

AMPHIBIAN AND REPTILE SURVEYS OF U. S. NAVY LANDS ON THE KITSAP AND TOANDOS PENINSULAS, WASHINGTON

MICHAEL J. ADAMS¹, STEPHEN D. WEST, AND LORRIE KALMBACH

*University of Washington, College of Forest Resources, Box 352100,
Seattle, Washington 98195 USA*

ABSTRACT—We inventoried amphibians and reptiles on 5 U.S. Naval holdings located on the Kitsap and Toandos Peninsulas, western Washington. Eight amphibians, including an introduced anuran, and 4 reptiles were detected, resulting in 87 new locality records. Six species were found on the Toandos Peninsula where no previous records exist. Of the species that historically or currently occur on the Kitsap Peninsula, 1 amphibian and 3 reptiles were not detected. Aquatic funnel trapping yielded the most detections for lentic-breeding amphibians, and plastic cover-sheets were best for reptiles. Wooden coverboards were not effective for sampling amphibians or reptiles.

Key words: amphibians, reptiles, inventory, western Washington, aquatic funnel traps, coverboards, monitoring

The U.S. Department of Defense manages over 12 million ha of land. As privately owned lands are developed near military reservations, the management of natural resources on these lands will become an increasingly important component of biological conservation in North America. Also, because military reservations are often long-term landscape elements, species-occurrence trends on military lands are of special interest (for example, Busby and Parmelee 1996).

The U.S. Navy manages many land-holdings on the Kitsap and Toandos peninsulas in Washington State. None have been surveyed for amphibians and reptiles and we could not locate herpetological records for the Toandos Peninsula (see McAllister 1995). Here, we report the results of herpetofaunal surveys on 5 U. S. Naval holdings (Fig. 1). These surveys will aid current conservation efforts on and around these holdings, and provide a basis for comparing trends in species composition and abundance over time.

METHODS

Study Areas

Three of the U.S. Naval holdings surveyed are on the Kitsap Peninsula and 2 are on the

Toandos Peninsula in western Washington (Fig. 1). The Kitsap Peninsula runs along the east side of the Olympic Peninsula and is only separated from it by the Hood Canal. The Toandos Peninsula protrudes from the Olympic Peninsula into Hood Canal.

The largest holding is the Submarine Base Bangor and the adjacent Ordnance Annex (A and D, Fig. 1). About half of this area is urban and half forested. The forest is mostly mature 2nd-growth Douglas-fir (*Pseudotsuga menziesii*) with some commercially thinned stands and clearcuts as well as a few meadows. Red alder (*Alnus rubra*) and western redcedar (*Thuja plicata*) also occur in moist areas. Abundant lentic habitats range from lakes to seasonally ponded marshes. A few permanent streams are present.

The Keyport Naval Undersea Warfare Center (C, Fig. 1) is a largely urban base, but there is a 2nd-growth Douglas-fir stand at the southern end and a few small wetlands are present. The Buffer Zone (B, Fig. 1) is located on a steep east-facing slope. It consists mostly of managed Douglas-fir forest in various stages of succession from recent clearcut to mature forest with some red alder and western redcedar stands interspersed. Several small streams are present; 2 are permanent. Zelatched Point (E, Fig. 1) is a west-facing hillside that supports 2nd-growth

¹ Present address: *Forest and Rangeland Ecosystem Science Center, U.S. Geological Survey, 3200 SW Jefferson Way, Corvallis, Oregon 97331 USA.*

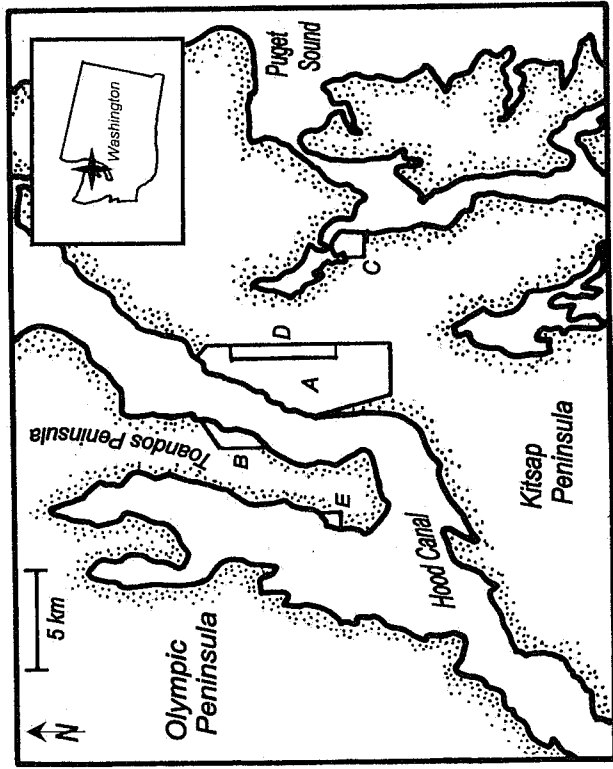


FIGURE 1. Locations of the 5 U.S. Naval holdings surveyed in western Washington. The Toandos and Olympic Peninsulas are in Jefferson County and the Kitsap Peninsula is in Kitsap County. A: Submarine Base Bangor; B: Buffer Zone; C: Keypoint Naval Undersea Warfare Center; D: Ordnance Annex; E: Zelatched Point.

Douglas-fir forest. One small wetland experiences occasional salt-water influxes.

Field Surveys

Five survey techniques were used from February to September in 1995 and 1996 to determine the presence of amphibians and reptiles. Lentic waters were surveyed using Gee's wire minnow traps following the habitat-based method of Adams and others (1997). All potentially occurring lentic-breeding amphibians, with the possible exception of *Bufo boreas* (western toad), can be caught in these traps (Adams and others 1998). Shorelines with steep inclines and little or no emergent vegetation were not trapped as these seldom support amphibians in the Puget lowlands. All lentic waters were surveyed with minnow traps.

TABLE 1. Amphibians and reptiles detected by land holding and habitat during 1995-96. Habitat types are: b, Beach, o = Open, w = Wetland, s = Stream and Seep, f = Forest. See Fig. 1 for locations of all land holdings.

Species	Bangor	Buffer Zone	Keypoint	Weapons Annex	Zelatched Point
AMPHIBIANS					
<i>Ambystoma gracile</i>	wf		w	w	
<i>A. macrodactylum</i>	w				
<i>Ensatina eschscholtzii</i>	f	f	f	f	f
<i>Hyla regilla</i>	wsf	f	wf	wf	
<i>Plethodon vehiculum</i>	s				
<i>Rana aurora</i>	wsf	s	w	wsf	
<i>R. catesbeiana</i>	w				
<i>Taricha granulosa</i>	ws				
REPTILES					
<i>Elgaria coerulea</i>	bo	f	o	o	o
<i>Thamnophis elegans</i>	o	of	o	of	
<i>T. ordinoides</i>	bo	of	of	of	
<i>T. sirtalis</i>	bow	f			

TABLE 2. Amphibians detected at 24 lentic sites during 1995-96. See Fig. 1 for locations of all land holdings. UTM = Universal Transverse Mercator grid system.

Site	UTM		<i>Ambystoma gracile</i>	<i>A. macrodactylum</i>	<i>Hyla regilla</i>	<i>Rana aurora</i>	<i>Rana catesbeiana</i>	<i>Taricha granulosa</i>	Trap nights
	E-W	N-S							
BANGOR									
Bullhead Marsh	522.2	5285.9	X			X		X	24
Cattail Lake	523.1	5290.1			X	X		X	38
Darter Road Marsh	522.2	5286.8			X			X	4
Devils Hole	520.1	5286.8			X			X	6
Exercise Pond	520.3	5286.5	X					X	24
Hunters Marsh	521.1	5288.8	X		X			X	17
Kiddie Pond	520.4	5285.3	X					X	14
Lake Ruth	522.0	5285.9	X				X	X	32
Lake Ruth W. Lagoon	522.1	5284.5	X				X	X	15
Parche Rd. Marsh	522.1	5285.3							4
Pond By Wilkes Marsh	522.7	5289.7	X						7
Storage Pond 37	520.7	5285.2	X					X	25
Storage Pond Bldg. 7001	519.7	5285.6	X					X	12
Storage Pond EHW	521.1	5288.6	X	X				X	15
Storage Pond Golet	520.4	5284.4		X				X	76
Trident Lake East	522.0	5280.7	X					X	24
Trident Lake West	521.9	5280.8	X					X	24
Wetland 63	522.5	5282.2		X				X	18
Wilkes Marsh	522.8	5290.1	X	X				X	17
ORDNANCE ANNEX									
Bull/Trep Annex	522.8	5286.3	X		X				6
MFO Marsh	523.0	5284.1	X						10
KEYPORT									
Ditch Gun Range	528.1	5281.8			X				4
Ditch Parallel Bradely	528.1	5282.3	X						9
ZELATCHED POINT									
Lagoon	513.6	5284.1							10

Visual encounter surveys (VES) consisted of walking through a habitat type and turning over any potential cover objects. Searches were not time or area constrained, but the number of worker-minutes spent searching was recorded. Visual encounter surveys were used in 5 habitat categories: Forest (any wooded area including a few shrub thickets but mostly Douglas-fir, some red alder and western redcedar); Open (any unforested terrestrial habitat other than beaches); Beach (along Hood Canal and Puget Sound); Wetland (any lentic habitat); and Stream and Seep. Wetland VES involved walking the perimeter of wetlands and making sweeps through the water with a dip-net similar to the method described by Thoms and others (1997). In faster flowing streams, a small seine constructed of hardware cloth was held against the substrate as rocks were turned over upstream (Bury and Corn 1991).

Wooden cover-boards were used to survey for terrestrial amphibians in wooded areas on

TABLE 3. Visual encounter survey effort in hours, 1995-96. Number of surveys appears in parentheses. NA = not applicable.

Holding	Beach	Open	Stream/seep	Wetland	Forest	Total
Bangor	4.0 (5)	5.8 (8)	39.0 (23)	39.9 (67)	15.9 (19)	104.6 (122)
Buffer Zone	2.8 (3)	1.9 (3)	6.4 (14)	NA	6.4 (7)	17.5 (27)
Keypoint	4.1 (6)	5.3 (9)	3.2 (4)	1.6 (10)	18.8 (20)	33.0 (49)
Weapons Annex	NA	3.0 (5)	3.0 (3)	4.3 (8)	0.8 (2)	11.1 (18)
Zelatched Point	2.3 (3)	3.3 (5)	NA	0.8 (3)	1.8 (2)	8.2 (13)
Total	13.2 (17)	19.3 (30)	51.6 (44)	46.6 (88)	43.7 (50)	174.4 (229)

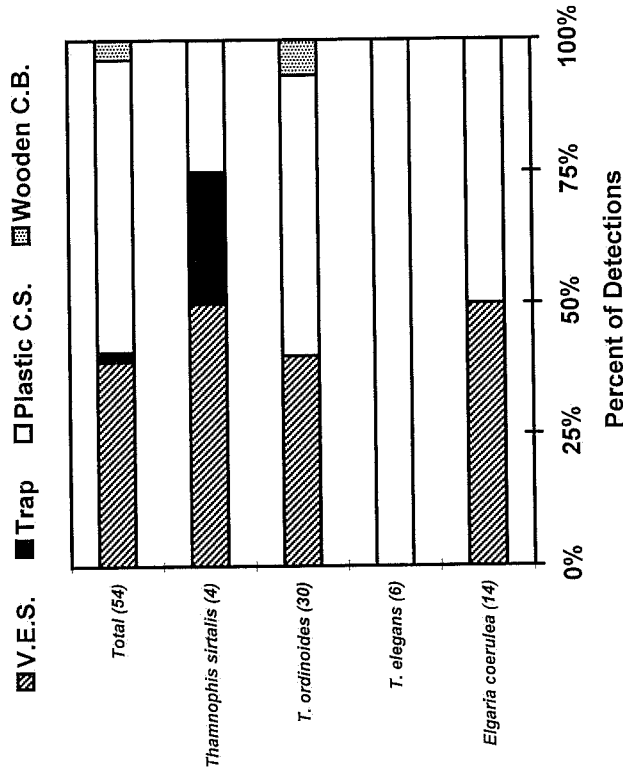


FIGURE 2. The proportion of reptile detections yielded by 4 techniques. The number of detections are shown in parentheses. A detection is defined as an event when any number of individuals of a species are discovered at a given site on a given date.

Bangor. These were waste slices off the edges of logs processed at a sawmill. They ranged from about 0.25 to 0.75 m². Sixteen transects of 5 cover-boards spaced 5-m apart were set out in October 1995. Cover-boards were checked approximately weekly from February to May 1996.

Plastic cover-sheets were 1-m² pieces of 3-mm black plastic that trap heat and were used to detect reptiles. In April, 6 transects (each with 5 covers spaced 5-m apart) were set on Bangor; in August, 4 were set on the Ordnance Annex and 2 were set on Keyport; and in September, 3 transects each were added to the Annex and Keyport. All plastic cover-sheets were set in open areas that received direct sunlight for much of the day. Plastic cover-sheets were checked approximately weekly from April to September 1996.

Call surveys were employed at wetlands to determine if *Hyla regilla* (= *Pseudacris regilla*) [Hedges 1986; Cocroft 1994], Pacific treefrog and *Rana catesbeiana* (bullfrog) were present. These are the only amphibians in the region with loud calls (Olson and Leonard 1997). Workers listened for calls around sunset during spring and summer months. Both species have

extended breeding seasons (Olson and Leonard 1997).

Field personnel received 27 hr each in training on amphibian and reptile identification and capture techniques. Once identified, all animals were released at the point of capture.

RESULTS

We found 7 native amphibians and 1 introduced anuran (*R. catesbeiana*; Table 1). At least 1 species of amphibian was detected at most of the 24 lentic sites, and species richness averaged 2.8 species per site. Excluding *R. catesbeiana* there were 2.7 species per site (Table 2). *Pseudacris regilla* was the most widespread lentic-breeding amphibian (18 sites, Table 2) followed by a nearly linear decline to the most restricted species which was *R. catesbeiana* (4 sites). No stream-amphibians were encountered, but *Plethodon vehiculum* (western redbacked salamander) was found in a small seep on Bangor. Amphibians were found on all holdings and in all habitats except Beach and Open.

At least 1 species of reptile was detected at all holdings. Reptiles found were *Elgaria coerulea* (northern alligator lizard) and 3 species of *Thamnophis* (garter snake; Table 1). No turtles

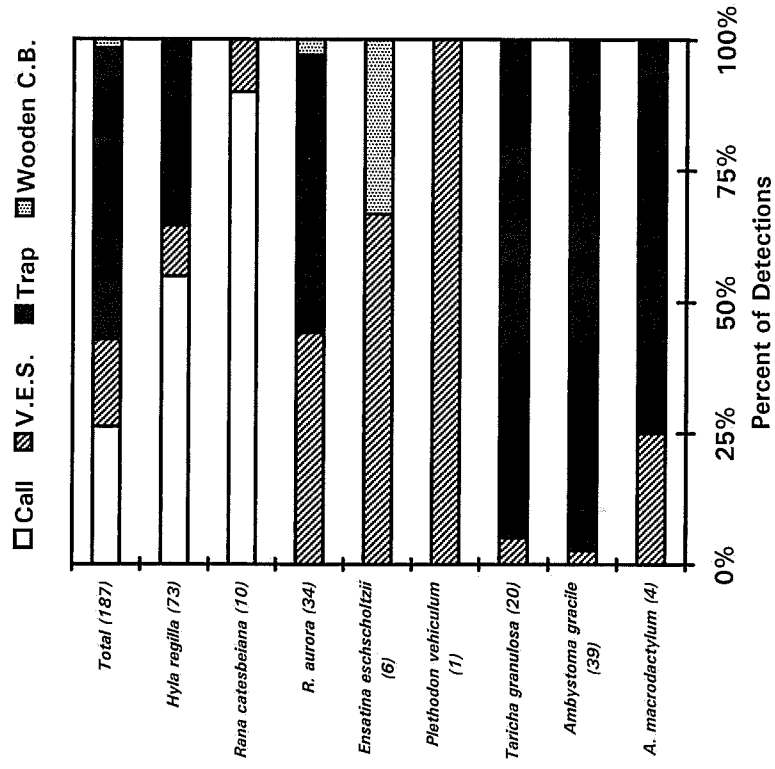


FIGURE 3. The proportion of amphibian detections yielded by 4 techniques. The number of detections are shown in parentheses. See Fig. 2 caption for definition of a detection.

were detected. Reptiles were found in all habitats except Stream and Seep, but were most prominent in open areas.

We conducted 229 VES (174.4 hr, Table 3) and 261 wooden cover-board and plastic sheet checks (181 wooden on Bangor, 39 plastic on Bangor, 22 plastic on Weapons Annex, 19 plastic on Keyport). Wooden cover-boards produced few detections, but the plastic cover-sheets were effective for detecting reptiles (Fig. 2). Funnel trapping (435 trap-nights, Table 2) yielded the most detections of lentic-breeding amphibians (Fig. 3), but this result was strongly influenced by frequent captures of *Taricha granulosa* (rough-skinned newt) and *Ambystoma gracile* (northwestern salamander). Funnel trapping did not detect *R. catesbeiana*. Only VES detected all species of amphibian, but VES produced relatively few detections overall.

DISCUSSION

Native lentic-breeding amphibians are common and widespread on Bangor, and several

species were found on other holdings despite a scarcity of lentic habitat. However, 2 native lentic-breeder that occur in the Puget lowlands were not detected on any of the holdings. One of these, *Rana pretiosa* (Oregon spotted frog), has never been recorded on the Kitsap or Toanodos Peninsulas (Nussbaum and others 1983; McAllister 1995). It was once more widespread but is now only known from 1 site in the Puget lowlands despite intensive surveys (McAllister and others 1993).

The absence of *B. boreas* detections in our survey is more notable because this species currently occurs on the Kitsap and Olympic Peninsulas as well as other parts of the Puget lowlands (Nussbaum and others 1983; Leonard and others 1993). However, *B. boreas* appears to be experiencing widespread declines in the western U.S. (Corn 1994). We do not know if *B. boreas* ever occurred on Bangor nor why it was not detected in the current survey, but the scarcity of this species in several recent Puget lowlands surveys is of concern (Richter and Azous

1995; Adams and others 1998; W. Leonard, Washington Department of Ecology, Olympia, WA, pers. comm.).

The apparent absence of stream-breeding amphibians on the Kitsap Peninsula was supported by this survey and is likely due to isolation and relatively flat topography lacking the steep elevational gradients generally preferred by these species (Bury and others 1991). The Toandos Peninsula, however, is not as isolated and includes some steep, persistent streams. Only 2 such streams occurred on our study area and these were heavily sedimented from upstream logging; conditions that may exclude some species (Bury and Corn 1988; Corn and Bury 1989). Additional stream surveys need to be done on the Toandos Peninsula and it is premature to conclude that stream-breeding amphibians are absent.

Three of the 7 native species of reptile that might occur on these holdings (Nussbaum 1983) were not detected. *Clemmys marmorata* (western pond turtle) appears nearly extinct north of the Columbia River (Storm and Leonard 1995). *Chiarina bottae* (rubber boa) is widespread, but was not detected in our surveys. It is difficult to detect in western Washington and may have been missed (Nussbaum and others 1983). The other missing species is *Sceloporus occidentalis* (western fence lizard), which occurs in small scattered populations on the beaches of the Puget Sound (Nussbaum and others 1983; McAllister 1995). This lizard is fairly easy to detect, but can be overlooked under cool or rainy conditions. Thorough searches of all beach habitat suggest that this species does not occur on the Navy holdings, but one of us (LK) caught a glimpse of a lizard in a driftwood pile on the beach at Zelatched Point. Subsequent visits did not detect lizards.

In contrast to the Olympic Peninsula, most of the land on the Kitsap and Toandos Peninsulas is privately owned. Because of the potential for conversion to other human uses, land held by the government is of added importance to regional conservation efforts. Bangor is especially valuable because it contains diverse habitats and supports most of the Puget lowland herpetofauna. In general, Naval operations of the recent past appear compatible with amphibian and reptile conservation. However, base closures elsewhere could lead to increased development on remaining bases. Continued urban

expansion in the Puget lowlands may cause amphibian and reptile declines due to habitat loss and fragmentation. Monitoring species occurrence patterns is needed to provide current distribution data and to identify population trends throughout the region.

ACKNOWLEDGMENTS

This work was supported by the U.S. Navy Submarine Base Bangor and the Keyport Naval Undersea Warfare Center. We thank T. James (Wildlife Biologist, Bangor) and C. Hasselman (Geologist, Keyport) for help throughout this effort. R. Bury, W. Leonard, and K. McAllister provided helpful comments on this manuscript.

LITERATURE CITED

- ADAMS MJ, BURY RB, SWARTS SA. 1998. Amphibians of the Fort Lewis Military Reservation, Washington: sampling techniques and community patterns. *Northwestern Naturalist* 79:12-18.
- ADAMS MJ, RICHTER KO, LEONARD WP. 1997. Surveying and monitoring pond-breeding amphibians using aquatic funnel traps. In: Olson D, Leonard W, Bury R, editors. *Sampling amphibians in lentic habitats: methods and approaches for the Pacific Northwest*. Northwest Fauna 4:47-54.
- BURY RB, CORN PS. 1991. Sampling methods for amphibians in streams in the Pacific Northwest. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 29 p.
- BURY RB, CORN PS. 1988. Responses of aquatic and streamside amphibians to timber harvest: a review. In: Raedeke KJ, editor. *Streamside management: riparian wildlife and forestry interactions*. Seattle, WA: Institute of Forest Resources, University of Washington. Contribution Number 59. p 165-181.
- BURY RB, CORN PS, AUBRY KB, GILBERT FF, JONES LLC. 1991. Aquatic amphibian communities in Oregon and Washington. In: Ruggiero LF, editor. *Wildlife and vegetation of unmanaged Douglas-fir forests*. Olympia, WA: USDA Forest Service. General Technical Report NW-285. p 353-362.
- BUSBY WH, PARMELEE JR. 1996. Historical changes in a herpetofaunal assemblage in the Flint Hills of Kansas. *American Midland Naturalist* 135:81-91.
- COCROFT RB. 1994. A cladistic analysis of chorus frog phylogeny (Hyllidae: Pseudacris). *Herpetologica* 50:420-437.
- CORN PS. 1994. What we know and don't know about amphibian declines in the west. In: Covington WW, DeBano LF, technical coordinators. *Sustainable ecological systems: implementing an ecological approach to land management*. Fort Collins,
- CO: USDA Forest Service. General Technical Report RM-247. p 59-67.
- CORN PS, BURY RB. 1989. Logging in western Oregon: responses of headwater habitats and stream amphibians. *Forest Ecology and Management* 29:39-57.
- HEDGES SB. 1986. An electrophoretic analysis of holarctic hyliid frog evolution. *Systematic Zoology* 35:1-21.
- LEONARD WP, BROWN HA, JONES LLC, McALLISTER KR, STORM RM. 1993. Amphibians of Washington and Oregon. Seattle, WA: Seattle Audubon Society. 168 p.
- McALLISTER KR. 1995. Distribution of amphibians and reptiles in Washington state. *Northwest Fauna* 3:81-112.
- McALLISTER KR, LEONARD WP, STORM RM. 1993. Spotted frog (*Rana pretiosa*) surveys in the Puget Trough of Washington, 1989-1991. *Northwestern Naturalist* 74:10-15.
- NUSSBAUM RA, BRODIE ED JR., STORM RM. 1983. Amphibians and reptiles of the Pacific Northwest. Moscow, ID: University of Idaho Press. 332 p.
- OLSON DH, LEONARD WP. 1997. Amphibian inventory and monitoring: a standardized approach for the Pacific Northwest. In: Olson D, Leonard W, Bury R, editors. *Sampling amphibians in lentic habitats: methods and approaches for the Pacific Northwest*. Northwest Fauna 4:1-21.
- RICHTER KO, AZOUS AL. 1995. Amphibian occurrence and wetland characteristics in the Puget Sound basin. *Wetlands* 15:305-312.
- STORM RM, LEONARD WP. (editors) 1995. *Reptiles of Washington and Oregon*. Seattle, WA: Seattle Audubon Society. 176 p.
- THOMS C, CORKRAN CC, OLSON DH. 1997. Basic amphibian survey for inventory and monitoring in lentic habitats. In: Olson D, Leonard W, Bury R, editors. *Sampling amphibians in lentic habitats: methods and approaches for the Pacific Northwest*. Northwest Fauna 4:35-46.

Submitted 17 November 1997, accepted 14 July 1998. Corresponding Editor: G. A. Green.