Managing Habitat to Benefit California Red-legged Frog (CRF)

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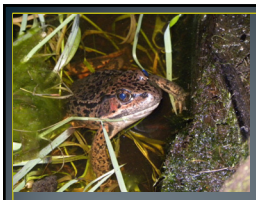
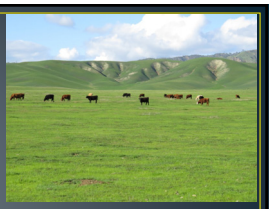


BIOGRAPHY

Trish Tatarian, MSc

Researcher (published) 10 years:
Radio-telemetry
Bd occurrence in Sierran populations
Genetic occurrence of Sierran populations
Biological consultant >20 years

BIOGRAPHY



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ADDITIONAL INFORMATION

WWW.ELKHORNSLOUGHCTP.ORG

See:
Bibliography
Peer-reviewed papers

CRF?

Pond A

Pond B

Both?

WORKSHOP OVERVIEW

- Gain a more complete understanding of the biological requirements of the species.
- Identify key components of occupied CRF habitat in a variety of situations, from man-made ponds, to in-stream pools, as well as upland habitats.
- Identify management strategies and solutions used to enhance aquatic and upland habitats to benefit the species.
- Use case examples and success stories to apply effective management strategies and solutions.

TOPICS COVERED

Management Objectives
Biology
Characteristics of Occupied Ponds
Design and Management of Ponds
Management of Habitats
Control of Invasive Species
Planning at the Landscape Level
Regulatory Requirements

IMPORTANT MANAGEMENT OBJECTIVES

- Manage populations, not individuals
- Focus on breeding habitat vs. adult habitat – more bang for your buck
- Set clear management and monitoring goals

MANAGEMENT

Definitions

- Stewardship – looking after a population
- Manipulative – direct (headstarting young) or indirect (altering habitat or predators)
- Custodial – protective

(Caughley and Sinclair 1994)

MANAGEMENT

Some Key Management Questions:

- What are the threats to CRF in the region and project area?
- How can the site be managed to increase or maintain CRF populations at local and regional level?
- What management practices are currently being used on the site - are they compatible with CRF?

MANAGEMENT

Some Relevant Elements Within a Management Plan:

- Maintenance/restoration of a suitable water body.
- Protection of buffer zones of natural vegetation to protect core breeding sites and refugia.
- Protection of integrity of ecological connectivity among wetlands in the landscape.
- Identify and resolve conflicts between current management practices and CRF.

(Semlitsch 2000)

MANAGEMENT

REGULATORY AGENCIES

USFWS

CDFW
ACE
RWQCB

BIOLOGY

Annual Cycle

Year 1
December-April.....Calling and Egg Laying
January-September….....Tadpole Stage*
June-September.....Metamorphs Appear*
June-December.....Juvenile Period

Year 2
Juvenile Period

Year 3
December-April.....First Breeding
(males and some females)

BIOLOGY

Survivorship

Stage	Age (months)	Survival	Number of Individuals
Egg>>metamorph	0-5	1-5%**	125
Metamorph>> juvenile	5-12	10%	12.5
Juvenile>>adult	12-24	25%	~3.12
Adults	24-80	~33%/yr	1

BIOLOGY

Breeding Habitat

BIOLOGY

Upland Habitat

Terrestrial prey - 90% of total prey items (Bishop 2011)

BIOLOGY

Adult Dispersal Habitat

Most do not move far

Movement between aquatic habitats

Escape adversity

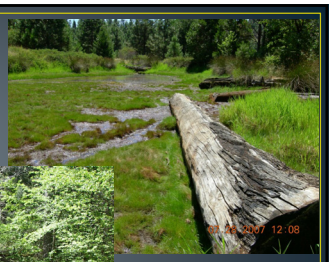
Move in damp conditions (first rains)

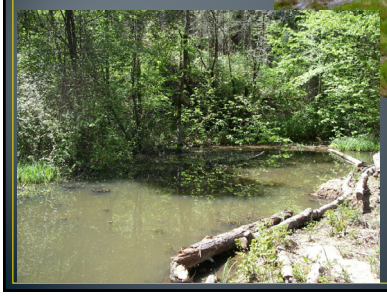
Move at night

Rarely use corridors

BIOLOGY

Metamorph Habitat





?

BIOLOGY

Physiology of Anurans

Majority of water loss is through the skin.

Reabsorption through the ventral pelvic region.

The larger the size the greater the distance travelled between aquatic sites.

Small amphibians have proportionately more surface area and, therefore, have higher rates of evaporative loss.

(*Wells 2007*)

CHARACTERISTICS OF PONDS OCCUPIED BY CRF

POND CHARACTERISTICS

Breeding Ponds

Lentic habitats that provide aquatic breeding and non-breeding habitat.

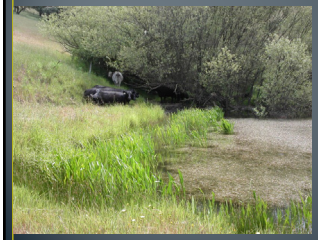
Coastal

Inland

Sierran

POND CHARACTERISTICS

Coastal Ponds



POND CHARACTERISTICS

Inland Ponds

POND CHARACTERISTICS

Sierran Ponds

POND CHARACTERISTICS

Coastal and Inland Ponds

		San Mateo Co (Reis 1999)	Recovery Plan (USFWS 2002)	Santa Cruz Co (Bulger et al 2003)	Sonoma Co (Cook and Jennings 2007)	Marin Co (Fellers and Kleeman 2007)	Contra Costa Co (Tatarian 2008)
Elevation (m)		0-10	<1,050	0-300	476	43	113
Surrounding Vegetation communities		Freshwater and brackish marsh, ponds and riparian	Variety	Redwoods and mixed conifer - hardwood	Mixed hardwood conifer	Grasslands and riparian	Grasslands and oak savanna
Water depth (m)		0.05-0.75	>0.7	NA	1.5	0.75-1.5	0.6-1.8
Pond Size (m^2)			NA	NA	110,000	0.5-2(6)	0.33 -0.8
Habitat	Pool (instream)	√	√				√
	Pond (isolated)	√	√	√	√	√	
Hydrology	Perennial	√	√	√		√	√
	Intermittent	√	√	√	√	√	√
Emergent/ shoreline	Dense (>25%)	√			√	√	
	Limited (<25%)						√
Fish	Native	√					
	Introduced						
Bullfrogs		√	√		√		

POND CHARACTERISTICS

Sierran Ponds

		Butte Co Hughes	Nevada Co Sailor Flat	El Dorado Co Spivey	Placer Co Big Gun	El Dorado Co Bear Creek	Little Oregon Creek
Elevation (m)		772	929	979	1014	792	624
Surrounding Vegetation communities		Montane hardwood conifer	Montane hardwood conifer	Sierran mixed conifer	Ponderosa pine/Mixed chaparral	Montane hardwood conifer	Montane hardwood conifer
Water depth (m)		0.3 – 1.4 m	1->2.5	1->2.5	1->2.5	1->2.5	<1
Pond Size (acres)		0.25	0.25	1.5	0.5-2 (6)	1.5	0.03
Habitat	Pond (instream)			√		√	
	Pond (isolated)	√	√		√		√
Hydrology	Perennial		√	√	√	√	
	Intermittent	√					√
Emergent/ shoreline	Dense (>25%)	√	√				
	Limited (<25%)			√	√	√	√
Fish	Native					√	
	Introduced				√		
Bullfrogs				√			

CRF?

Pond A **Pond B**

Both?

DESIGN AND MANAGEMENT OF CRF PONDS

POND DESIGN

When Creating Ponds, Consider:

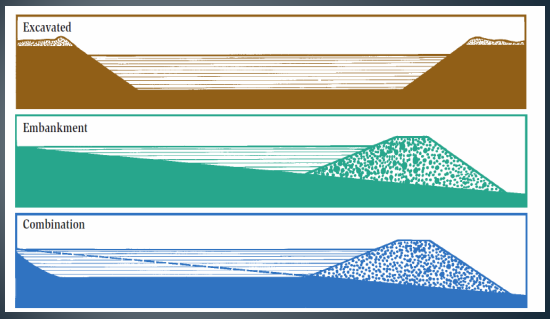
Types of ponds

Locations

Permits Required – CDFW, ACE, RWQCB

(e.g.) damming a drainage

POND DESIGN



(Austin, et al. 1996)

POND DESIGN

LOCATION is Everything

(Comparisons between two 1-acre ponds)

Ohio- supported by 10-15 acre watershed (Austin, et al. 1996)

California - supported by 50-100 acre watershed (Deal, et al. 1997)

BUT

Contra Costa County –supported by 10 acre watershed (Deal, et al. 1997)

Marin County – supported by 2 acre watershed (Deal, et al. 1997)

POND DESIGN

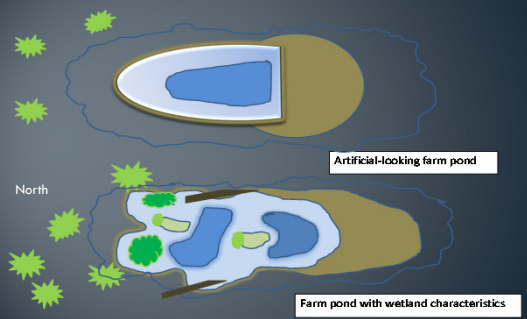
Providing Suitable Structure

Goal: Creating Microhabitats

- Heterogeneity of habitats – cattails, willows, rushes, floating veg., open water
- Varied water depths - deep water, shallow water
- Soils – support vegetation and hold water

POND DESIGN

POND DESIGN



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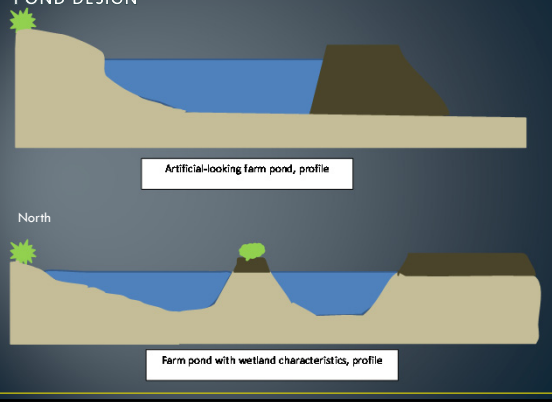


POND DESIGN

Use Livestock Ponds to Manage for CRF Population

BUT

- **Rarely maintenance free**
- **Manage for soil accretion/aquatic biomass accumulation**
- **Prevent individual loss**

POND DESIGN

Livestock Access – Coastal vs. Inland

POND DESIGN

Livestock Access

POND DESIGN

Livestock Access – How Much?

POND DESIGN

Effects of Loss or Modification of Habitat

Loss of vegetation: fewer oviposition sites

Soil accretion: shallower ponds, increased evapotranspiration, change in vegetation components, less open banks and fewer sunny areas, less refugia, fewer oviposition and tadpole rearing sites

POND MANAGEMENT

Maintenance and Rehabilitation

POND MANAGEMENT

Appropriate Seasons for Maintenance

Dry season – May 15 - October 15

During the driest season – September –October

- After young have metamorphosed
- Pond at a naturally low water level
- Pond refills naturally with next rain event

POND MANAGEMENT

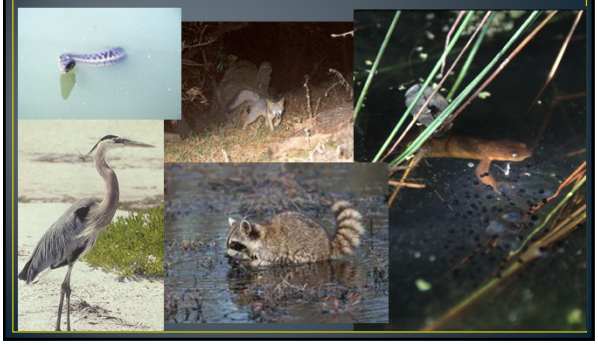
Non-native Predator Control

During maintenance:

- Change hydrology
- Change vegetation

POND MANAGEMENT

Native Predator Control



GRAZING MANAGEMENT

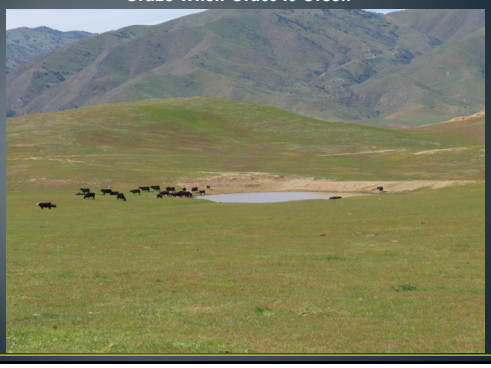
GRAZING MANAGEMENT

Make Sure Management is Feasible for Rancher

GRAZING MANAGEMENT

GRAZING MANAGEMENT

Graze When Grass is Green



GRAZING MANAGEMENT

Provide Additional Water Source

GRAZING MANAGEMENT

Fence a Portion of the Pond

GRAZING MANAGEMENT

Use Temporary Fencing to Exclude From Ponds or Move to Another Field When Metamorphs are Leaving Pond

GRAZING MANAGEMENT

Turbidity & Pond Inundation Time: More Research Needed

MANAGEMENT OF STREAM AND RIPARIAN HABITATS

STREAM AND RIPARIAN

Lotic habitats and associated vegetation that help with the retention of biological components to maintain chemical, physical and biological values. The width of the riparian corridor dependent on water table.

STREAM AND RIPARIAN

Habitat Use:
Refugia, Predator Avoidance, Egg-laying, Development, Foraging

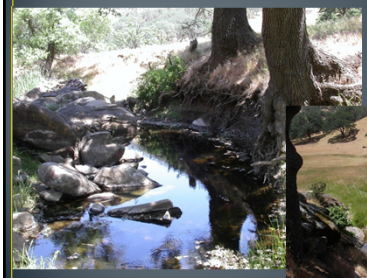
STREAM AND RIPARIAN

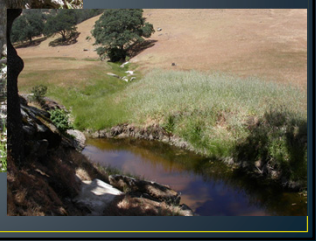
Characteristics of Occupied Habitat

	Coastal	Inland	Sierran
Inundation period	Typically perennial, but calm and stable during breeding	Typically ephemeral, with perennial pools	Ephemeral, with perennial pools
Vegetation	Emergent and riparian	Emergent veg for egg laying and structures to escape predators	Emergent and exposed northern banks
Depth	Perennial stream = 18 inches	Perennial stream = 18 inches Perennial pool = 2 feet	Dammed pools (>3 feet)
Livestock Access Recommendation	Yes, year-round	Yes, limitations	No
Fish Present	Typically absent	No	Yes

STREAM AND RIPARIAN

STREAM AND RIPARIAN






STREAM AND RIPARIAN


STREAM AND RIPARIAN
Livestock Access


STREAM AND RIPARIAN
Livestock Access


STREAM AND RIPARIAN
Grazing Management for Streams, Springs & Other Moist Habitats
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STREAM AND RIPARIAN
Riparian Pasture


STREAM AND RIPARIAN
Permanent Riparian Fencing

STREAM AND RIPARIAN

Cattle Crossing

STREAM AND RIPARIAN

Off-Stream Drinking Water

STREAM AND RIPARIAN

Herd Cattle to Less Sensitive Areas

STREAM AND RIPARIAN

Moderate Grazing

STREAM AND RIPARIAN

Residual Dry Matter Standards

Table 2. Minimum RDM standards for annual grassland/hardwood rangeland in pounds per acre (dry weight)

Woody cover	RDM standard for percent slope (lb/acre)			
(%)	0–10	10–20	20–40	>40
0–25	500	600	700	800
25–50	400	500	600	700
50–75	200	300	400	500
75–100	100	200	250	300

Note: Metric conversion: 1 lb/acre = 1.12 kg/ha.

For areas with average annual rainfall between 12 and 40 inches

STREAM AND RIPARIAN

Improve Livestock Distribution

STREAM AND RIPARIAN

Strategic Placement of Cattle Attractants

STREAM AND RIPARIAN

Move Cattle to Less Compactible/Erodible Soils

STREAM AND RIPARIAN

Maintain Vegetated Buffers

STREAM AND RIPARIAN

Effects of Loss/Modification of Habitat

- Loss of riparian vegetation = fewer oviposition sites
- Decreased shading of aquatic systems = increased evapotranspiration, change in vegetation components, more open banks, more erosion
- Decreased structure in stream = less refugia
- Increased flow of water = fewer oviposition and tadpole rearing sites

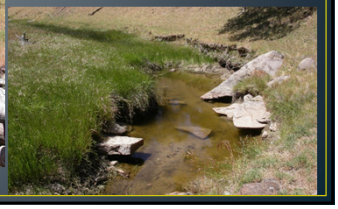
STREAM AND RIPARIAN

Maintenance/Restoration

(ref: California Salmonid Stream Habitat Restoration Manual)

Use: Boulders, Logs, Root wads

Don't Use: Plastic Mesh



MANAGEMENT OF SPRINGS, SEEPS AND OTHER MOIST HABITATS

SPRINGS, SEEPS AND OTHER

Lentic habitats provide surface and sub-surface flows that support wetland vegetation within upland habitats or as headwaters to perennial creeks.

SPRINGS, SEEPS AND OTHER

Refugia

(Protection from high temperatures, dry-down)

SPRINGS, SEEPS AND OTHER

Refugia

(Protection from adult breeding CRF or other predators)

SPRINGS, SEEPS AND OTHERS

Characteristics of Occupied Habitat

	Coastal	Inland	Sierran
Inundation period	Present when ponds dry	Often same regime as ponds	a) Present when ponds dry, if headwaters, b) Dry before ponds
Vegetation	Wetlands	Intermixed wetland and upland	Wetlands a) 100% b) 0%
Depth	Shallow to surface	Surface to subsurface	Subsurface
Livestock Access Recommendation	Yes	No	No

SPRINGS, SEEPS AND OTHERS

Coastal

SPRINGS, SEEPS AND OTHERS

Inland

SPRINGS, SEEPS AND OTHERS

Sierran

SPRINGS, SEEPS AND OTHERS

Graze in Spring or Fence Out Seep/Spring

SPRINGS, SEEPS AND OTHER

Effects of Loss/Modification of Habitat

- Change in surface or subsurface flows = loss of refugia
  - Loss of microclimate = loss of rehydration potential for individuals

UPLAND HABITAT MANAGEMENT

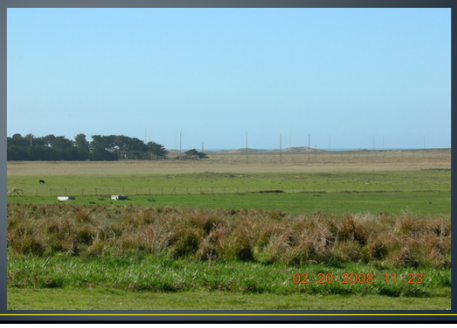
UPLAND HABITAT MANAGEMENT

Foraging
Stream flood escape
Corridors

Microhabitats: boulder, barn door laying on the ground, large logs, grassland thatch, cow hoof print, crevice, ground squirrel burrow

UPLAND HABITAT MANAGEMENT

Coastal



UPLAND HABITAT MANAGEMENT

Inland

UPLAND HABITAT MANAGEMENT

Sierran

Maintenance of Hydrologic Components

UPLAND HABITAT MANAGEMENT

Grazing Management for Upland Habitats

UPLAND HABITAT MANAGEMENT

Moderate Grazing

UPLAND HABITAT MANAGEMENT

Residual Dry Matter Standards

Table 2. Minimum RDM standards for annual grassland/hardwood rangeland in pounds per acre (dry weight)

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75–100	100	200	250	300

Note: Metric conversion: 1 lb/acre = 1.12 kg/ha.

For areas with average annual rainfall between 12 and 40 inches

UPLAND HABITAT MANAGEMENT

Effects of Loss or Modification of Habitat

- Loss of surface flows to nearest water body = reduction in size of water body
- Loss of structure = less refugia
- Loss of microclimate near water body = increase in temperature and potentially lose aquatic water body

UPLAND HABITAT MANAGEMENT

Summary of Livestock Grazing Tools

1) Modify timing of grazing
2) Modify number of cattle
3) Provide additional water troughs, strategically placed away from water ways
4) Provide strategically placed salt/minerals
5) Develop riparian pastures
6) Install exclosure fencing
7) Herd livestock away from sensitive areas
8) Establish vegetated buffer strips
9) Modify kind (species) and class (gender or age class) of grazing animal

UPLAND HABITAT MANAGEMENT

Rodent Control

- Beneficial: control dam face undermining
- Detrimental: potential for CRF to be killed in burrows from fumigation, plugging, or igniting burrows

Recommendations

- Enhance raptor populations, use lead-free ammunition

CONTROL OF INVASIVE SPECIES

CONTROL OF INVASIVE SPECIES

PLANTS

INVERTEBRATES (e.g. CRAYFISH)

VERTEBRATES (FISH, BULLFROGS)

CONTROL OF INVASIVE SPECIES

PLANTS

Aquatic species (i.e., parrotfeather (*Myriophyllum aquaticum*)) may increase sedimentation in a pond, decrease habitat heterogeneity, and prevent availability of shallow open water for metamorphs to grow.

Upland species (i.e., Harding grass (*Phalaris aquatica*) and velvet grass (*Holcus lanatus*) can grow in dense stands and decrease habitat heterogeneity.

CONTROL OF INVASIVE SPECIES

CONTROL OF INVASIVE SPECIES

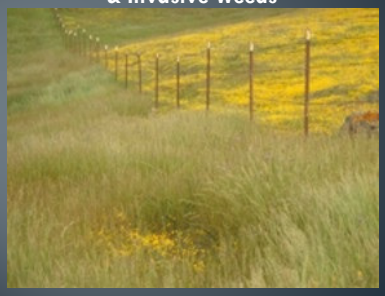
CONTROL OF INVASIVE SPECIES

VEGETATION CONTROL

Bio-control
Herbicides
Environmental
Mechanical Removal
Bio-control
Hand Removal

CONTROL OF INVASIVE SPECIES

Grazing to Control Tall, Dense Annual Grasses & Invasive Weeds



CONTROL OF INVASIVE SPECIES

HERBICIDES

Buffer zone (no-use) for ground application 260 feet from the edge of CRF habitats and 400 feet buffer for aerial application from the edge of all habitats, including upland habitat. Regulations apply in 33 counties where CRF are known to occur.

(California Department of Pesticide Regulation 2013 http://www.cdpr.ca.gov/docs/endspec/rl_frog/index.htm)

CONTROL OF INVASIVE SPECIES

HERBICIDE EXCEPTIONS: Invasive Species and Noxious Weed Control Programs

- Handheld devices doing spot treatments allowed beyond 15 feet from aquatic habitats
- No pesticide use during precipitation or 24 hrs. prior
- Applied by certified applicator
- Additional exemptions

(California Department of Pesticide Regulation 2013 http://www.cdpr.ca.gov/docs/endspec/rl_frog/index.htm)

CONTROL OF INVASIVE SPECIES

INVERTEBRATES

Crayfish (*Procambarus* sp., *Oronectes* sp. and *Pacifistacus* sp.): Require CDFW crayfish permit and Scientific Collecting Permit for *Pacifistacus* sp.

(CDFG Informational Leaflet No.31)

Allowable methods: hand, hook, line, dip net (<6 feet) or trap (<3 feet of any dimension)

CONTROL OF INVASIVE SPECIES

Crayfish Biology

- Burrow depth 1-3 feet, and deeper during drought conditions
- Opening of completed burrow is covered at the top with a mud plug
- Typically permanent ponds with warm waters
- Reproduction – spring through autumn
- Eggs hatch – fall or following spring

(UC IPM Pest Management Guidelines: Rice - AN Pub. No 3465)

CONTROL OF INVASIVE SPECIES

Crayfish Control Recommendations

- Pond drainage - depending on CRF metamorph presence
- Trapping
- Increasing water depth to lower temperatures
- Increasing heterogeneity of vegetation

CONTROL OF INVASIVE SPECIES

VERTEBRATES

Fish (i.e., Mosquitofish (*Gambusia affinis*) and Centrarchids (e.g., green sunfish (*Lepomis cyanellus*), etc): Requires CDFW fishing license

Bullfrogs (*Lithobates catesbeianus*): Requires CDFW fishing license; allowable methods are bow and arrow, air gun if stipulated specifically through CDFW Scientific Collecting Permit

CONTROL OF INVASIVE SPECIES

Vertebrate Control Recommendations

- Pond draining
- Trapping
- Deepening pond to lower temperatures
- Increase heterogeneity of vegetation

Bullfrog control? That's another story…

CONTROL OF INVASIVE SPECIES

Bullfrog Biology

- Up to 6 inches in length
- Travel overland up to 1 km
- Prefer non-vegetated habitats
- Warmer waters
- Larvae typically over-winter BUT can metamorphose the same year as hatching (Cohen and Howard 1958, Moyle 1973, Tatarian, pers. obs.)
- Larvae can sustain themselves in mud when ponds are drained
- Fast colonization of habitats, typically perennial ponds (larger) and streams, except in Sierra Foothills (Moyle 1973).

Ephemeral habitats are next to be invaded

CONTROL OF INVASIVE SPECIES

Bullfrog Control Recommendations

Effective with isolated populations:

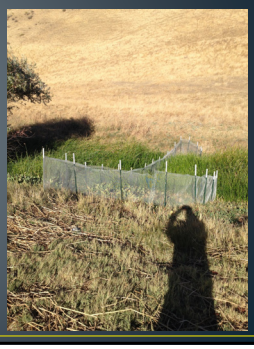
- Decrease bullfrog population growth rate (modeling): Adult control, mortality rate of > 65%/year every two years or draining ponds every two years. (*Doubledee, et al. 2003*)
- Metamorph control in fall is the most effective. (*Govindarajulu, et al. 2005*)

CONTROL OF INVASIVE SPECIES

CONTROL OF INVASIVE SPECIES

CONTROL OF INVASIVE SPECIES

You're Lucky if You Can Do This…



CONTROL OF INVASIVE SPECIES

But How Do You Handle This?
(Metapopulation Control)

PLANNING AT THE LANDSCAPE LEVEL

LANDSCAPE LEVEL

BUFFER ZONES

BREEDING SITE NETWORKS

MOVEMENT CORRIDORS

LANDSCAPE LEVEL

Buffer Zones

Purpose - Retain aquatic conditions, and allow individuals to forage, escape into refugia and move throughout the habitats.

Components – woody debris, leaf litter and duff, forbs, shrubs, trees

Depth-of-edge microclimatic influences dependent on vegetation beyond the immediate riparian habitat. (Richter 1997)
e.g. large trees and shrubs vs grasslands

LANDSCAPE LEVEL

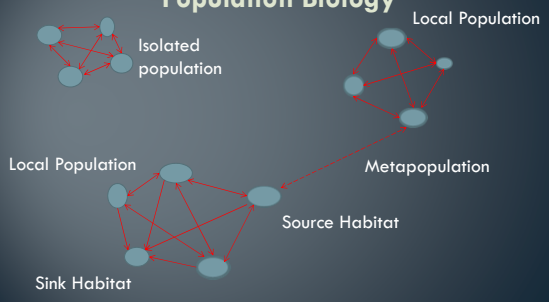
Buffer Zones

Beneficial to habitat - Retention of biological components to maintain chemical, physical and biological values of lentic and lotic habitats. Vegetation width and composition important during droughts.

Beneficial to individuals – Supports the home range of the species. Movement from breeding to non-breeding habitat (aquatic and non-aquatic) is unique at each wetland. *(Rittenhouse and Semlitsch 2007)*

LANDSCAPE LEVEL

Population Biology



LANDSCAPE LEVEL

Breeding Site Networks

LANDSCAPE LEVEL

Movement Corridors

Beneficial to the population – allows for migration between local populations

"One size does not fit all"

Behavior variances due to:
Climate
Vegetation
Timing
Predators

LANDSCAPE LEVEL

Movement Generalities

- Most CRF do not move far – adults don't explore
- Movement occurs between aquatic habitats
- CRF move during damp conditions (first rains and winter)
- CRF move at night
- But, CRF movement corridors can be difficult to detect or recognize (e.g. not always aquatic, topography not as limiting as one imagines).

LANDSCAPE LEVEL

Defining Elements of Good CRF Integrated Landscape Management

- Maintain breeding ponds and provide metamorph habitat
- Maintain landscape connectivity, which is dependent on the location (i.e., coastal, inland or Sierran habitats).
- Look for direct line movements between water bodies.
- Create "stepping stones" (structures) between water bodies (occupied) and other habitats (unoccupied) and resources.
- Take into account ephemeral changes to the landscape.

REGULATORY REQUIREMENTS

REGULATORY REQUIREMENTS

- Section 7 (B.O.) or 10 consultation (HCP)
- Maintenance under 4(d) rule – artificial stock ponds, and routine maintenance
- Safe Harbor Agreement – if listed species habitat maintained, landowners are not prohibited from incidental take (injure or kill) of state-listed as long as the take occurs on a farm or ranch during the course of routine and ongoing agricultural activities

REGULATORY REQUIREMENTS

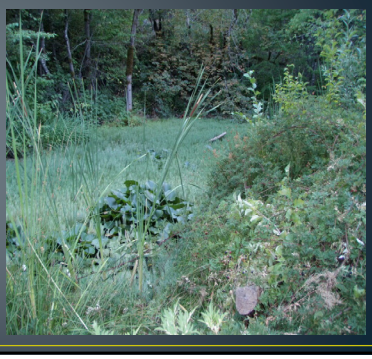
- Some cost-share incentives (Recovery Program, Partners for Fish and Wildlife)
- RWQCB – aquatic habitats
- ACE – aquatic habitats
- CDFW – aquatic habitats
- Enhance habitat for population BUT no "take" of individuals

CASE EXAMPLES

CASE EXAMPLE 1

Sailor Flat

- 100 % aquatic vegetation cover
- 100 % shade cover in shallow areas
- Soil accretion of shallow areas



CASE EXAMPLE 1

Sailor Flat

- Cooperative Agreement – USFWS, land owner
  - Pre-construction surveys to determine population
  - Removal of individuals the night before dewatering
  - Held individuals on-site during removal
  - Post-construction surveys to determine population

CASE EXAMPLE 1

Sailor Flat

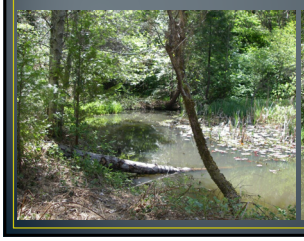
Number of CRF observed in the Pond

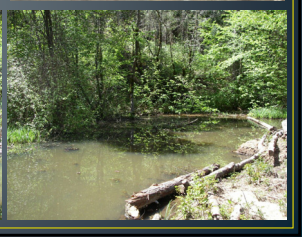
Date	Adults	Metamorphs
8/2006 (survey)	5	1
9/2006 (survey)	7	2
10/2006 (captures)	16	22

CASE EXAMPLE 1

Sailor Flat - Success

Date	Adults	Metam.
8/2007 (survey)	9	40





CASE EXAMPLE 2

EBMUD Sediment Pond

CASE EXAMPLE 2

EBMUD Sediment Pond – Contra Costa County*

Cattle grazing and stock ponds

1990's - CRF population high

1996 - CRF listed and maintenance stopped

2000's - pond started to fail and CRF population down to 5 localities

2008 - created HCP as management document with various restoration methods (research)

2013 – CRF population at 39 locations

(*Bert Mulchaey, Biologist, EBMUD, pers. comm. 2013)

CASE EXAMPLE 2

EBMUD Sediment Pond

CASE EXAMPLE 2

EBMUD Sediment Pond

Elkhorn Ranch Ponds

CASE EXAMPLE 3

Elkhorn Ranch Ponds – Monterey County

Eradication at a large scale as part of a conservation action

HO: California red-legged frog change their habitat use or hide in presence of bullfrog

- 12 ponds supported CRF and BF in which BF were controlled
- BF Removal – June – Oct. 2004, until 2006. Hand capture, gigs, seining
- Inverse relationship of number of BF to CRF
- CRF adults used willows and tule, and were closer to shore in presence of BF. This is habitat typically used by smaller CRF.
- High resource partitioning – when no BF present CRF able to use all habitats and reduced potential predation on smaller CRF by larger CRF.

D'Amore, et al. 2009

WHERE ARE THE FROGS?

Pond A **Pond B**

Both

Questions…