Learning to live with invasive species we cannot control

John M. Randall

Global Invasive Species Team

&

jrandall@tnc.org

http://tncweeds.ucdavis.edu

Yellow starthistle (*Centaurea solstitialis*)


Red brome (*Bromus madritensis* ssp. *rubens*)

Cheat grass (*Bromus tectorum*),
Dinosaur National Monument, Utah


CALIFORNIA REPUBLIC

Assessment
Prevention
Early Detection
Control & Restoration
(& Learning to Live With The Incorrigibles)

Continental **Ecoregion** **Landscape** **Small Park**

Assessment
Prevention
Early Detection
Control & Restoration

(Learning to Live With The Incorrigibles)

Continental **Ecoregion** **Landscape** **Small Park**

Four General Approaches

1. **Provide native species with refugia from invasive species or otherwise mitigate their harmful effects (e.g. predation, competition, disease)**

2. **Manage/restore ecosystem processes that favor natives (e.g. fire, hydrology)**

3. **Identify individuals/populations of native species with increased abilities to compete with or persist alongside the invasive species and use propagules in restoration efforts**

4. **Change the conservation goal from restoration of a pre-existing community to the 'rehabilitation' of a portion of that community or even to a 'new' mixed community of native and non-native species with desirable ecosystem functions and properties possible.**

1. **Provide native species with refugia from invasive species or otherwise mitigate their harmful effects (e.g. predation, competition, disease)**

Passer domesticus
(House sparrow)

Sialia sialis
Eastern bluebird

Helping Birds in Nest Boxes

http://www.prbo.org/cms/index.php?mid=186&module=browse

	Entrance hole dimension (inches)	# Eggs laid	Color of eggs	Incubation Period(# days until hatch)	Chick Period(#days in box)
Ash-throatedFlycatcher	1 ½	4-5	Creamy white, blotched with lavender and brown.	15	14-16
Bewick's Wren	1 ¼	5-7	White, flecked with brown and/or purple.	12-14	14
Black-capped Chickadee	1 ¼	6-8	White with fine, reddish-brown spots.	12-13	16
Chestnut-backed Chickadee	1 ¼	6-8	White or cream in color; sometimes unmarked, or speckled reddish brown and brown.	12-14	22-23
House Sparrow(Undesirable: invasive, non-native)	1 1/4	4-6	Dull gray with brown spots.	10-13	14-17
House Wren	1 ¼	6-8	White (may be tined pink or gray); profusely marked with lavender and/or brown spots.	13	12-18
Mountain Bluebird	1 9/16	5-6	Glossy, pale blue.	13	18-21
MountainChickadee	1 ¼	5-7	White with reddish dots	12-14	18-21
Oak Titmouse	1 ¼	6-8	White; unmarked or faintly marked with reddish brown.	14-16	16-21
Tree Swallow	1 ½	4-6	White (may be pinkish)	13-16	20
Violet-greenSwallow	1 ½	4-6	White (may be pinkish).	13-14	16-24
Western Bluebird	1 9/16	4-6	Light blue.	13-14	17-18
White-breasted Nuthatch	1 ¼	5-8	White, pinkish-white, or cream-colored; heavily spotted with reddish brown, brown, or purplish-red.	12	14

Felis catus

Vulpes vulpes

Sminthopsis murina
(Common Dunnart)

Antechinus flavipes
*(***Yellow-footed Antechinus***)*

Stokes, Pech, Banks and Arthur. 2004.
Foraging behavior and habitat use by *Antechinus flavipes* and *Sminthopsis murina* (Marsupiala: Dasyuridae) in response to predation risk in eucalypt woodland.
Biological Conservation 117: 331-342.

1. Refuge from predation: ground level wire netting.

2. Native marsupials foraged preferentially under the netting.

…Not yet known if predation rates decline, or if native species survival rates increase

Dactylanthus taylorii

***Dactylanthus taylorii* Recovery Plan, NZ DOC**

Himantopus novaezelandiae

Kaki (black stilt)

Recovery plan 2001–2011

	Phase 1	Preformance Measure	Phase 2
By 2001	Maximize number of pairs Maximize number of chicks	Produce 78 chicks per year Recruit 11-16 young per year to adult population	Continue with chick mortality research
By 2005	Maximize fertility Maximize survival rates of released Kaki Reduce mortality rate of captive chicks		Chick mortality is mitigated Causes of adult mortalityare identified and controlled Best Techniques for predatorcontrol are in use
By 2006	Complete implementation of extra 10 aviary spaces Complete assessment of disease risk duringtransfer		Wild recruitments ratesare better than 50% Annual adult mortalityis less than 10%
By 2007		Produce 123 chicks per year Recruit up to 80 young per year to adult population	Exess chicks are returned to wild pairs

Goal: By 2011 - Kaki population is more that 2500 inderviduals, recuitments exceeds adult mortality

Houbara bustard

(*Chlamydotis undulata*)

Van Heezik, Seddon & Maloney. 1999. Animal Conservation

Griffin, Blumstein & Evans. 2000. Conservation Biology.

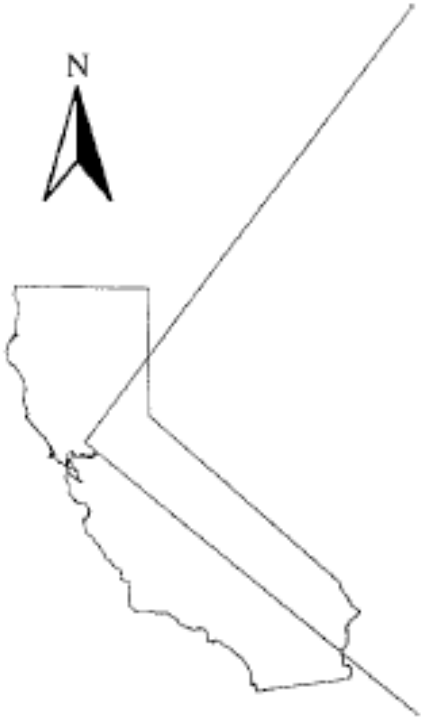
Blumstein. 2006. Ethology

2. **Manage/restore ecosystem processes that favor natives (e.g. fire, hydrology)**

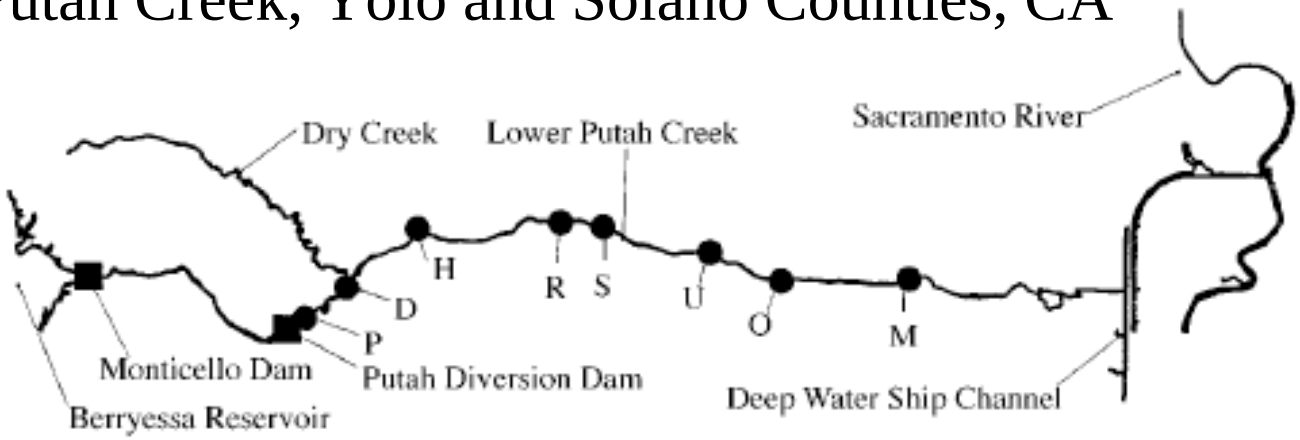
Marchetti and Moyle. 2001.

Effects of flow regime on fish assemblages in a regulated California stream

Ecological Applications 11: 530-539



Putah Creek, Yolo and Solano Counties, CA



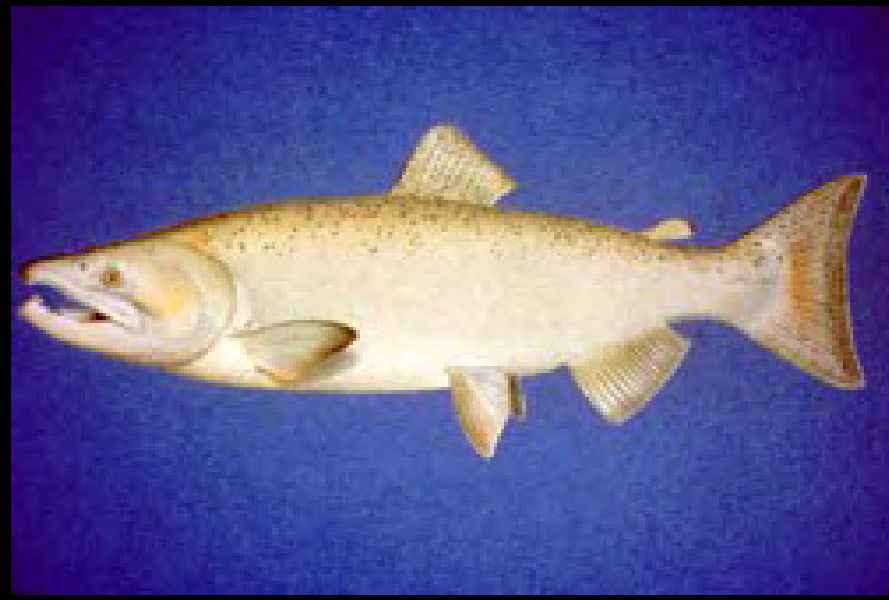
Sampled fish over 5 years

-Two unusually dry years (1994, 1995)

-Two unusually wet years (1997, 1998)

Native

Hesperoleucus symmetricus
California roach



Oncorhynchus tshawytscha
Chinook salmon

Hysterocarpus traski
tule perch

Ptychocheilus grandis
Sacramento pikeminnow

Non-native

Salmo trutta
Brown trout

Gambusia affinis
Western mosquitofish

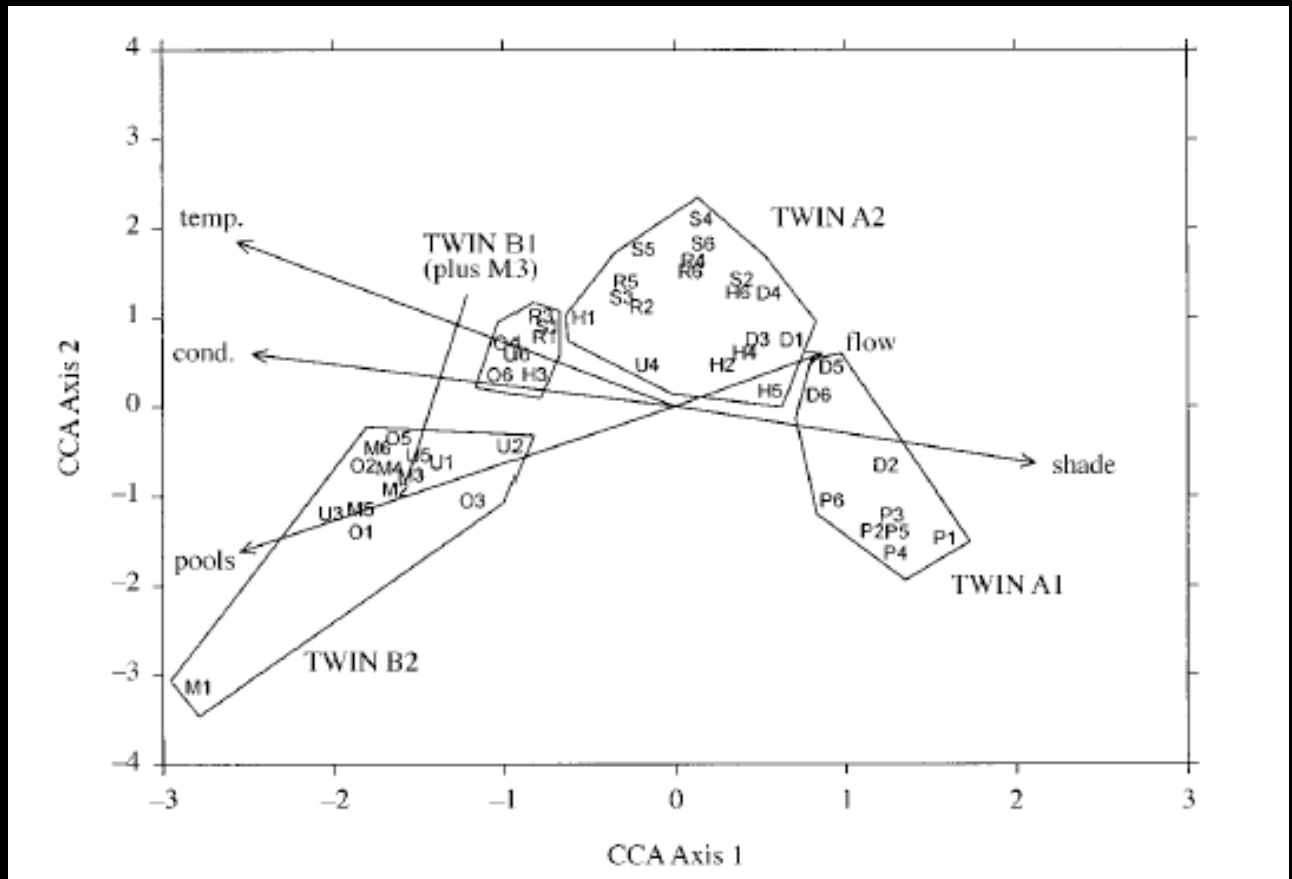
Lepomis macrochirus
bluegill

Morone saxatilis
Striped bass

Marchetti and Moyle (2001)

Results:

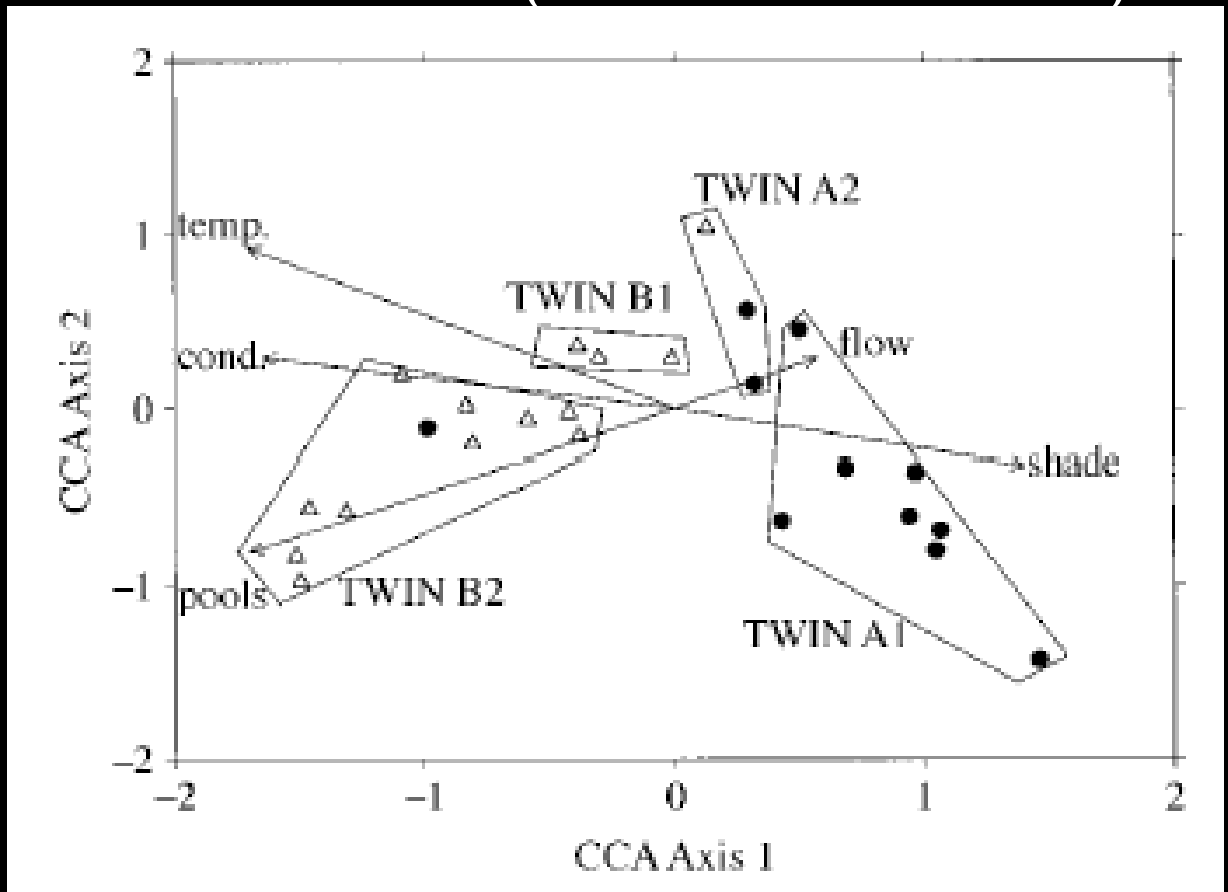
1. During wet years downstream site conditions became similar to upstream conditions.



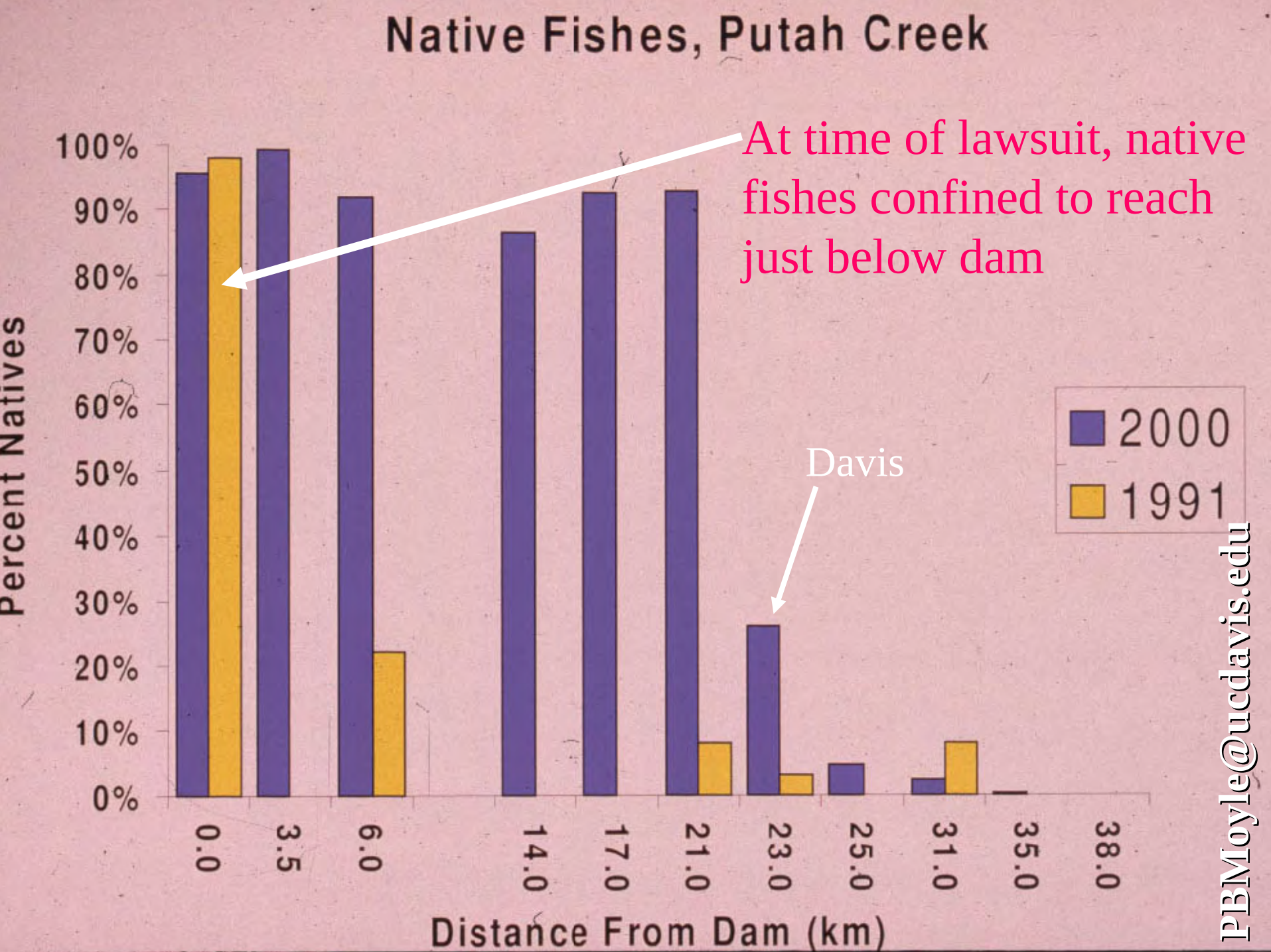
Marchetti and Moyle (2001)

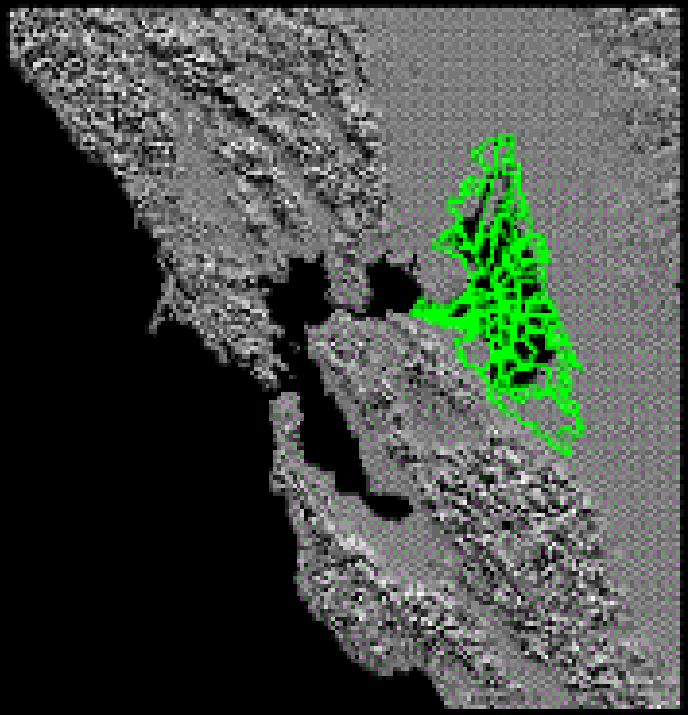
Results:

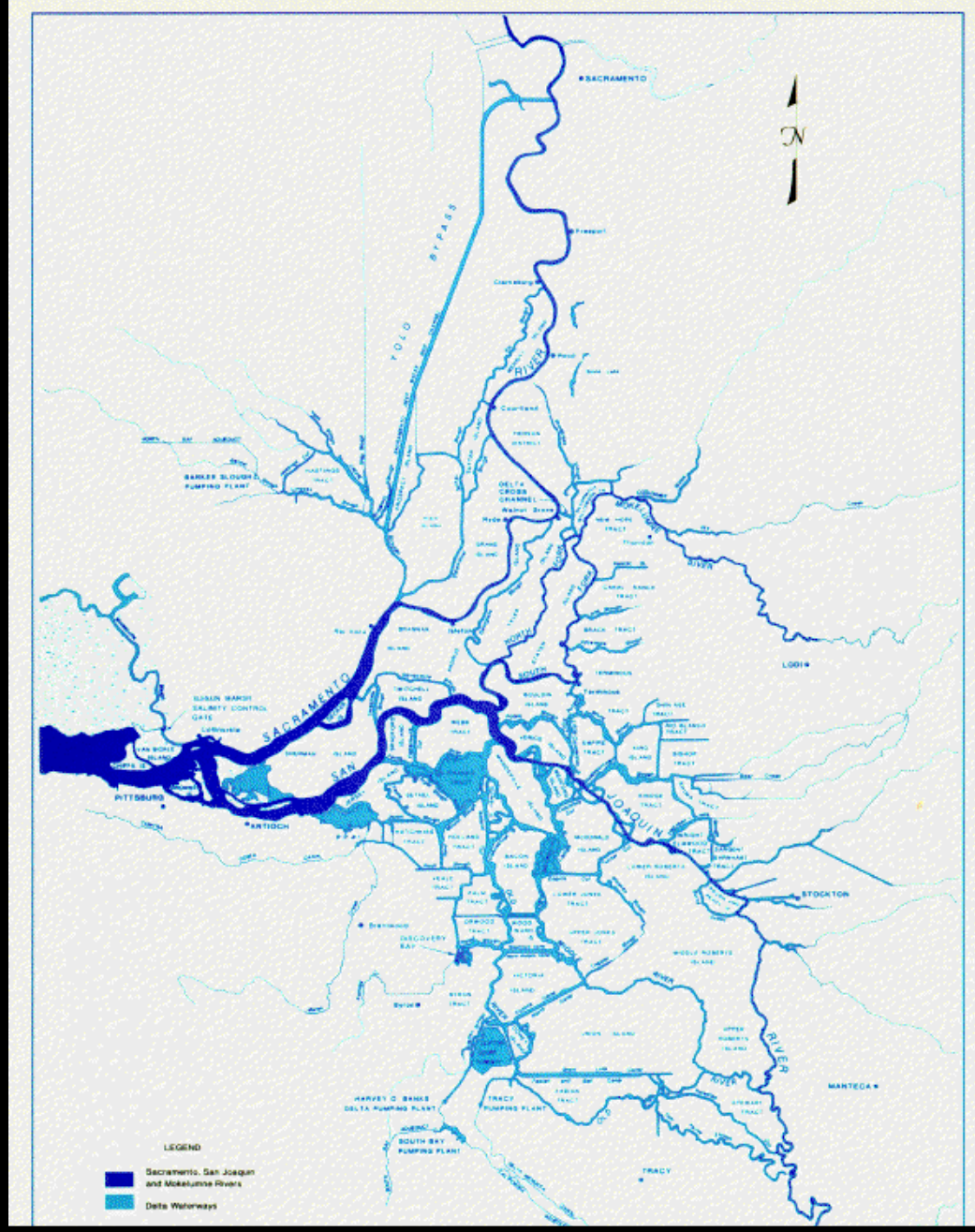
2. Fish community composition changed at downstream sites (non-native ---> native).



Native (solid circle) and non-native species (open triangle)


Native Fishes, Putah Creek
At time of lawsuit, native fishes confined to reach just below dam
Davis
2000
1991
Percent Natives
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.0
3.5
6.0
14.0
17.0
21.0
23.0
25.0
31.0
35.0
38.0
Distance From Dam (km)
PBMoyle@ucdavis.edu





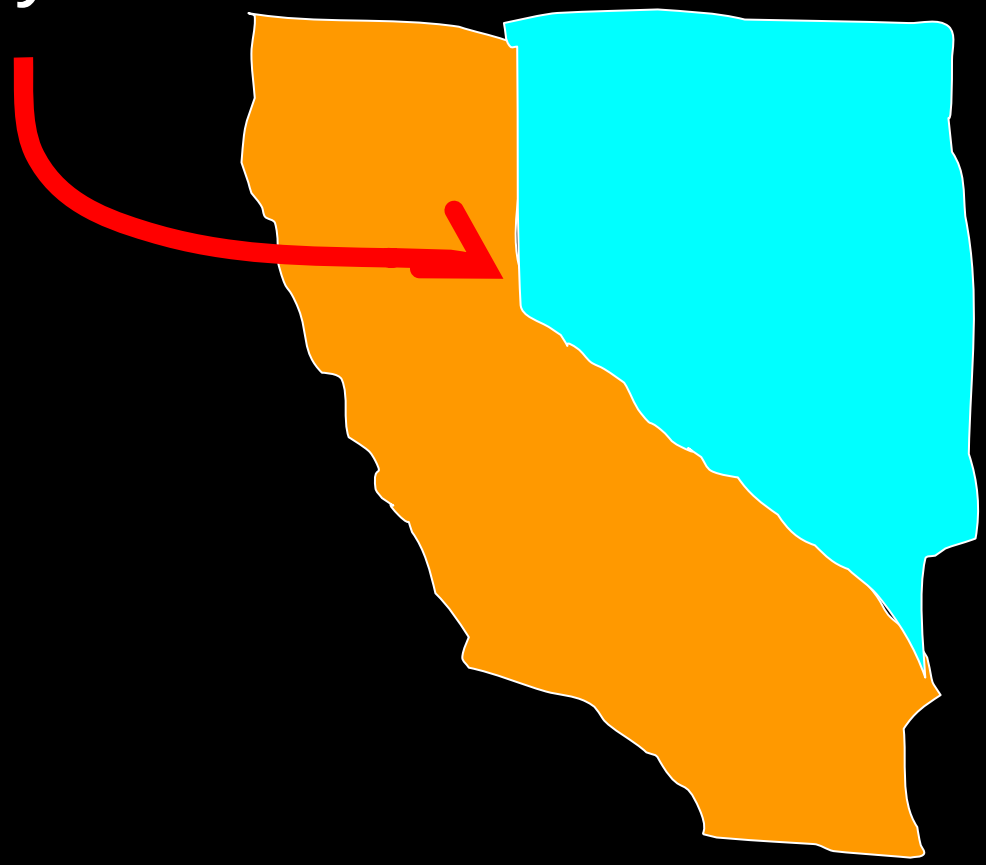
Sacramento – San Joaquin Delta

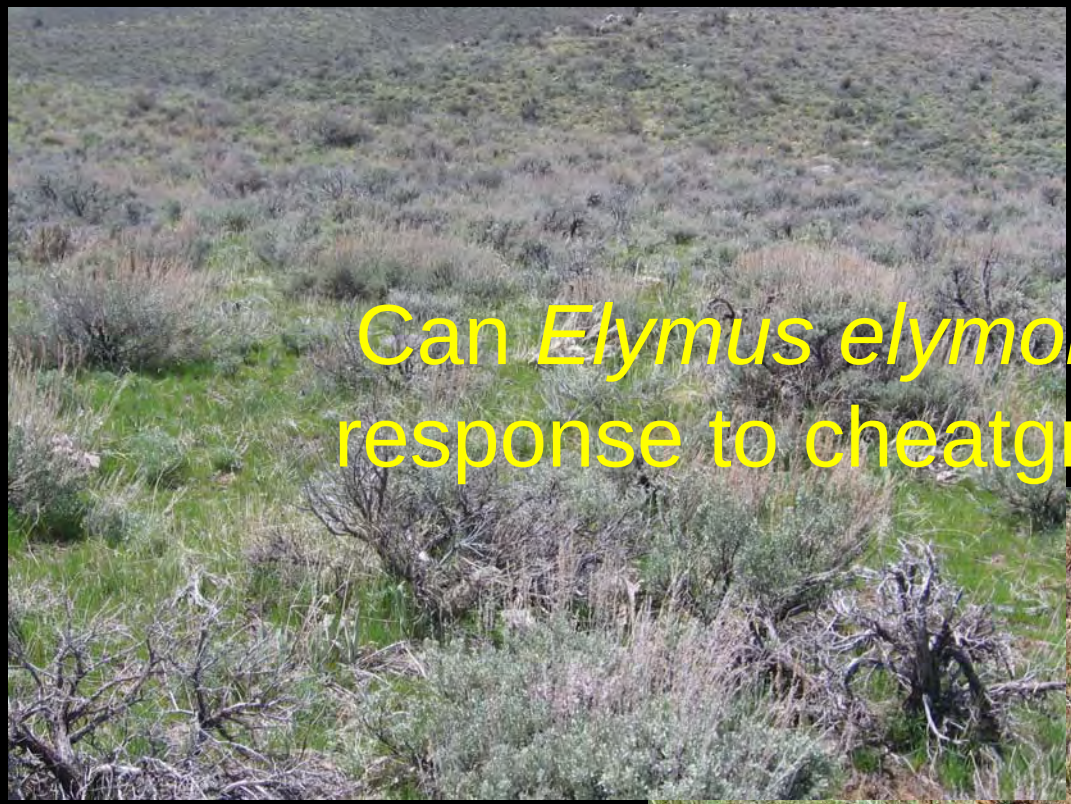
Prescribed fire kills invasive vines, restores sandhill pinelands

3. **Identify individuals/populations of native species with increased abilities to compete with or persist alongside the invasive species and use propagules in restoration efforts**

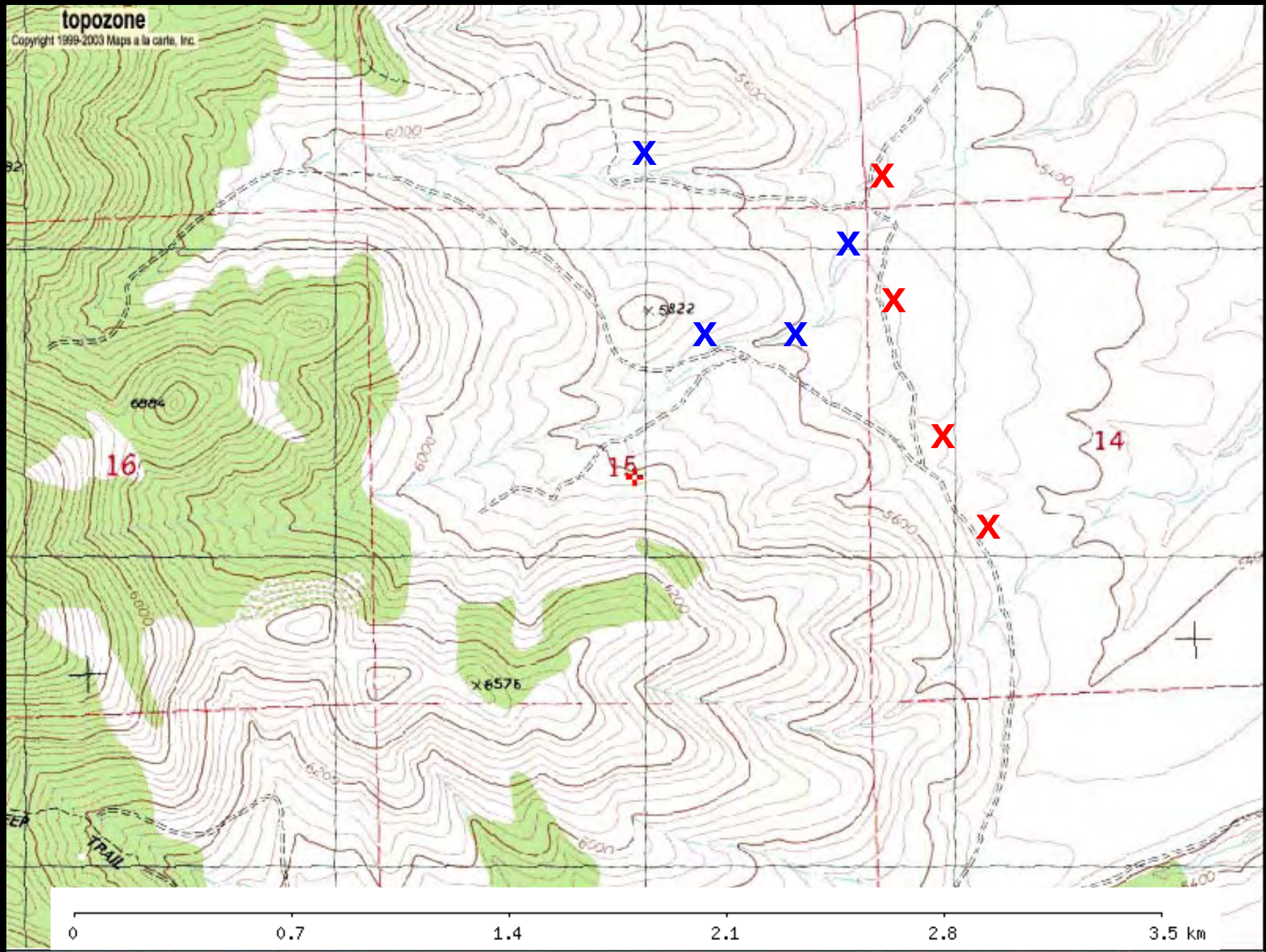
Pilot study
Beth Leger, U. Nevada, Reno

Balls canyon



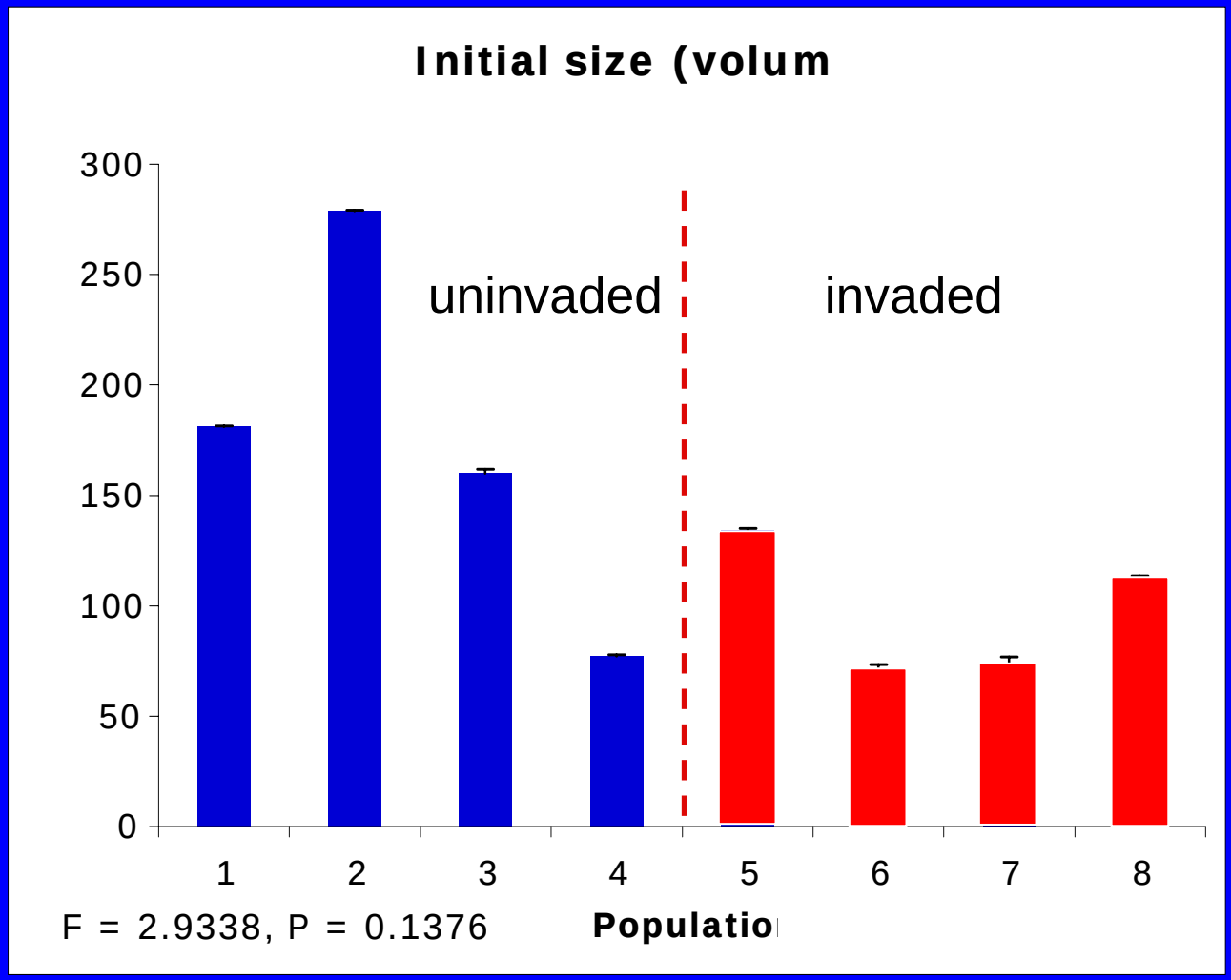


Can *Elymus elymoides* evolve in response to cheatgrass invasion?

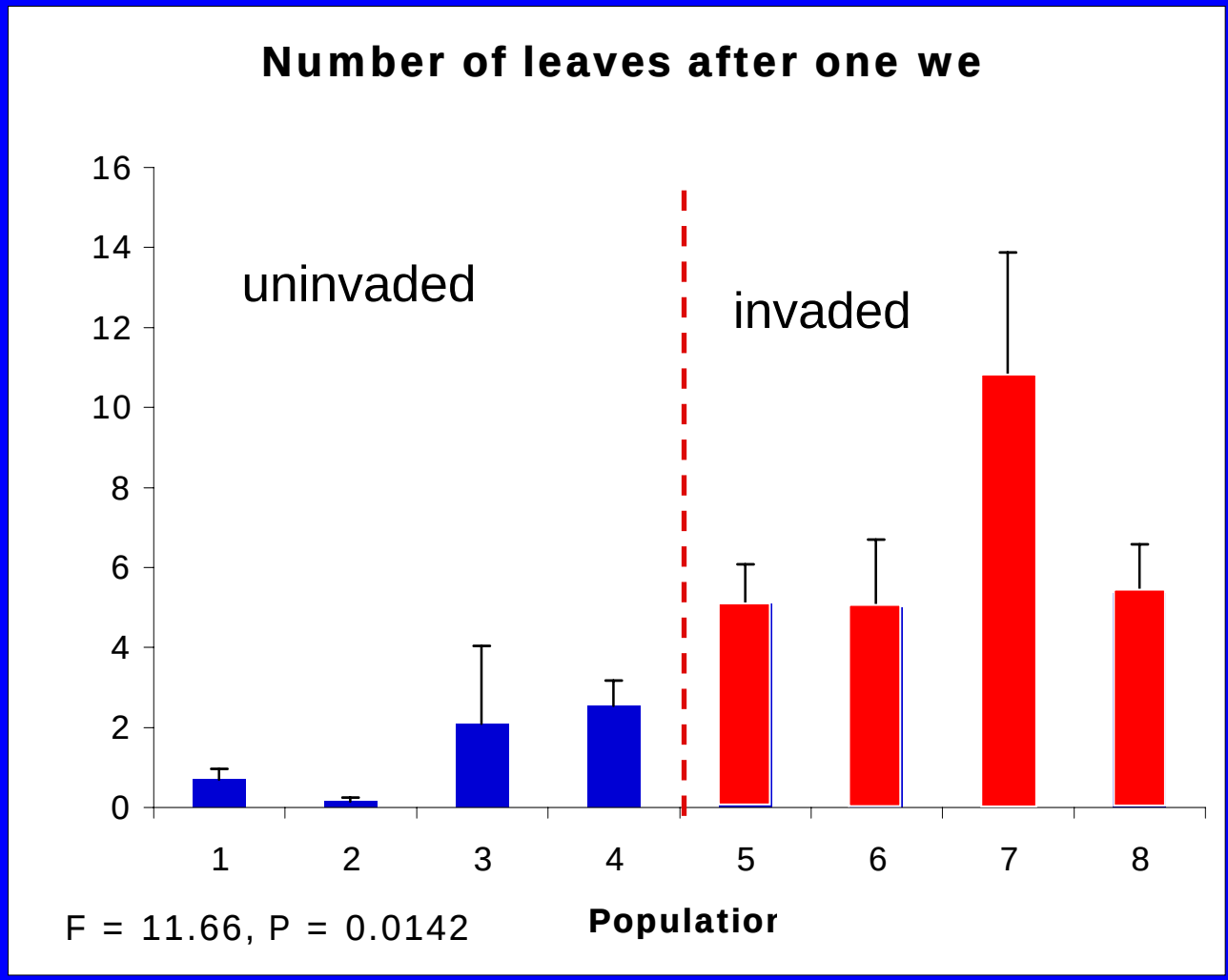

topozone
Copyright 1999-2003 Maps a la carte, Inc.
6000
5822
6884
16
15
14
6576
TRAIL
0
0.7
1.4
2.1
2.8
3.5 km

Methods

- Collect 10 individuals from 8 locations
- Split individuals in half
- Treat one half of each individual (a pot) with cheatgrass (~100 seeds)

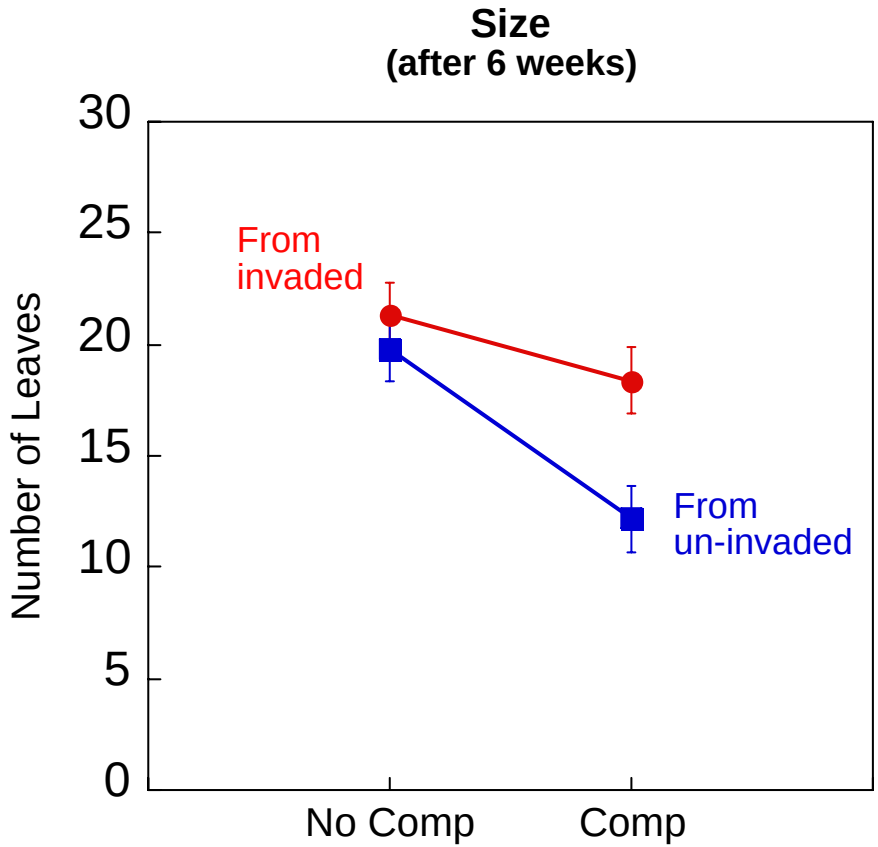


Beth Leger, eleger@cabnr.unr.edu



Beth Leger, eleger@cabnr.unr.edu

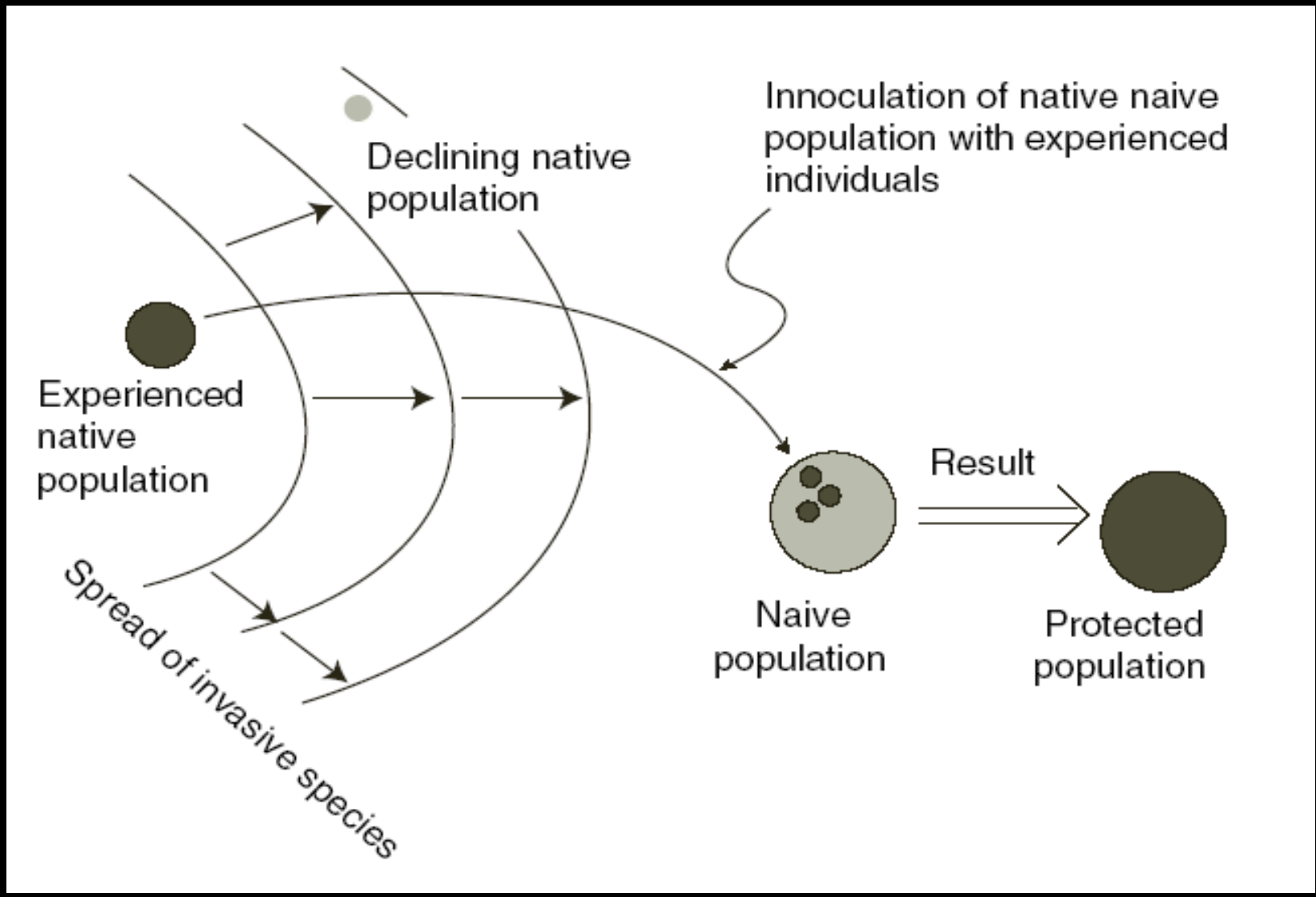
Plants collected from invaded sites do better under competition



Comp: $P = 0.0004$
Interaction: $P = 0.0884$

Also see:
Nasri and Doescher. 1995
J. Range Management……

Beth Leger, eleger@cabnr.unr.edu



Schlaepfer, Sherman, Blossey and Runge. 2005. Introduced species as evolutionary traps. Ecology Letters 8: 241-246

4. **Change the conservation goal from restoration of a pre-existing community to the ‘rehabilitation’ of a portion of that community or even to a ‘new’ mixed community of native and non-native species with desirable ecosystem functions and properties possible.**

Hawaii Volcanoes National Park

lava crosses road and meets the sea

Dry forest invaded by fire-promoting grasses

Table 1. Fire history at Hawai'i Volcanoes National Park, 1924–1995.

Years	Human-caused		Lava-caused		Other causes		Total fires (*n*)
	n	Area (acres)	*n*	Area (acres)	*n*	Area (acres)	
1924–1931	8	38	0	0	0	0	8
1932–1939	6	124	0	0	0	0	6
1940–1947	11	2	0	0	0	0	11
1948–1955	4	50	0	0	0	0	4
1956–1963	3	1	3	198	0	0	6
1964–1971[a]	3	1,686	4	2,716	1	215	8
1972–1979[b]	15	2,211	5	5,063	1	1	21
1980–1987	29	3,327	5	1,184	5	10,942	39
1988–1995	8	4,407	16	2,325	5	395	29

[a] First fire in broomsedge/beardgrass fuels during 1969.
[b] Goats controlled in park lowlands during 1972.

Tunison, D'Antonio and Loh. 2002
Fire and invasive plants in Hawai'I Volcanoes National Park

Site type	Common name (Hawaiian)	Scientific name
Seasonal woodland	ʻAʻaliʻi	*Dodonaea viscosa*
	ʻEmoloa	*Eragrostis variabilis*
	Heupueo	*Agrostis avenacea*
	ʻIliahi	*Santalum paniculatum*
	Kupaoa	*Dubautia ciliolata*
	Koʻokoʻolau	*Bidens hawaiiensis*
	Kolea	*Myrsine lanaiensis*
	Mamane	*Sophora chrysophylla*
	Naio	*Myoporum sandwicense*
	Neleau	*Rhus sandwicensis*
	Naupaka kīlauea	*Scaevola kilaueae*
	ʻOhelo	*Vaccinium reticulatum*
	Pawale	*Rumex skottsbergii*
	Pua kala	*Argemone glauca*
	ʻUlei	*Osteomeles anthyllidifolia*
Coastal	ʻAwikiwiki	*Canavalia hawaiiensis*
	Pili	*Heteropogon contortus*
	Konakona	*Panicum nephelophilum*
	Kaioio	*Panicum pellitum*
	ʻIlima	*Sida fallax*
	ʻOhai	*Sesbania tomentosa*

Tunison, D'Antonio and Loh. 2002

Myoporum sandwicense; fire tolerant native, seasonal woodland

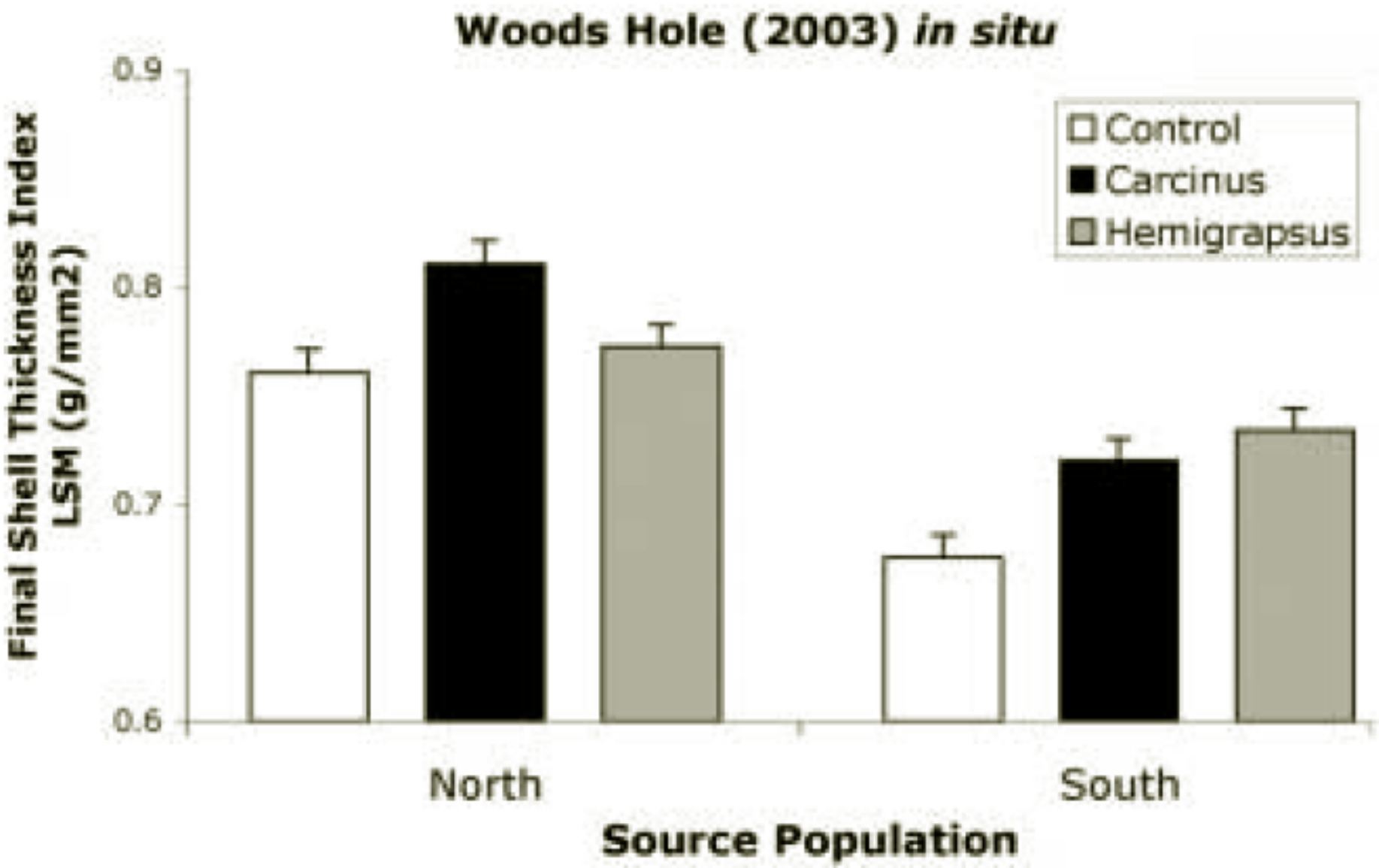
Sesbania tomentosa; fire tolerant native, coastal vegetation

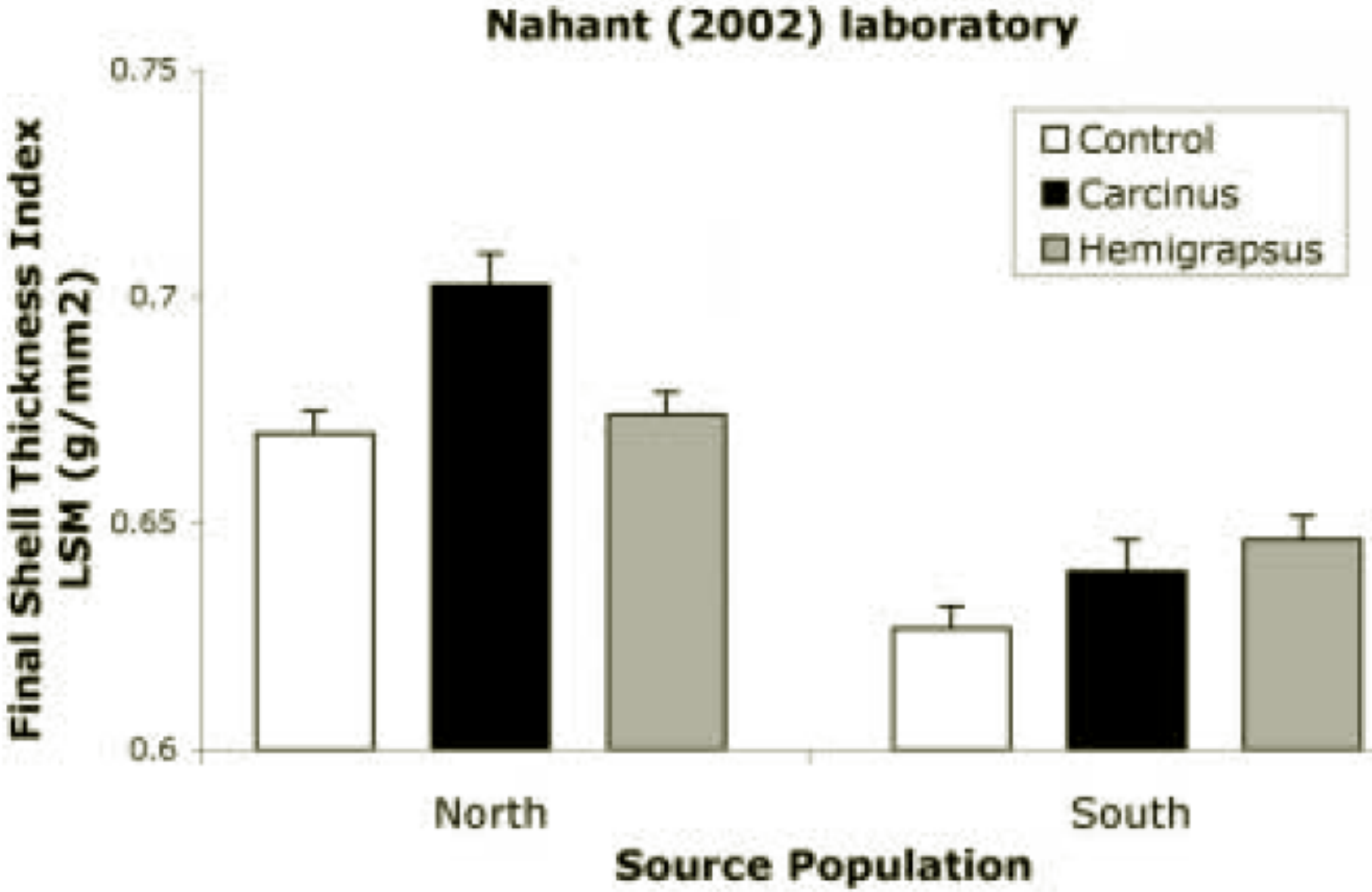
1. We cannot control some invaders.

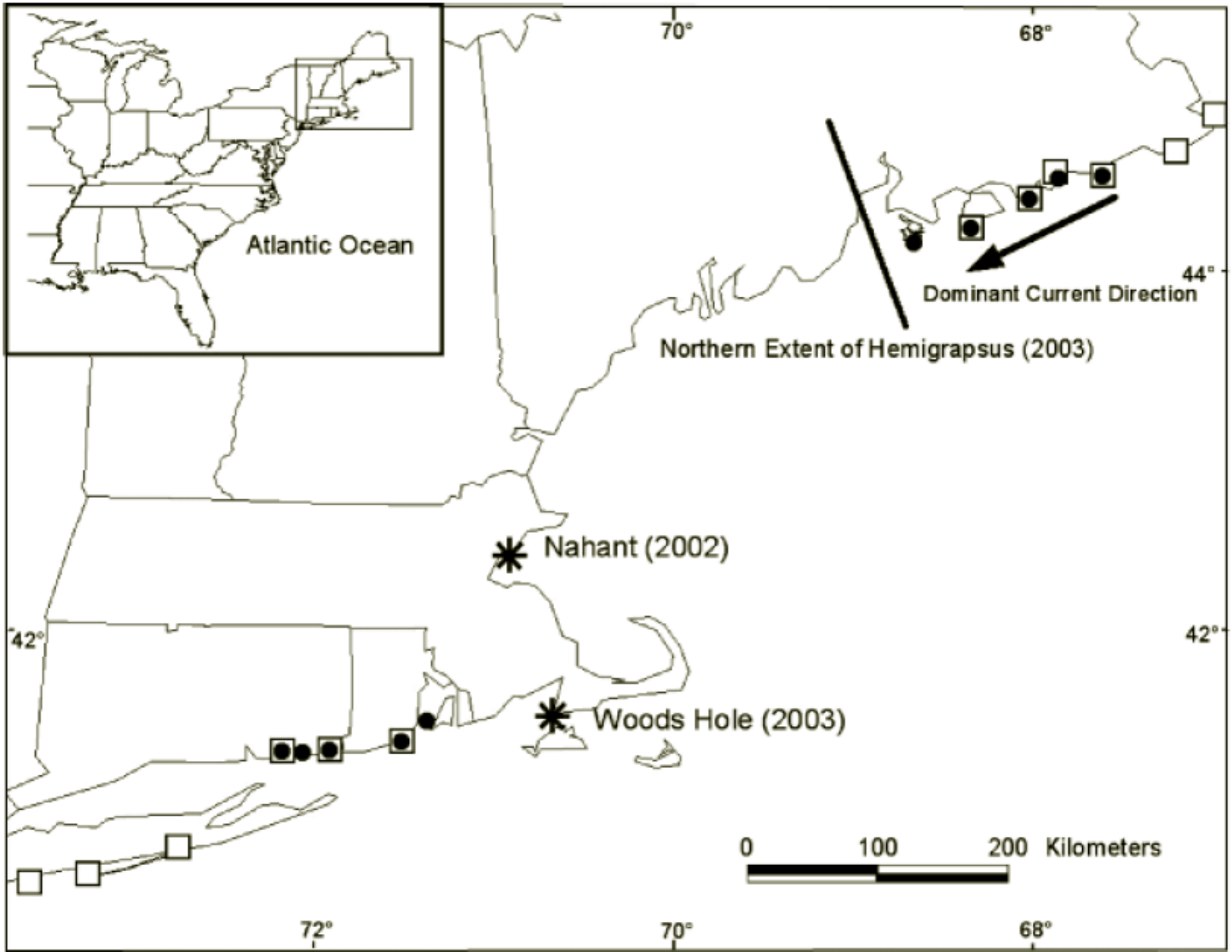
2. Need to develop more systematic approach to promoting/maintaining native species and communities (conservation targets) in these situations.

3. Some research and applications underway already, topic offers opportunity for exciting applied and theoretical research.

BIRD FLU HITS TRAILER PARK IN FLORIDA


Woods Hole (2003) in situ
Final Shell Thickness Index LSM (g/mm2)
0.9
0.8
0.7
0.6
Control
Carcinus
Hemigrapsus
North
South
Source Population


Nahant (2002) laboratory
Final Shell Thickness Index LSM (g/mm2)
0.75
0.7
0.65
0.6
Control
Carcinus
Hemigrapsus
North
South
Source Population


Atlantic Ocean
70°
68°
44°
Dominant Current Direction
Northern Extent of Hemigrapsus (2003)
Nahant (2002)
42°
42°
Woods Hole (2003)
0
100
200 Kilometers
72°
70°
68°