Aquatic invertebrates in dune ponds at Sand Dunes Wilderness Study Area

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Introduction

The Killpecker Sand Dunes are the second largest sand dune field in North America and stretch from the Ferris Mountains to north of Rock Springs, Wyoming. An area in the western portion of the dunes is protected as a wilderness study area (WSA) prohibiting motorized vehicles (Sand Dunes WSA). The WSA includes 27,109 acres owned by the Bureau of Land Management. Sand dunes are constantly shifting and can reach heights of 100 ft. Desert elk, pronghorn, mule deer, raptors and mountain lions live in Sand Dunes WSA.

One of the most unique aspects of Sand Dunes WSA are the aeolian ice cells that form from snow that accumulates on the leeward side of the dunes and are subsequently covered with sand. The sand insulates the snow and ice allowing it to slowly melt and form ponds. These ponds vary in size seasonally and annually depending on climate and conditions. The objectives of our study were to 1.) describe basic conditions in the ponds and 2.) identify the invertebrates living in these dune ponds.

Study Sites

We sampled 11 ponds in the Sand Dunes WSA (Figure 1). We sampled 7 ponds that were on the margin of the dune field in 2012 and all the ponds in the dune field were dry. We sampled 6 ponds in 2014 when the spring was wetter and we sampled ponds in the dune field. At each pond, we measured basic water quality using a Professional Plus Multiprobe made by Yellow Springs Instrument that was calibrated before sampling. We photographed each site and recorded location using a global position system. We sampled aquatic invertebrates using a D-frame dipnet with 250 µm mesh. Invertebrates were sorted from the debris in the field and preserved in ~75% ethanol. We identified invertebrates to the lowest taxonomic level possible given available keys, and age and condition of the specimen using a variety of keys (Burch 1982, Smith 2001, Merritt et al. 2008, Thorp and Covich 2010).

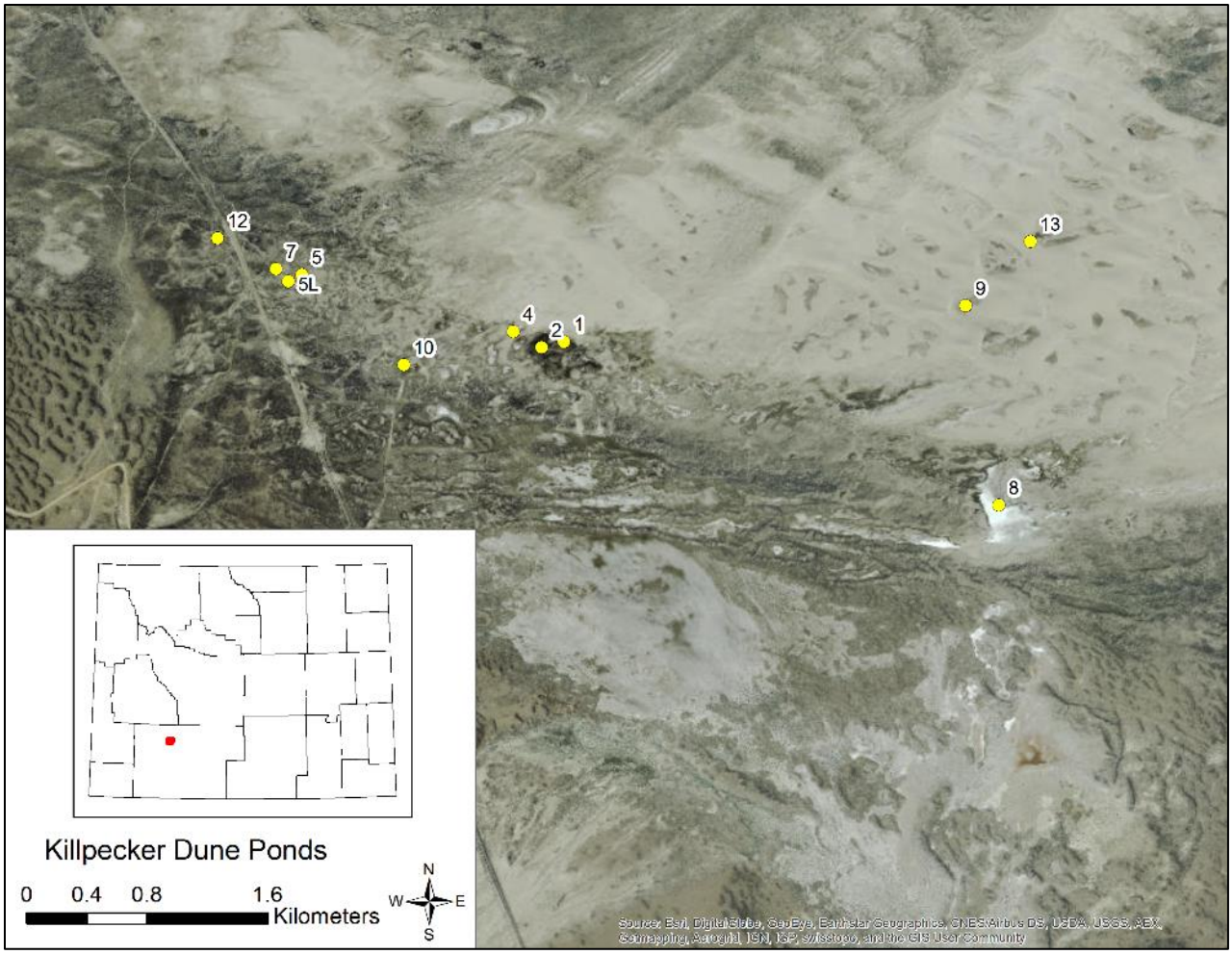

Figure 1. The ponds sampled in the Sand Dunes Wilderness Study Area.

Results

Table 1. Basic water quality measurements in dune ponds during 2012

Pond	2	4	5	5L	7	10	12
Water temperature (˚C)	35.6	31.5	25.8	20.2	21.4	28	22.1
Dissolved Oxygen (% saturation)	242	251	139	149	124	85	120
Dissolved Oxygen (mg/L)	15.9	16.6	10.6	12.8	10.4	6.2	9.7
Specific conductivity (µS/cm)	1193	14161	443.2	438.2	543	1652	769
pH	9.87	9.52	8.38	8.45	9.02	8.26	8.11
Oxidation-Reduction Potential (mV)	42	-50.4	61.7	177.6	145.8	48.6	130.6

Table 2. Basic water quality measurement in dune ponds during 2014.

Pond	1	2	7	8	9	13
Water temperature (˚C)	5.7	9.5	12.3	20.2	16.8	18.9
Dissolved Oxygen (% saturation)	53	86	129	71	105	102
Dissolved Oxygen (mg/L)	6.3	9.3	13	5.2	9.6	8.5
Specific conductivity (µS/cm)	770.9	752	434.3	29401	972	1106
pH	9.13	8.4	9.21	10.36	9.23	9.41
Oxidation-Reduction Potential (mV)	-44.1	-5.2	64.4	118.5	203.9	450.6

Table 3. Invertebrates collected in dune ponds during 2012. Taxa with question marks indicate the most likely identification given the available keys or condition of the specimen.

Order/Class	Family	Dune2B	Dune 4B	Dune5C	Dune5B	Dune7B	Dune10B	Dune12B
Annelida	Hirudinida						Helobdella stagnalis	
Arachnida	Acari				Acari	Acari		
Coleoptera	Dytiscidae	Agabus Larvae			Agabus Larvae	Agabus Larvae	Agabus	
Coleoptera	Dytiscidae					Coptotomus	Laccophilus	Laccophilus
Coleoptera	Dytiscidae	Hygrotus sellatus					Hygrotus sellatus	
Coleoptera	Haliplidae				Haliplus			Haliplus
Coleoptera	Hydraenidae						Ochthebius	
Coleoptera	Hydrophilidae				Tropisternus		Tropisternus	
Coleoptera	Hydrophilidae						Berosus	
Coleoptera	Hydrophilidae	Helophorus			Helophorus		Helophorus	Helophorus
Copepoda	Calanoida		Sinocalanus?				Sinocalanus?	
Crustacean	Cladoceran				Cladoceran	Cladoceran		
Diptera	Chironomidae	Chironomidae	Chironomidae	Chironomidae	Chironomidae	Chironomidae	Chironomidae	
Ephemeroptera	Baetidae			Procloeon	Procloeon	Procloeon		
Hemiptera	Corixidae	Early Instar					Early Instar	Early Instar
Hemiptera	Corixidae		Hesperocorixa	Hesperocorixa	Hesperocorixa	Hesperocorixa	Hesperocorixa	
Hemiptera	Gerridae	Gerris						Limnoporus
Hemiptera	Notonectidae	Notonecta kirbyi		Notonecta kirbyi	Notonecta kirbyi	Notonecta kirbyi		Notonecta kirbyi
Hemiptera	Saldidae	Specimen in rough shape						
Lepidoptera	Noctuidae	Semi-aquatic						
Molluska	Bivalvia				Sphaeriidae	Sphaeriidae		
Molluska	Gastropoda			Stagnicola	Stagnicola			Stagnicola
Molluska	Gastropoda			Physella	Physella			
Odonata	Aeshnidae				Anax junius	Anax		Anax
Odonata	Coenagrionidae			Enallagma annexum	Enallagma annexum	Enallagma annexu	Telebasis salva	
Odonata	Lestidae	Archilestes californica		Archilestes californica	Archilestes californica			
Odonata	Libellulidae			Libellula composita	Libellula composita			Libellula comanche
Trichoptera	Limniphilidae			Limnephilus	Limnephilus	Limniphilus		

Table 4. Invertebrates collected in dune ponds during 2014. Taxa with question marks indicate the most likely identification given the available keys or condition of the specimen. An "x" indicates the presence of an invertebrate at the taxonomic level listed on the left.

Order/Class	Family	Dune 1	Dune2	Dune 7	Dune 8	Dune 9	Dune 13
Diptera	Chironomidae (larva)	x	x	x			
Diptera	Chironomidae (pupa)	x				x	
Diptera	Ceratopogonidae (larva)	Culicoides & Bezzia/Palpomyia	Culicoides & Bezzia/Palpomyia				Leptocenops
Diptera	Ceratopogonidae (pupa)	x	x				x
Diptera	Dolichopodidae (larva)					x	x
Diptera	Dolichopodidae (pupa)					x	
Diptera	Culicidae (larva)	Aedes & Culiseta					
Diptera	Culicidae (pupa)	x					
Diptera	Dixidae (larva)	Dixella					
Diptera	Tipulidae (larva)	Oriomosia?					
Diptera	Stratiomyiidae (larva)	Odontomyia	Nemotelus				
Diptera	Unk larva		x				x
Diptera	Unk pupa			x		x	
Coleoptera	Dytiscidae (adult)	Hygrotus	Desmopachria				
Coleoptera	Dytiscidae (larva)		Agabus? & unk early instar				
Coleoptera	Hydrophilidae (adult)	Hydrobius & Helophorus	Helophorus	Laccophilus			Helophorus
Coleoptera	Heteroceridae (adult)					x	x
Coleoptera	Staphylinidae (adult)	x				x	x
Coleoptera	Carabidae (adult)						
Coleoptera	Carabidae (larva)	x					
Coleoptera	Cicindelidae (now Carabidae)						x
Hemiptera	Corixidae		Corisella?				
Hemiptera	Notonectidae			Notonecta kirbyi			
Hemiptera	Unk adult						x
Hemiptera	Unk larva	x	x	x			
Ephemeroptera	Caenidae			Caenis			
Odonata	Lestidae		Lestes				
Odonata	Libellulidae		Pachydiplax				
Collembola	Collembola	x					x
Annelida	Oligochaeta	x	x	x			
Annelida	Hirudinea			Hellobdella stagnalis			
Mollusk	Gastropoda		Physa acuta	Physidae			
Mollusk	Gastropoda	Gyraulus parvus	Lymnaeidae	Lymnaeidae			
Mollusk	Gastropoda			Gyraulus deflectus			
Mollusk	Bivalvia			Sphaeriidae			
Crustcea	Cladocera	Daphnia pulex	Daphnia pulex		ephippia only		
Crustcea	Copepoda	Homocyclops?					
Arachnida	Acari			x			

Dune Pond 1

Date: 19 June 2014

Coordinates: 41.99153°N -109.23430°W NAD83

Elevation: 2053 m

Pond Description: Enclosed in fence, shallow water and area covered with rushes

Habitat in pond: Rushes cover entire pond

Pond substrate: Sand and organic matter

Size: 57 x 20 m

Depth: 2 cm

Invertebrates (see tables 1 and 2 for complete list)**:**

Trueflies: No-see-um (*Culicoides*, *Bezzia*/*Palpomyia*), Mosquitos (*Aedes*, *Culiseta*), Meniscus midges (*Dixella*), Cranefly (likely *Oriomosia*), Soldierfly (*Odontomyia*)

Beetles: Predaceous diving beetles (*Hygrotus*), Water scavenger beetles (*Hydrobius*, *Helophorus*)

Snails: Ramshorn snail (*Gyraulus parvus)*

Crustaceans: Water fleas (*Daphnia pulex*), Copepods (likely *Homocyclops*)

Dune Pond 2

Dates: 10 July 2012 and 19 June 2014

Coordinates: 41.99128°N -109.23564 NAD83

Elevation: 2063 m

Pond Description: Pond inside enclosure at margin of dunes

Habitat in pond: Bull rushes around margin of pond, submerged aquatic vegetation on bottom

Pond substrate: Sand and silt, black and anoxic below surface

Width: 18 m

Depth: 8 cm

Invertebrates (see tables 1 and 2 for complete list)**:**

Trueflies: No-see-um (*Culicoides*, *Bezzia*/*Palpomyia*), Soldierfly (*Nemotelus*), Non-biting midges (Chironomidae)

Beetles: Predaceous diving beetles (*Desmopachria, Hygrotus sellatus,* likely *Agabus*), Water scavenger beetles (*Helophorus*)

True bugs: Water boatmen (likely *Corisella*), Water skaters (Gerris), Backswimmers (*Notonecta kirbyi*), Shorebugs (Saldidae)

Damselflies: Skimmers (*Archilestes californica*)

Dune Pond 4

Date: 15 July 2012

Coordinates: 41.99197°N -109.23733°W NAD83

Elevation: 2065 m

Pond Description: No riparian vegetation, used by cattle

Habitat in pond: Open water, floating algae and some rushes

Pond substrate: Silt and sand, anoxic below surface

Size: 32 m

Depth: 15 cm

Invertebrates (see tables 1 and 2 for complete list)**:**

Trueflies: Non-biting midges (Chironomidae)

True bugs: Water boatmen (*Hesperocorixa*)

Crustaceans: Water fleas (likely *Sinocalanus*)

Dune Pond 5

Date: 10 July 2012

Coordinates: 41.99450°N -109.24994°W NAD83

Elevation: 2073

Pond Description: Long and narrow pond east of railroad grade

Habitat in pond: Submerged aquatic vegetation

Pond substrate: Mostly sand, some silt

Size: 5 x 37 m

Depth: 90 cm

Invertebrates (see tables 1 and 2 for complete list)**:**

Trueflies: Non-biting midges (Chironomidae)

Mayflies: Small minnow mayflies (*Procloeon*)

True bugs: Water boatmen (*Hesperocorixa*), Backswimmers (*Notonecta kirbyi*)

Dragonflies: Skimmer (*Libellula composita*)

Damselflies: Narrow-winged damselflies (*Enallagma annexum*), Skimmers (*Archilestes californica*)

Snails: Bladder snails (*Physella*), Pond snails (*Stagnicola*)

Dune Pond 5L

Date: 11 July 2012

Coordinates: 41.99419°N -109.25075°W NAD83

Elevation: 2066

Pond Description: Shallow, elongate pond used by cattle

Habitat in pond: Submerged aquatic vegetation

Pond substrate: Sand and silt

Size: 8 x 37 m

Depth: 18 cm

Invertebrates (see tables 1 and 2 for complete list)**:**

Trueflies: Non-biting midges (Chironomidae)

Mayflies: Small minnow mayflies (*Procloeon*)

Caddisfly: Northern Caddisflies (*Limnephilus*)

True bugs: Water boatmen (*Hesperocorixa*), Backswimmers (*Notonecta kirbyi*)

Dragonflies: Skimmer (*Libellula composita*), Green darner (*Anax junius*)

Damselflies: Narrow-winged damselflies (*Enallagma annexum*), Skimmers (*Archilestes californica*)

Snails: Bladder snails (*Physella*), Pond snails (*Stagnicola*)

Clams: Fingernail clam (Sphaeriidae)

Crustaceans: Water flea (Cladoceran)

Dune Pond 7

Dates: 11 July 2012 and 19 June 2014

Coordinates: 41.99475°N -109.25147°W NAD83

Elevation: 2071 m

Pond Description: U-shaped pond, used by cattle, tiger salamander larvae use the pond

Habitat in pond: Algae and submerged aquatic vegetation

Pond substrate: Mostly sand and some silt

Size: 32 x 23 m

Depth: 60 cm

Invertebrates (see tables 1 and 2 for complete list)**:**

Trueflies: Non-biting midges (Chironomidae)

Mayflies: Small minnow mayflies (*Procloeon*), Small squaregill mayflies (*Caenis*)

Caddisfly: Northern Caddisflies (*Limnephilus*)

Beetles: Predaceous diving beetles (*Agabus*, *Coptotomus*), Water scavenger beetles (*Laccophilus*)

True bugs: Water boatmen (*Hesperocorixa*), Backswimmers (*Notonecta kirbyi*)

Dragonflies & **Damselflies:** Green darner (*Anax*), Narrow-winged damselflies (*Enallagma annexum*)

Snails: Bladder snails (Physidae), Pond snails (Lymnaeidae), Ramshorn snail (*Gyraulus deflectus*)

Clams: Fingernail clam (Sphaeriidae)

Crustaceans: Water flea (Cladoceran)

Mites: Water mites (Acari)

Leeches: (*Helobdella stagnalis*)

Dune Pond 8


Date: 18 June 2014

Coordinates: 41.98428°N -109.20835°W NAD83

Elevation: 2034 m

Pond Description: At margins of dunes, drying

Habitat in pond: No vegetation

Pond substrate: Clay and sand, soft, anoxic sediments

Size: 83 x 58 m

Depth: 2.5 cm

Invertebrates:

Cladocera ephippia (dormant eggs)

Dune Pond 9

Date: 18 June 2014

Coordinates: 41.99313°N -109.21032°W NAD83

Elevation: 2041 m

Pond Description: Pond in sand dunes

Habitat in pond: Shallow pond lacking vegetation

Pond substrate: Sand

Size: 9 x 39 m

Depth: 6 cm

Invertebrates (see tables 1 and 2 for complete list):

Trueflies: Non-biting midges (Chironomidae), Long-legged flies (Dolichopodidae)

Dune Pond 10

Date: 10 July 2012

Coordinates: 41.99050°N -109.24386°W NAD83

Elevation: 2057 m

Pond Description: L-shaped pond, used by cattle, poor water clarity

Habitat in pond: Very little vegetation in pond

Pond substrate: Sand and silt

Size: 6 x 30 m

Depth: 15 cm

Invertebrates (see tables 1 and 2 for complete list)**:**

Trueflies: Non-biting midges (Chironomidae)

Beetles: Predaceous diving beetles (*Agabus*, *Laccophilus, Hygrotus sellatus*), Minute moss beetles (*Ochthebius*), Water scavenger beetles (*Tropisternus*, *Berosus*, *Helophorus*)

True bugs: Water boatmen (*Hesperocorixa*)

Damselflies: Narrow-winged damselflies (*Telebasis salva*)

Crustacea: Copepods (likely *Sinocalanus*)

Leeches: (*Helobdella stagnalis*)

Dune Pond 12

Date: 11 July 2012

Coordinates: 41.99611°N -109.25497°W NAD83

Elevation: 2074 m

Pond Description: Small pond used by cattle

Habitat in pond: Rushes and submerged aquatic vegetation

Pond substrate: Sand and silt

Size: 3 x 18 m

Depth: 46 cm

Invertebrates (see tables 1 and 2 for complete list)**:**

Beetles: Predaceous diving beetles (*Laccophilus*), Water scavenger beetles (*Helophorus*), Crawling water beetles (*Haliplus*)

True bugs: Backswimmers (*Notonecta kirbyi*), Water skaters (*Limnoporus*)

Dragonflies: Skimmer (*Libellula comanche*), Green darner (*Anax*)

Snails: Pond snails (*Stagnicola*)

Dune Pond 13

Date: 18 June 2014

Coordinates: 41.99597°N -109.20647°W NAD83

Elevation: 2041 m

Pond Description: In dunes, 3 ponds drying in depression that were previous connected

Habitat in pond: Rushes in on pond, no vegetation in other ponds

Pond substrate: Sand with organic matter and silt layer on top

Size: 18 x 39 m

Depth: 9 cm

Invertebrates (see tables 1 and 2 for complete list)**:**

True flies: No-see-ums (*Leptocenops*), Long-legged flies (Dolichopodidae)

Beetles: Water scavenger beetles (*Helophorus*)

Photos of some aquatic invertebrates collected in the dune ponds.

Dragonflies and damselflies

Beetles


Agabus
Berosus
Coptotomus
Hygrotus sellatus
Ochthebius
Tropisternus

True bugs

Crustacean

Caddisflies

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