurus pricei*	Entire	2	T
Cavefish, Alabama	*Speoplatyrhinus poulsoni*	Entire	4	E
Cavefish, Ozark	*Amblyopsis rosae*	Entire	4	T
Chub, bonytail	*Gila elegans*	Entire	6	E
Chub, Borax Lake	*Gila boraxobius*	Entire	1	E
Chub, Chihuahua	*Gila nigrescens*	Entire	2	T
Chub, Gila	*Gila intermedia*	Entire	2	E
Chub, humpback	*Gila cypha*	Entire	6	E
Chub, Hutton tui	*Gila bicolor ssp.*	Entire	1	T
Chub, Owens Tui	*Gila bicolor ssp. snyderi*	Entire	8	E
Chub, Pahranagat roundtail	*Gila robusta jordani*	Entire	8	E
Chub, slender	*Erimystax cahni*	Entire	4	T
Chub, Sonora	*Gila ditaenia*	Entire	2	T
Chub, spotfin	*Erimonax monachus*	Entire	4	T

In Mississippi

OSTEICHTHYES					
Acipenser oxyrinchus desotoi	Gulf Sturgeon	G3T2	S1	LT	LE
Scaphirhynchus albus	Pallid Sturgeon	G1	S1	LE	LE
Scaphirhynchus suttkusi	Alabama Sturgeon	G1	SH	LE	LE
Notropis boops	Bigeye Shiner	G5	S1		LE
Notropis chalybaeus	Ironcolor Shiner	G4	S1		LE
Phenacobius mirabilis	Suckermouth Minnow	G5	S1		LE
Phoxinus erythrogaster	Southern Redbelly Dace[1]	G5	S2		LE
Crystallaria asprella	Crystal Darter	G3	S1		LE
Etheostoma blennioides	Greenside Darter	G5	S1		LE
Etheostoma rubrum	Bayou Darter	G1	S1	LT	LE

MISSISSIPPI NATURAL HERITAGE PROGRAM

Listed Species of Mississippi

- 2015 –

SPECIES NAME	COMMON NAME	GLOBAL RANK	STATE RANK	FEDERAL STATUS	STATE STATUS
Percina aurora	Pearl Darter	G1	S1	C	LE
Percina phoxocephala	Slenderhead Darter	G5	S1		LE
Noturus exilis	Slender Madtom	G5	S1		LE
Noturus munitus	Frecklebelly Madtom	G3	S2		LE
Noturus gladiator	Piebald Madtom	G3	S1		LE

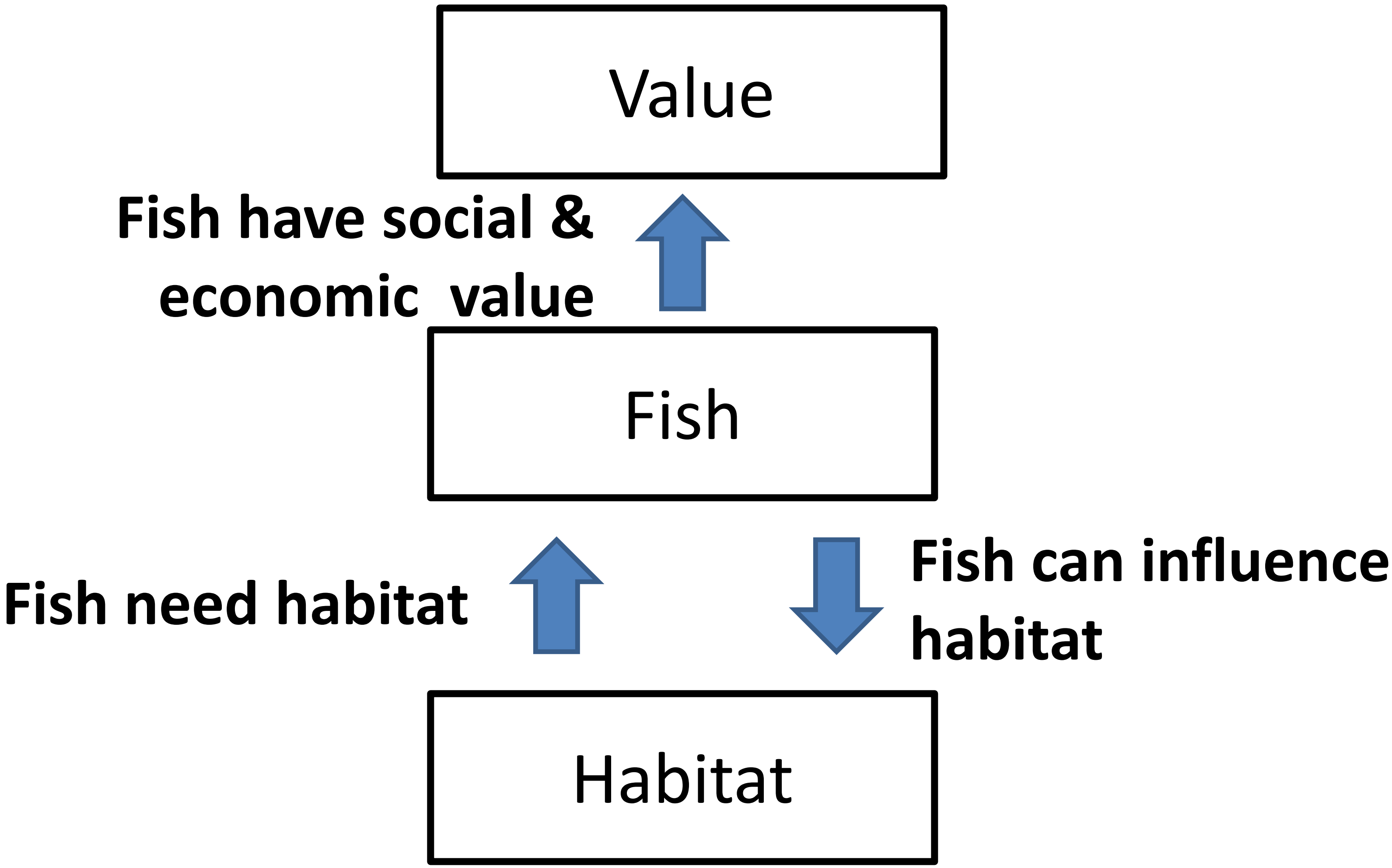
Recovery of the Oregon Chub

- Endangered 1993
- Unlisted 2015, first fish ever!

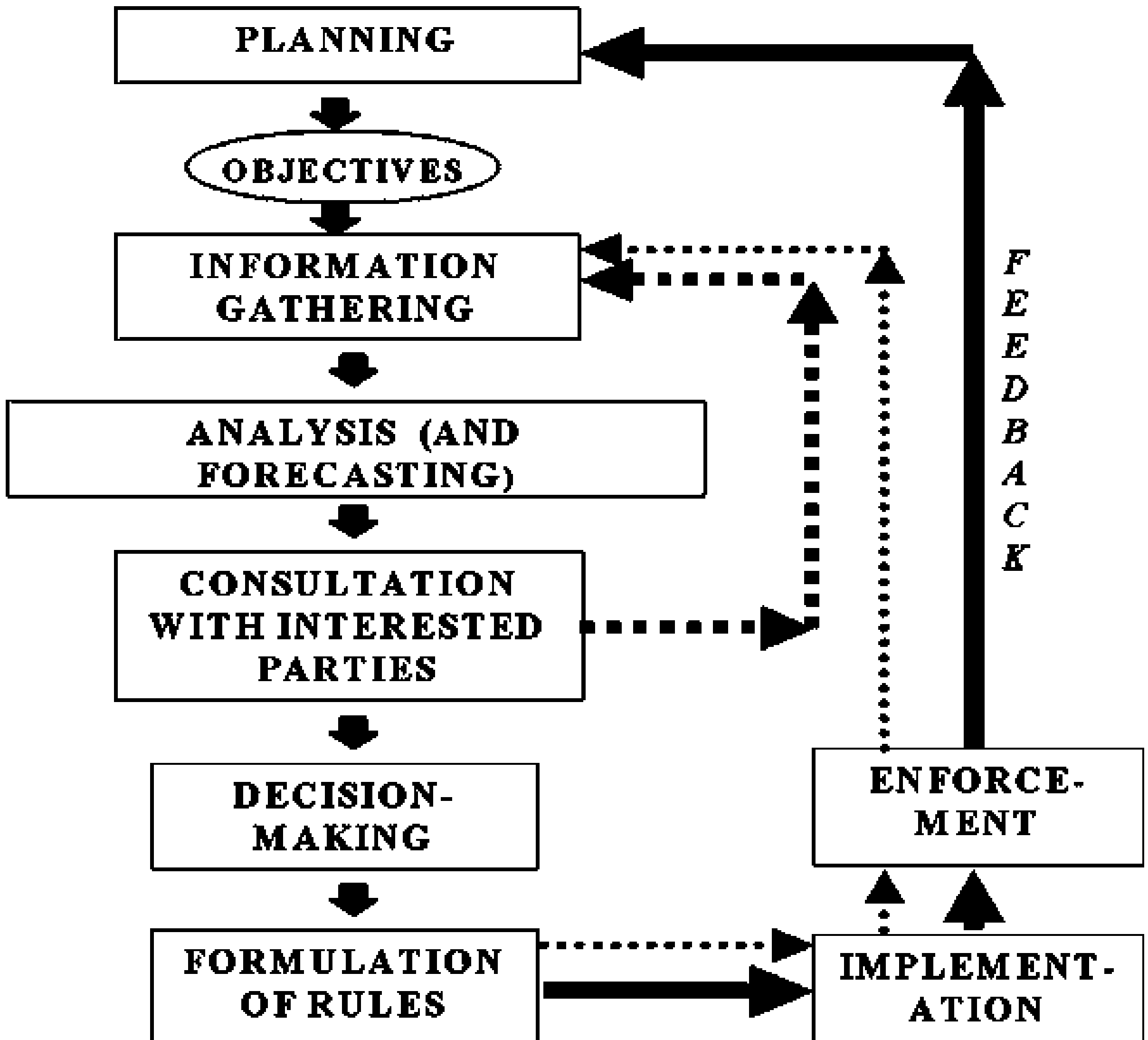
WF4313/6413-Fisheries Management

Module 2: Population Dynamics

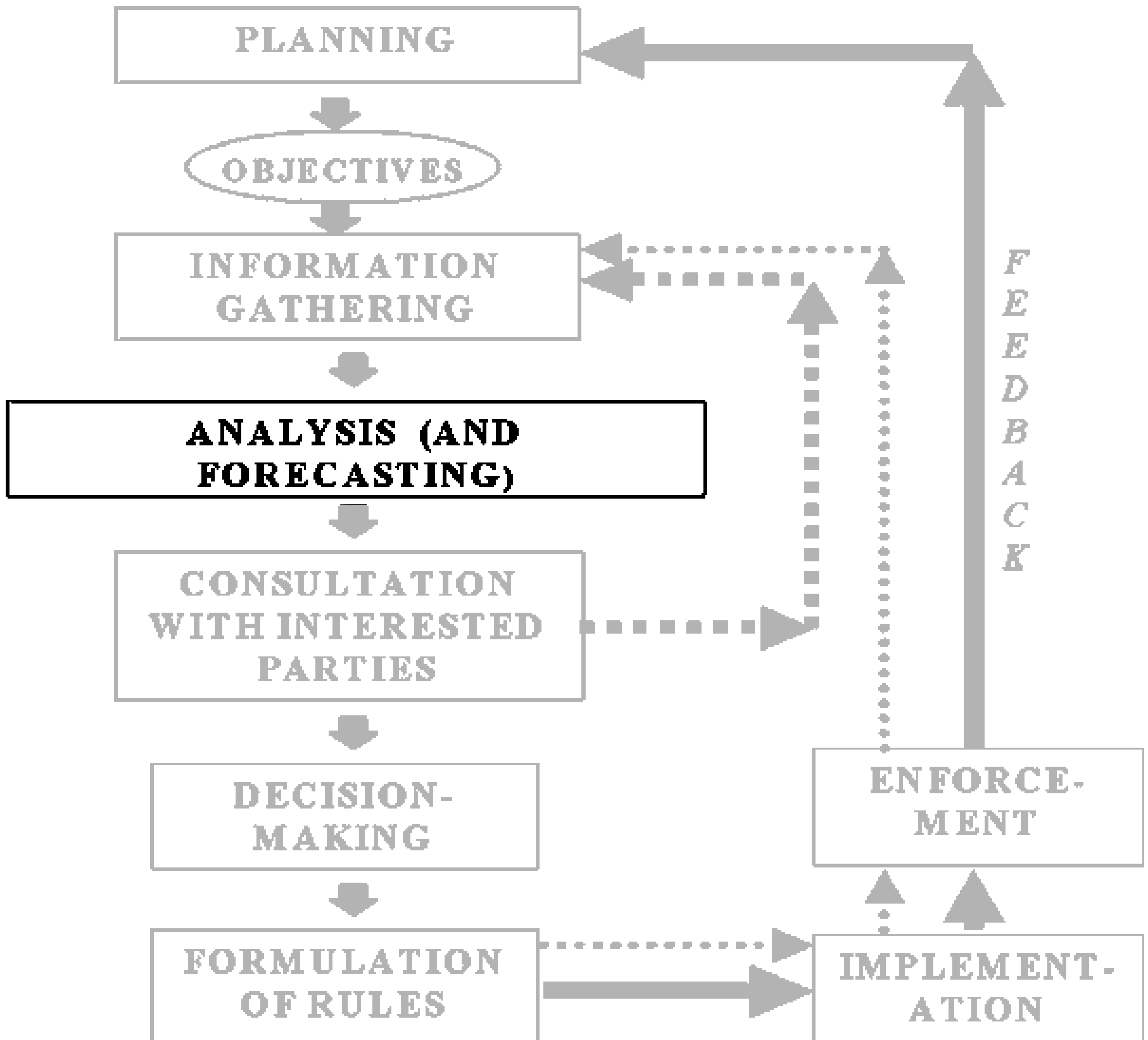
A fishery


Value
Fish have social & economic value
Fish
Fish need habitat
Fish can influence habitat
Habitat

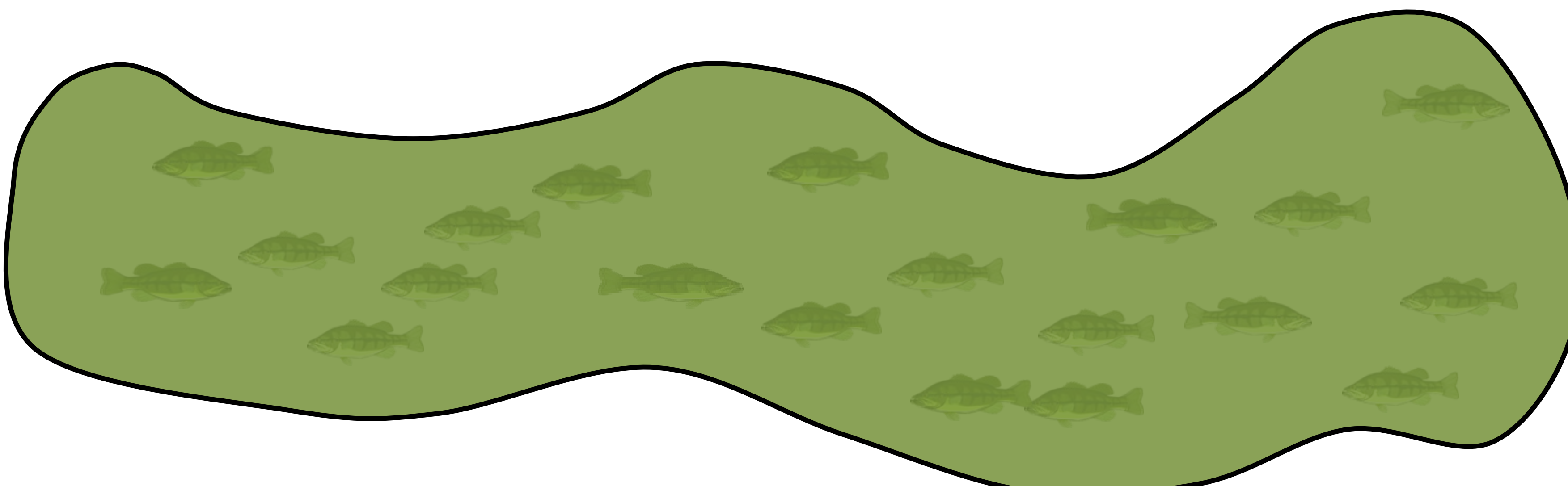
Fisheries Management Conceptually



Fisheries Management Conceptually



"The trouble with fish is that you never get to see the whole population. They're not like trees, whose numbers can be estimated by flying over a forest. Mostly you see fish only when they're caught…" Schnute 1987



Our "view" of fish populations comes from a variety of sources: anglers, commercial fisheries, and sampling gears. Each has inherent biases, and we rarely have complete information about the fishery of concern.

Thinking ***inside*** the box

Fish	Value	Habitat

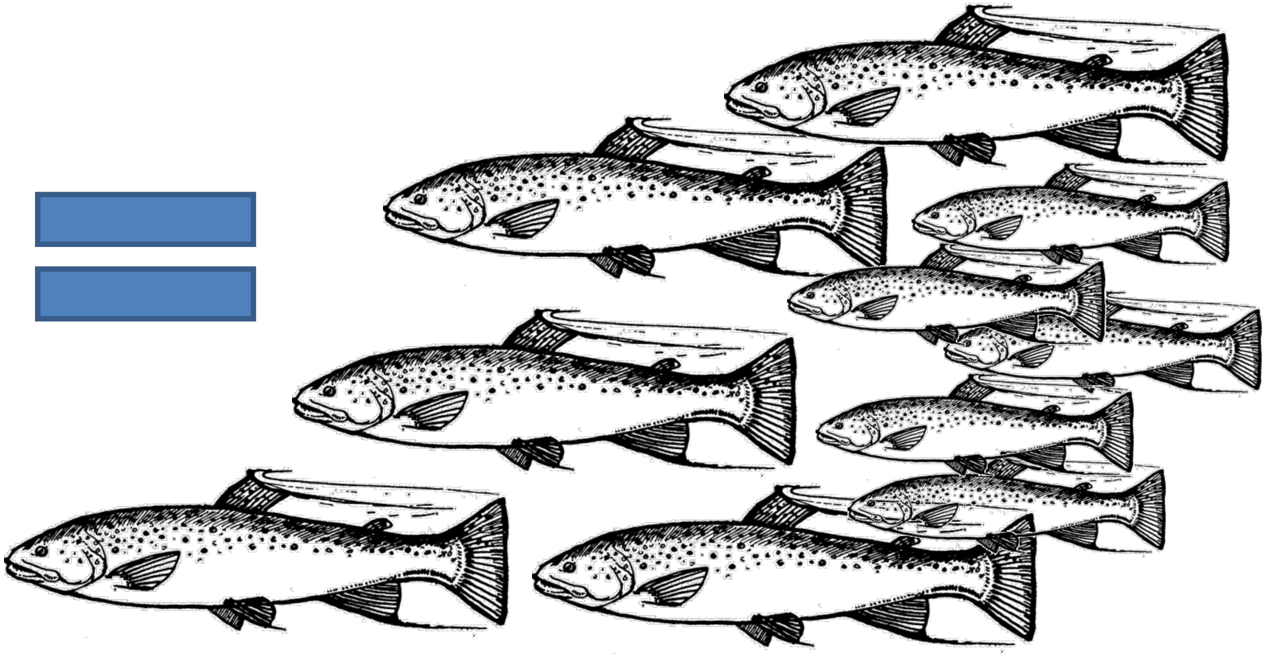
10 Fish or
28 Kilograms

Thinking *inside* the box

Fish	Value	Habitat

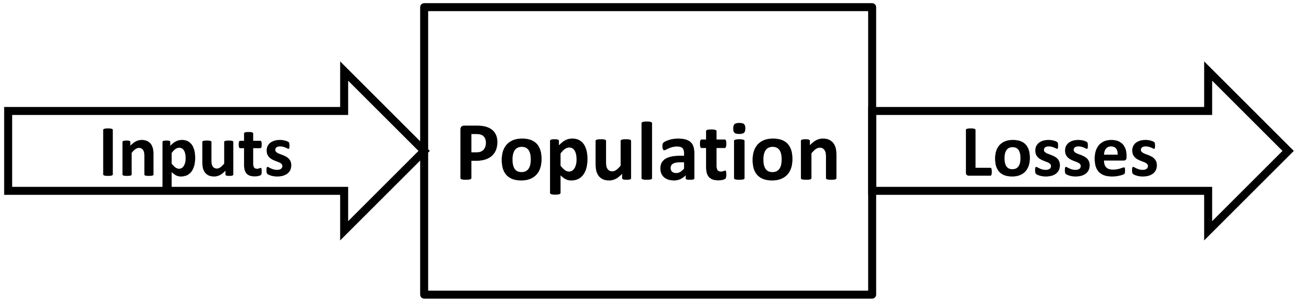
10 Fish or 28 Kilograms

=



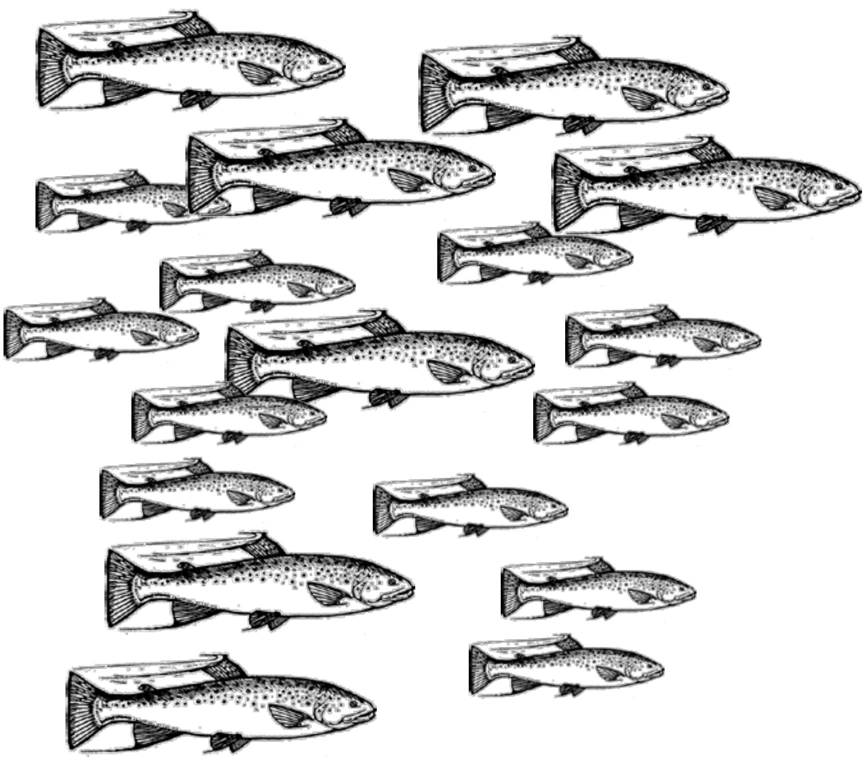
Thinking *outside* the box

Population dynamics in a nutshell:

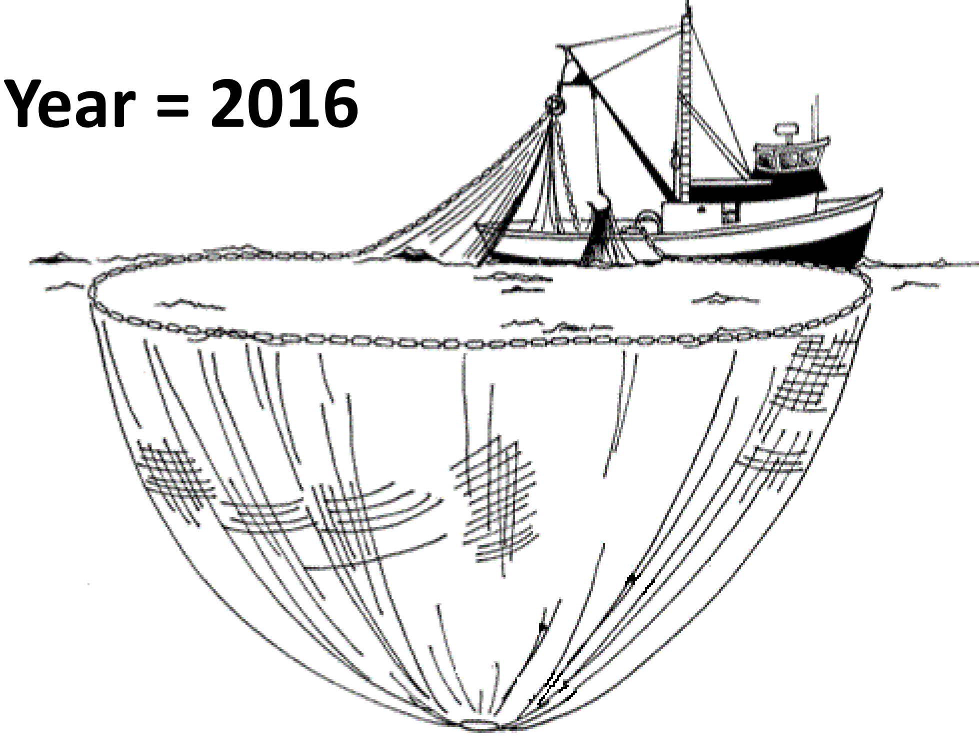


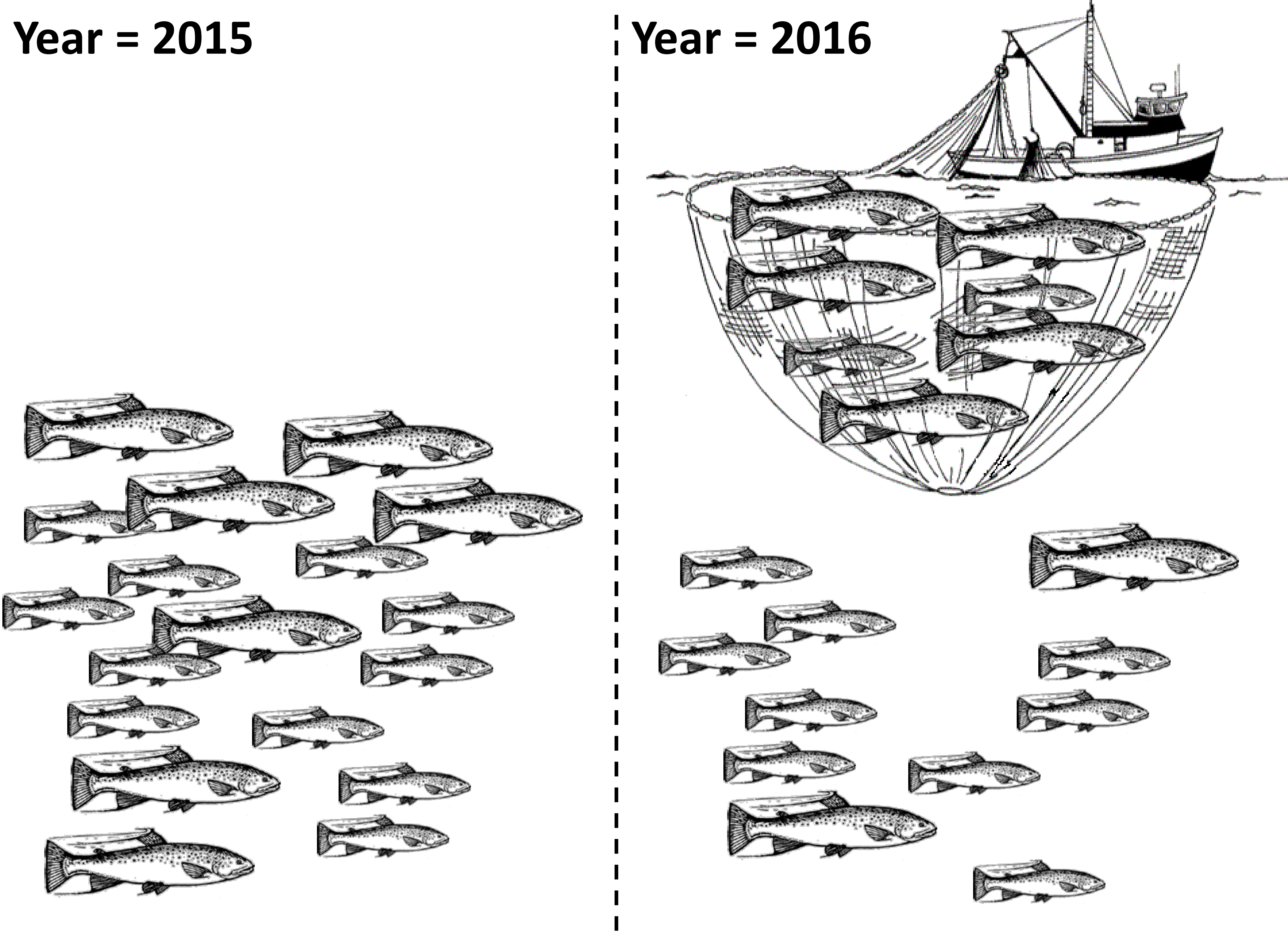
[Population change] = [Inputs] – [Outputs]

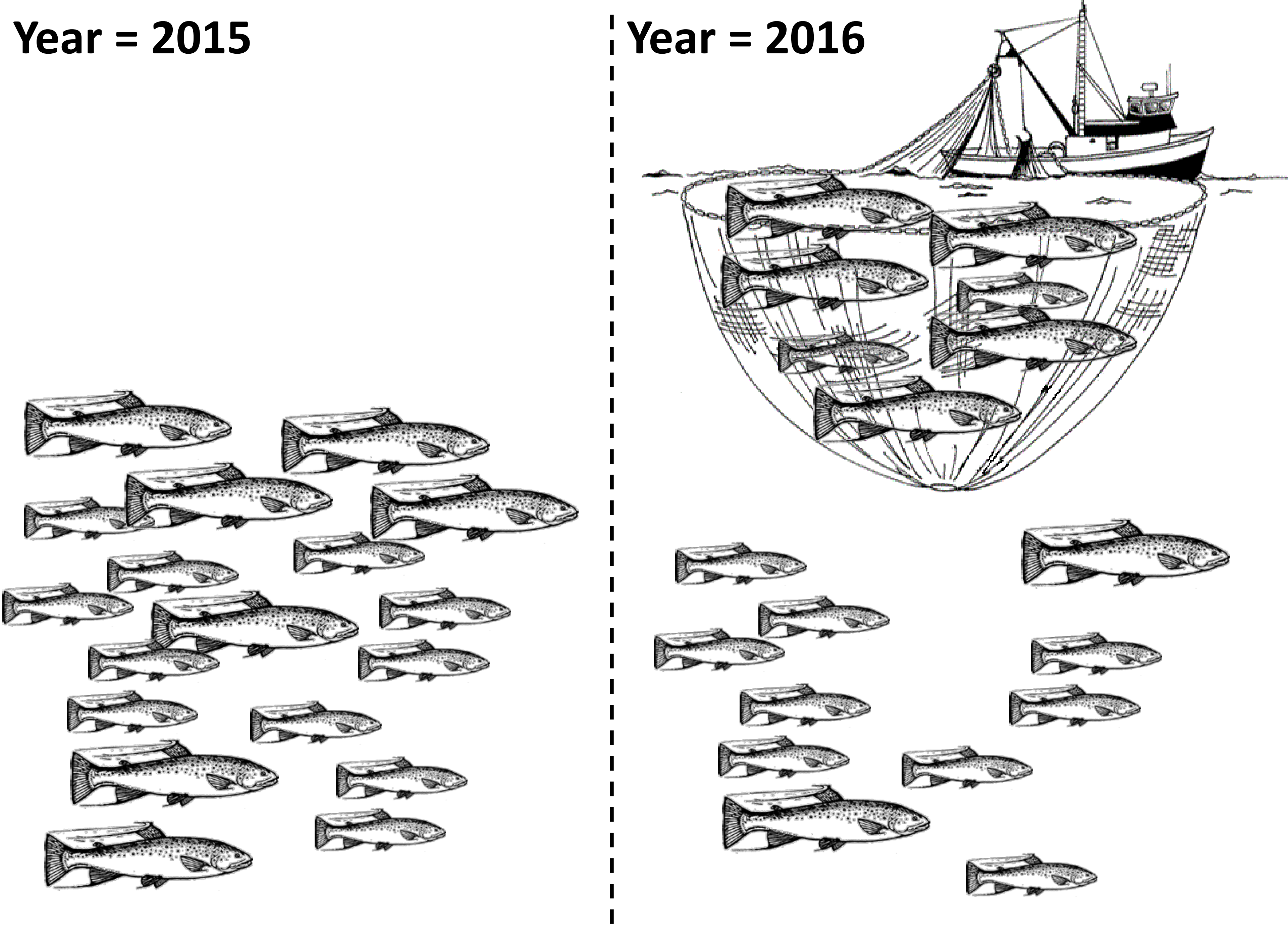
Year = 2015

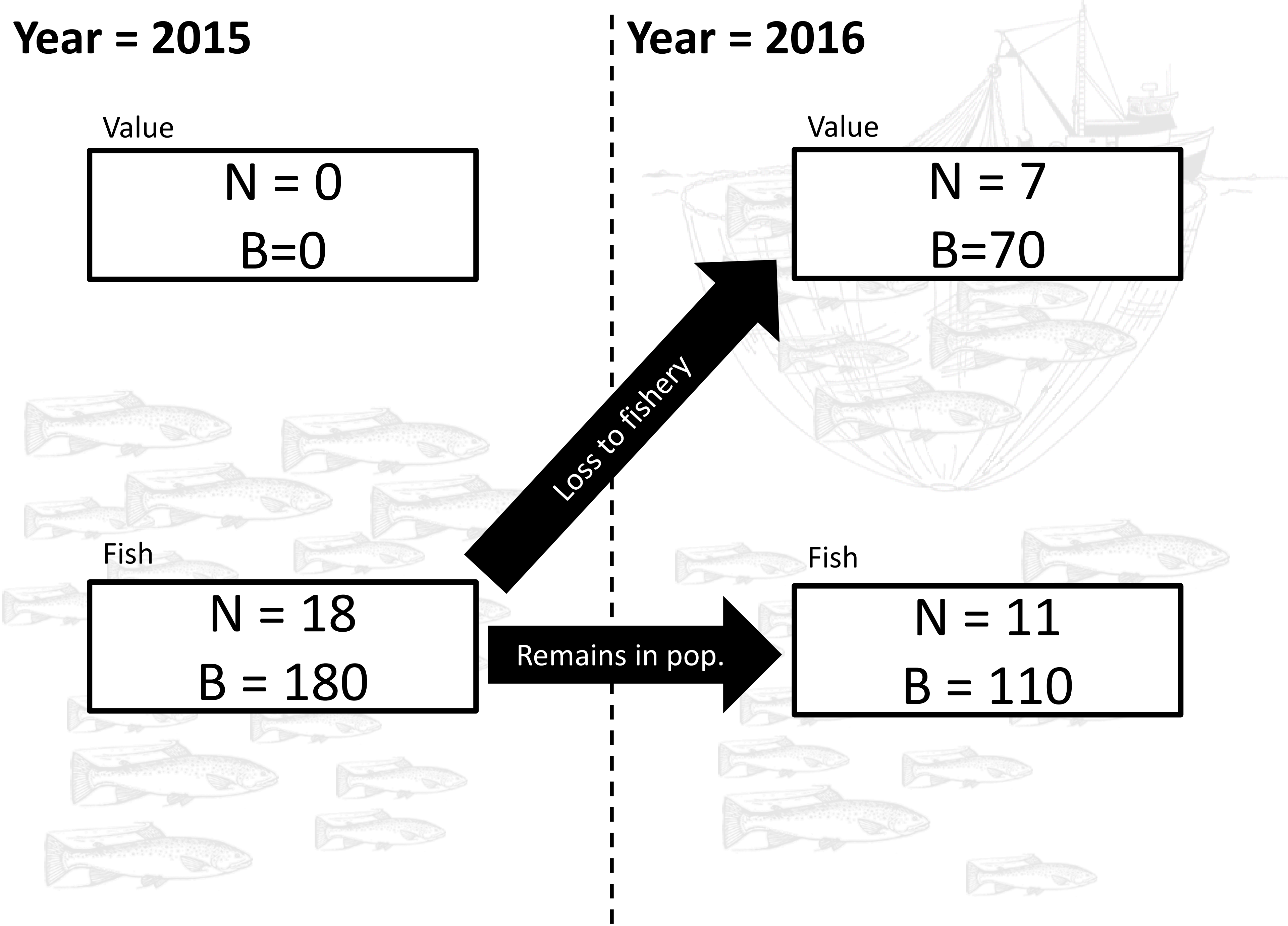


Year = 2016



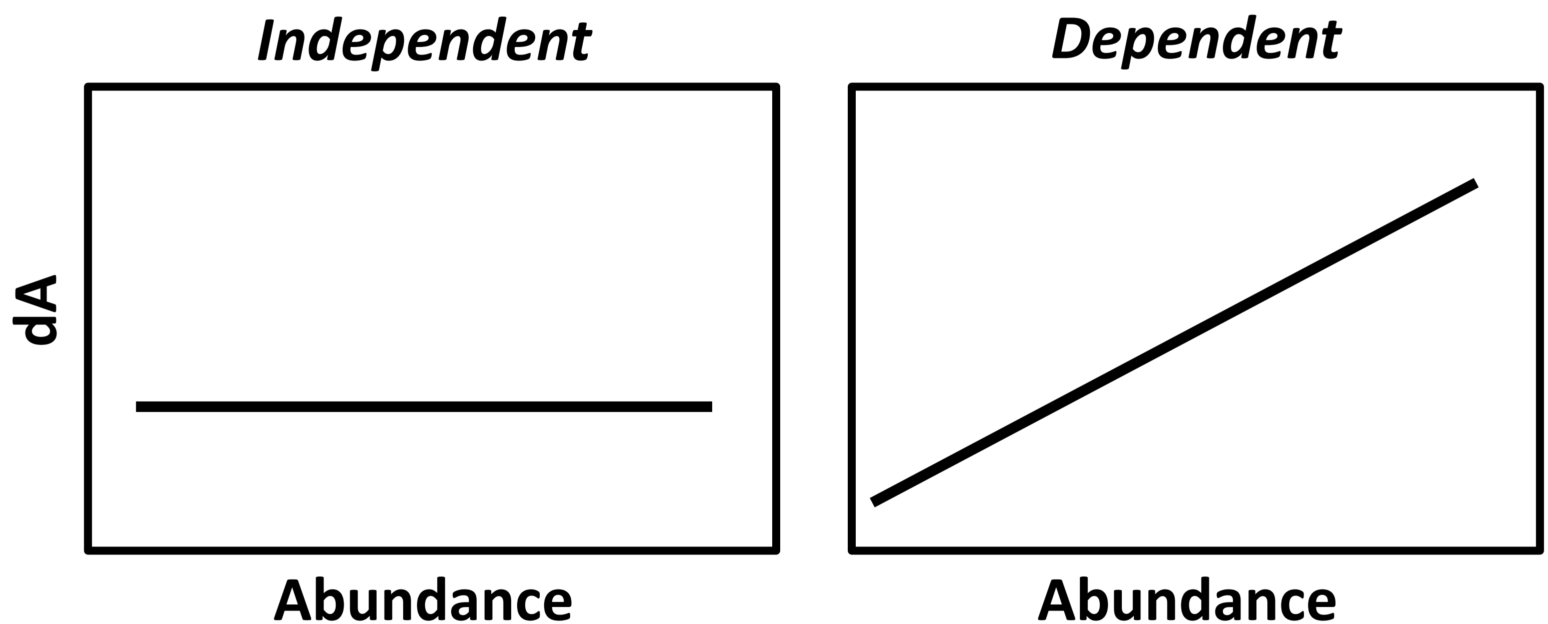

Year = 2015
Year = 2016


Year = 2015
Year = 2016


Year = 2015
Year = 2016
Value
N = 0
B=0
Value
N = 7
B=70
Loss to fishery
Fish
N = 18
B = 180
Remains in pop.
Fish
N = 11
B = 110

Revisiting gains and losses

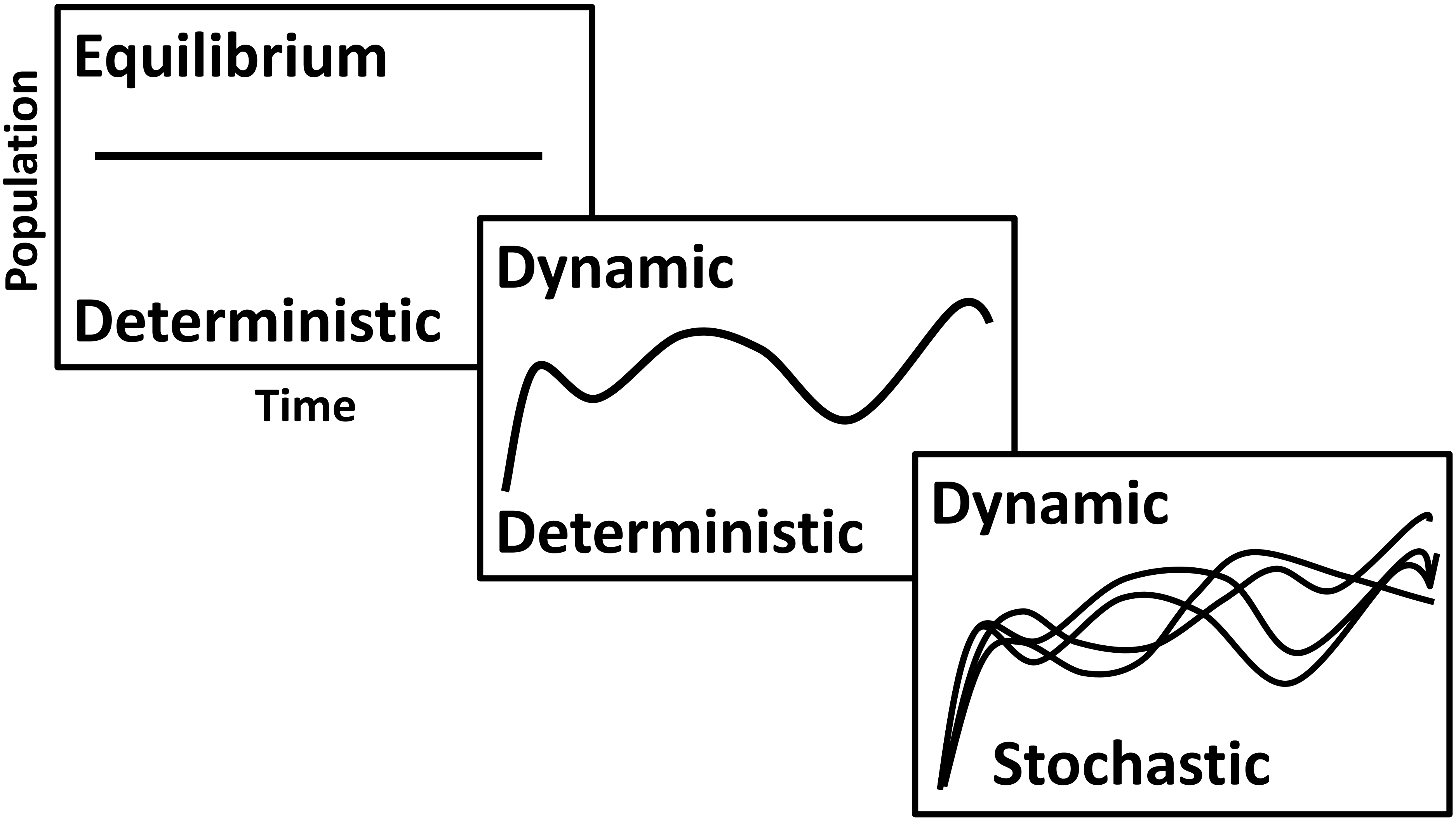
Change in abundance (dA=gains-losses) can be <u>independent</u> or <u>dependent</u> of population abundance



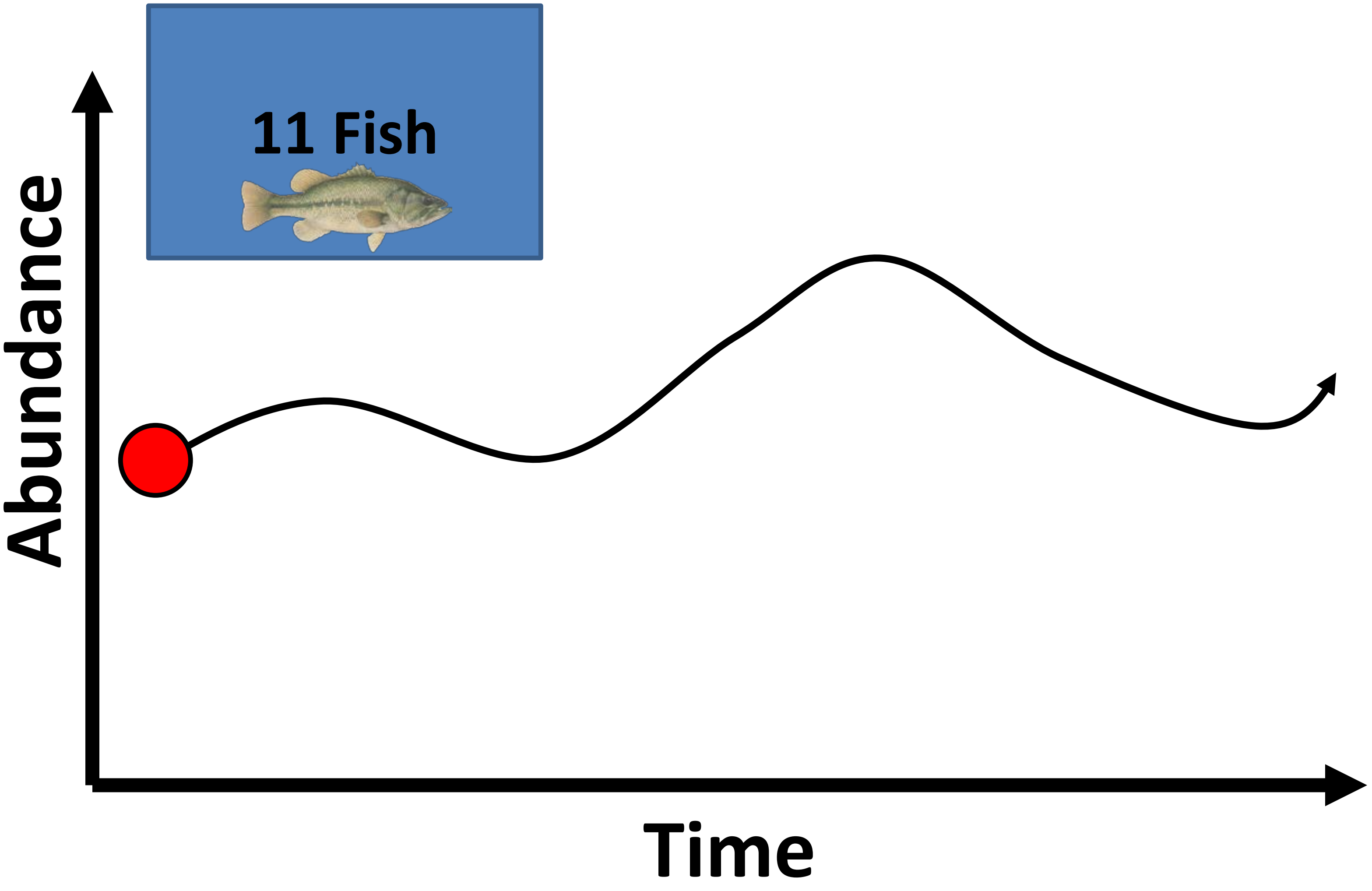
Population dynamics

- What are population dynamics?
- Suppose in 2015 we have a pond with 11 Largemouth Bass in it.

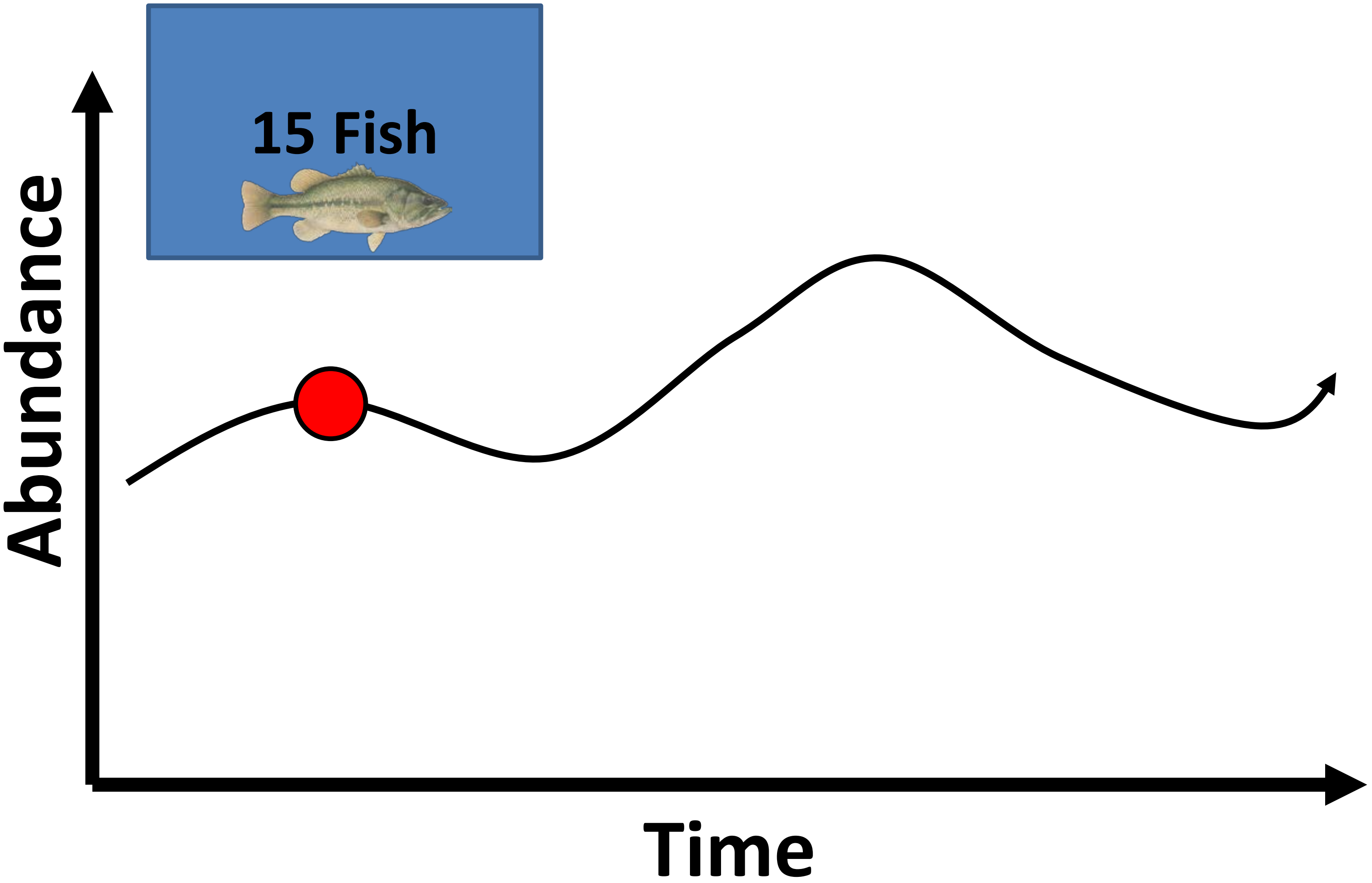
Population dynamics model types



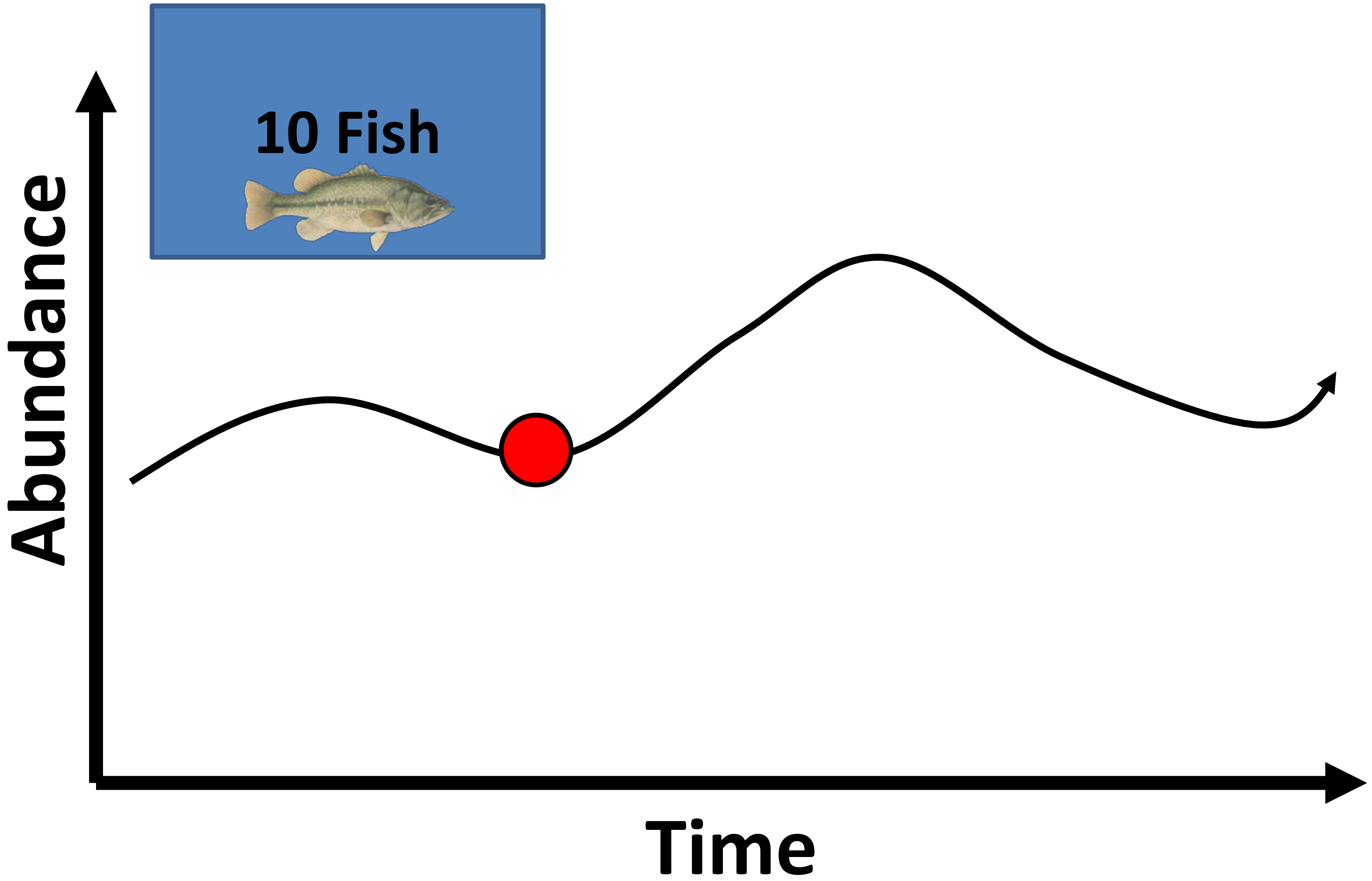
2015



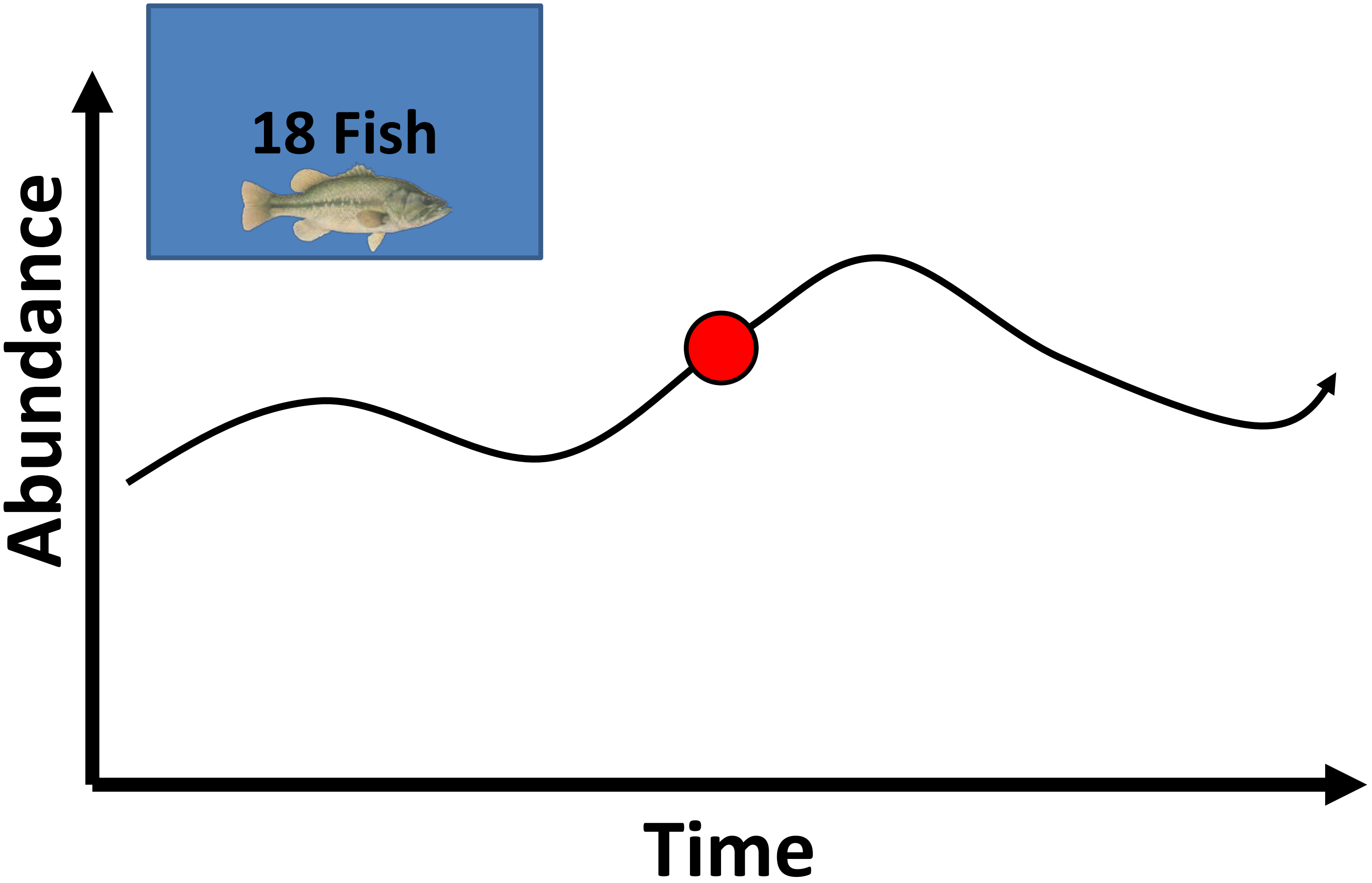
2016



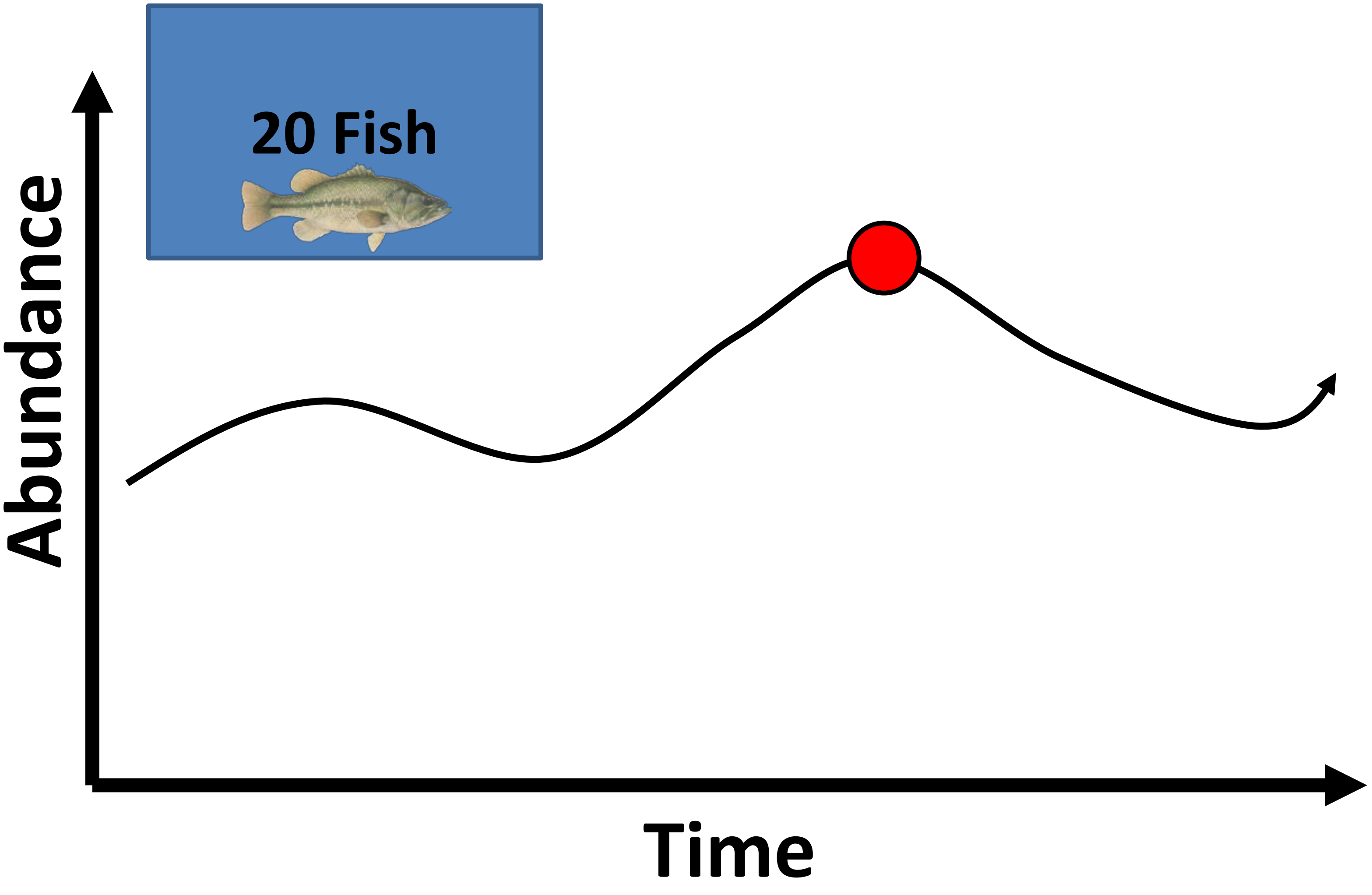
2017



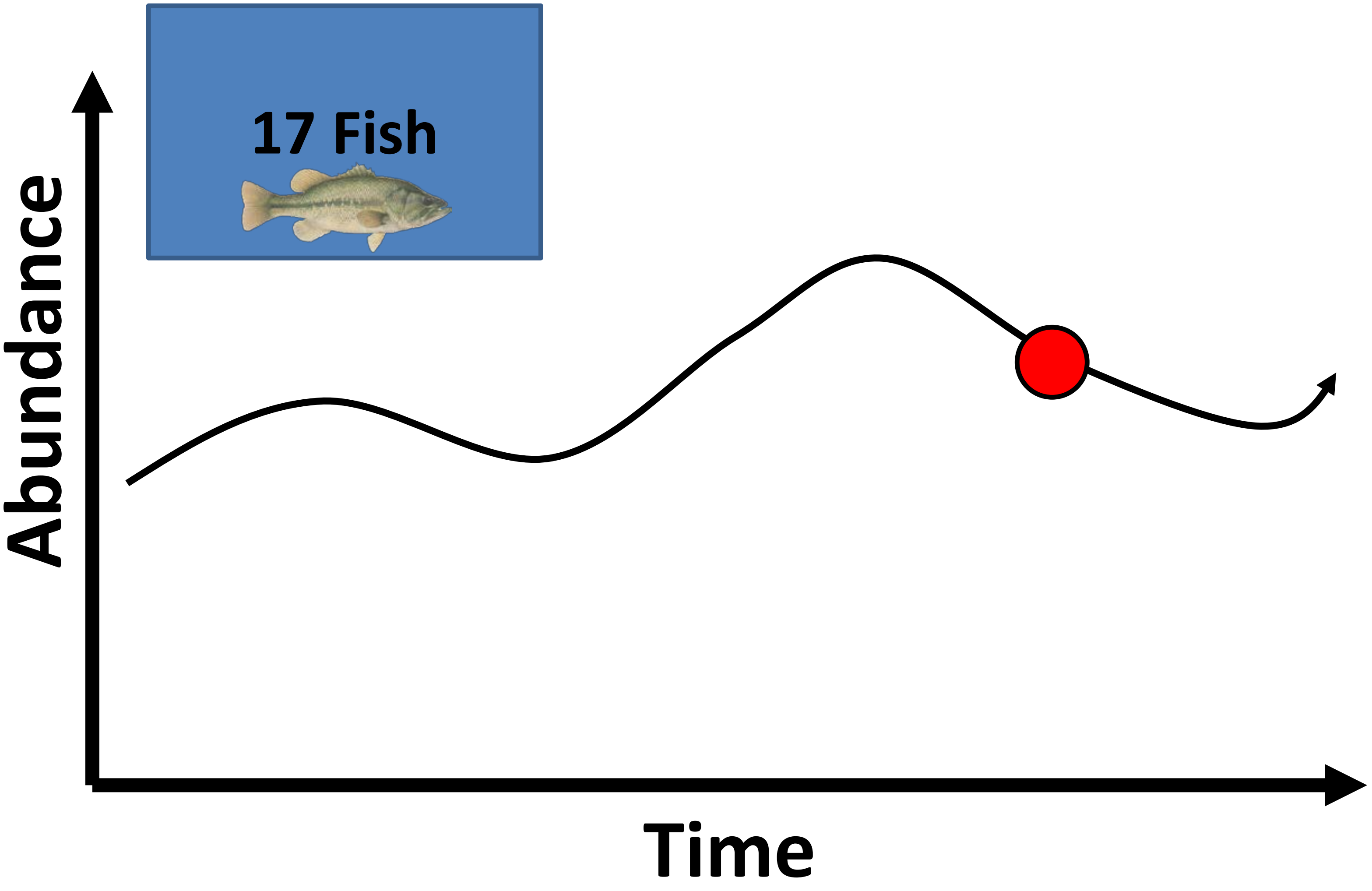
2018



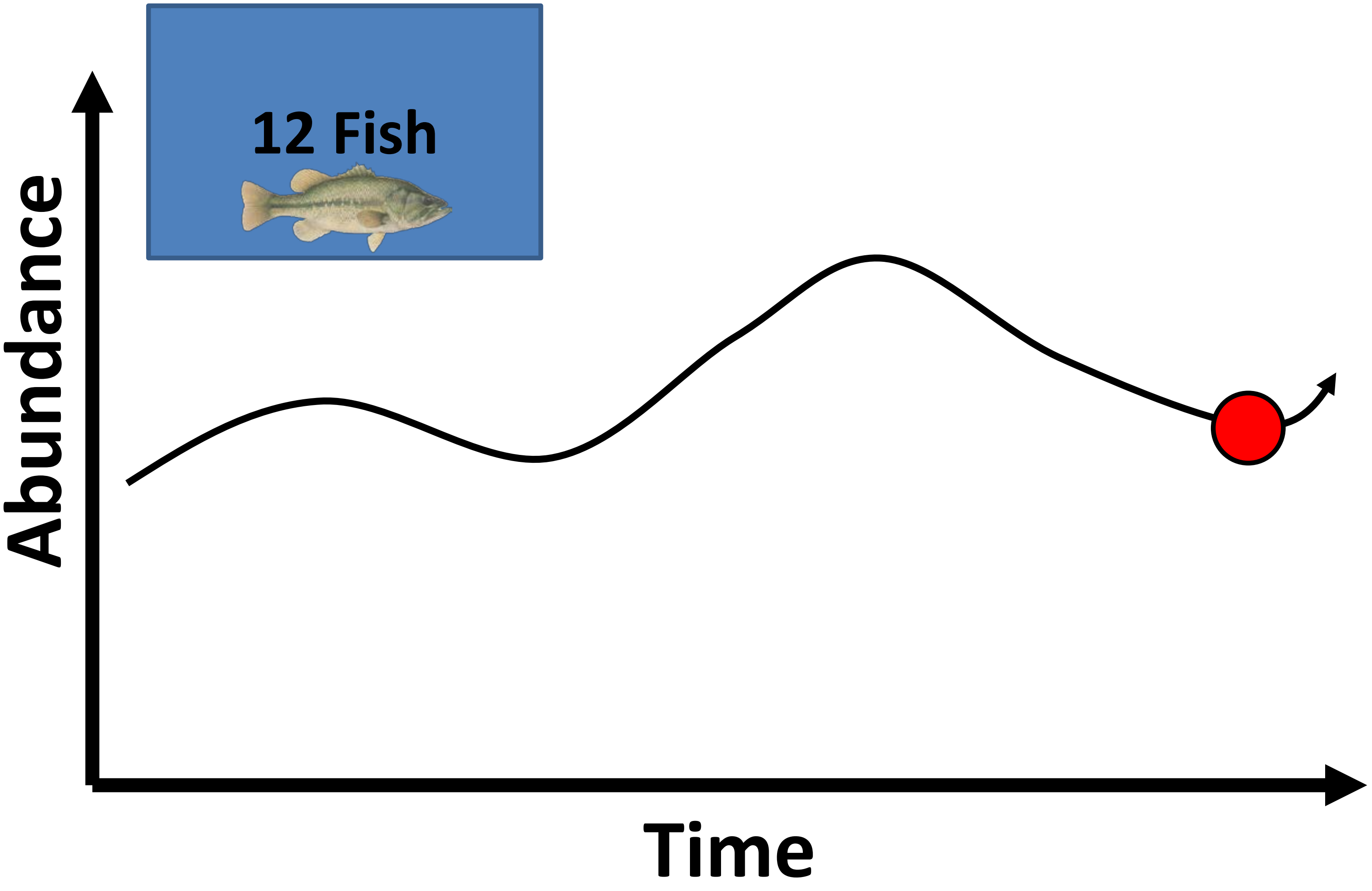
2019



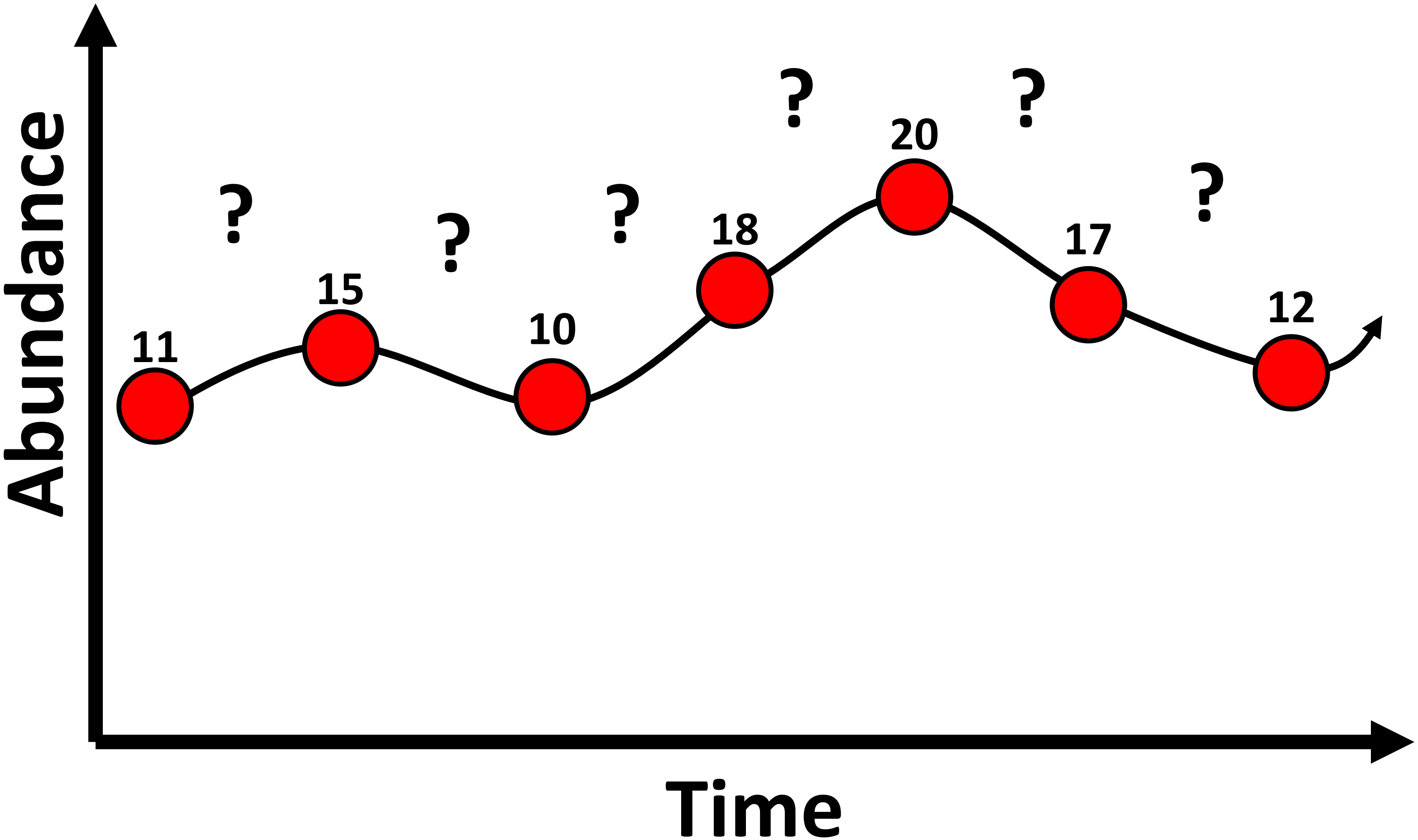
2020



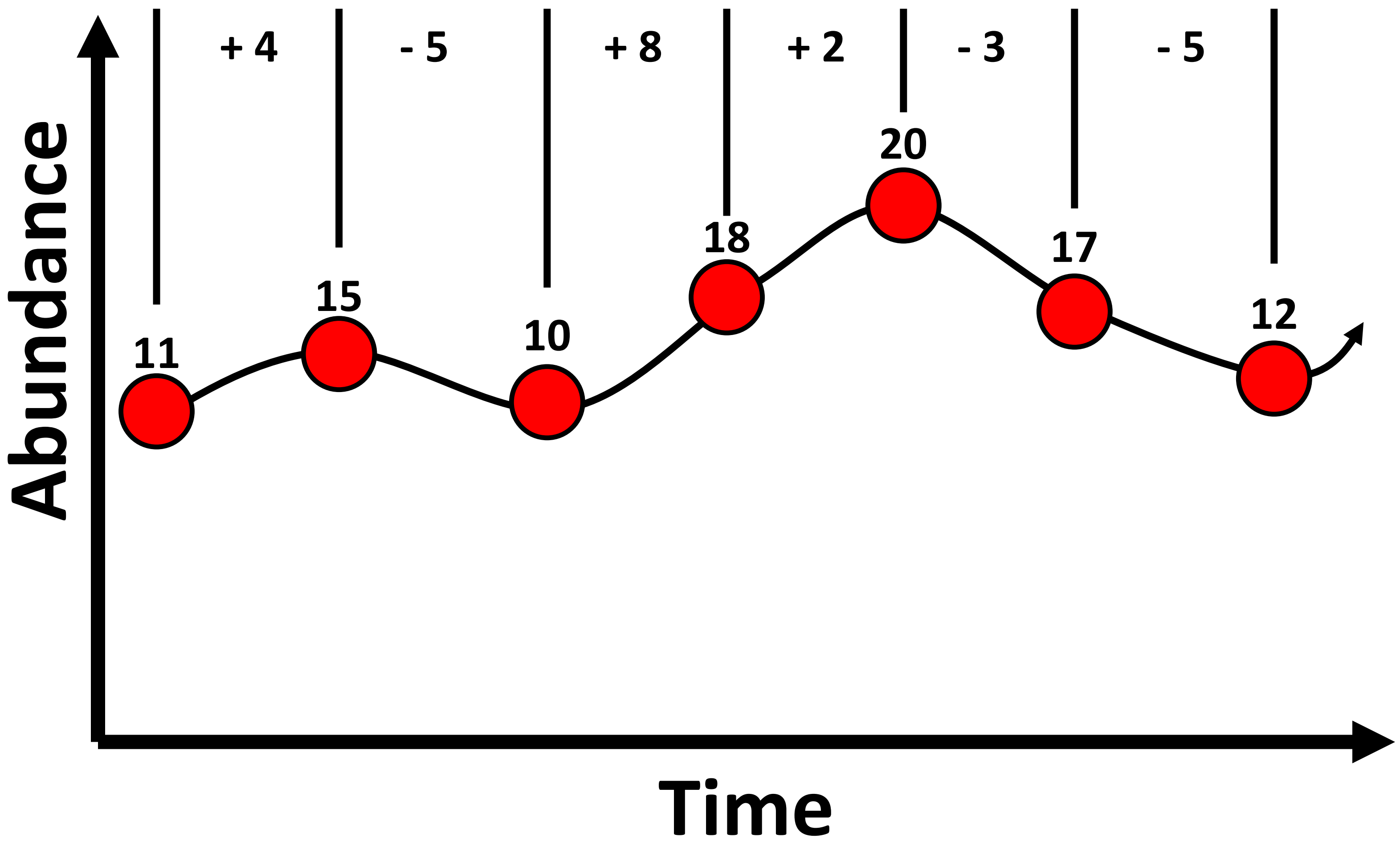
2021



2015 ... 2021



Change in population abundance over time



Year	Abundance	$Abundance_{year+1}$-$Abundance_{year}$
2015	11	4 = 15-11
2016	15	-5 = 10 - 15
2017	10	3 = 18-10
2018	18	2 = 20-18
2019	20	3 = 17-20
2020	17	-5 = 12-17
2021	12	? = ?-12

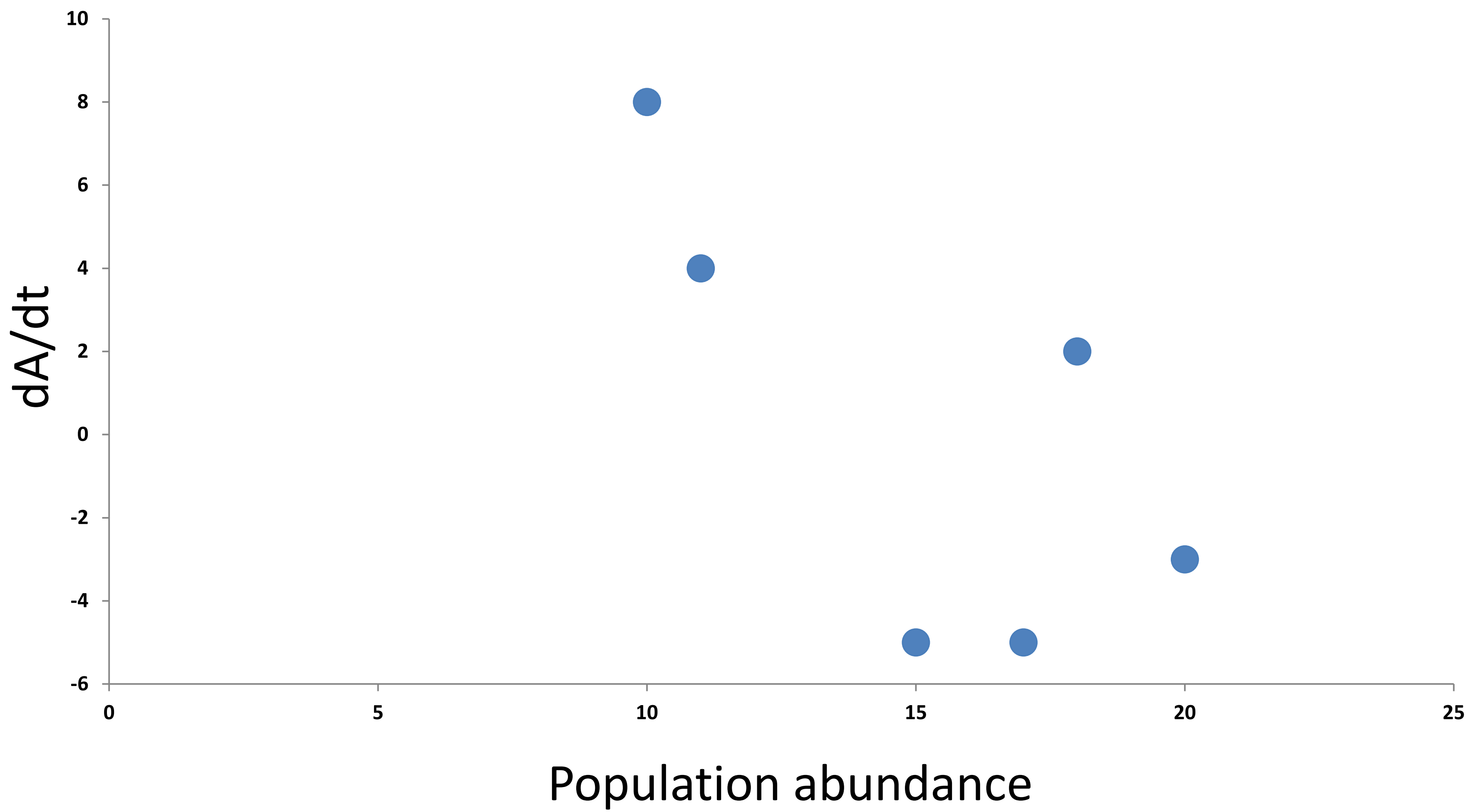
Population changes (gains & losses)

Year	Abundance	$Abundance_{year+1}$-$Abundance_{year}$
2015	11	4 = 15-11
2016	15	-5 = 10 - 15
2017	10	3 = 18-10
2018	18	2 = 20-18
2019	20	3 = 17-20
2020	17	-5 = 12-17
2021	12	? = ?-12

Year	Abundance	Abundance$_{year+1}$-Abundance$_{year}$
2015	11	4 = 15-11
2016	15	-5 = 10 - 15
2[illegible]	[illegible]	[illegible]
2[illegible]	[illegible]	[illegible]
2019	20	3 = 17-20
2020	17	-5 = 12-17
2021	12	? = ?-12

$$\frac{dAbundance}{dt} = Abundance_{year+1} - Abundance_{year}$$

Independent or dependent?



These are 'net changes' in the population over time

Year	Abundance	$Abundance_{year+1}$-$Abundance_{year}$
2015	11	4 = 15-11
2016	15	-5 = 10 - 15
2017	10	3 = 18-10
2018	18	2 = 20-18
2019	20	3 = 17-20
2020	17	-5 = 12-17
2021	12	? = ?-12

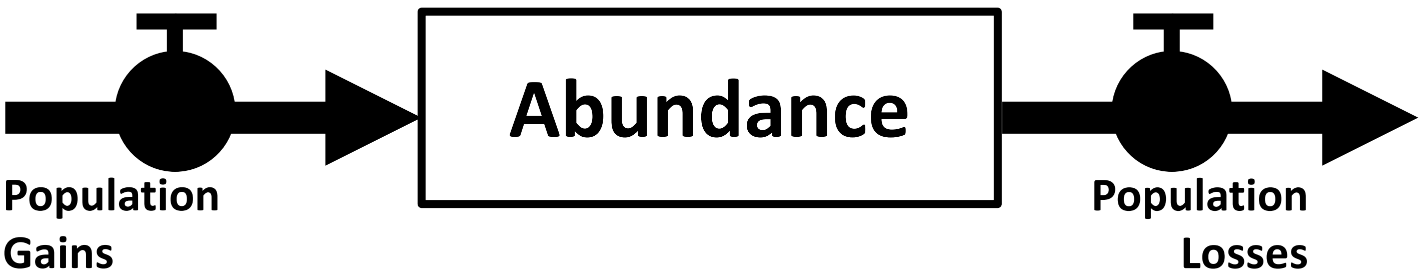
Gains and losses

Reflect the balance of population gains and losses

Year	Abundance	$Abundance_{year+1} - Abundance_{year}$
2015	11	4 = 15-11
2016	15	-5 = 10 - 15
2017	10	3 = 18-10
2018	18	2 = 20-18
2019	20	3 = 17-20
2020	17	-5 = 12-17
2021	12	? = ?-12

Gains and losses

Population dynamics in a nutshell:



$$\frac{dAbundance}{dt} = gains - losses$$