### Figures

1	Figures
2	
2 3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16 17	
17	
10	
20	
20	
22	
23	
24	
25	NOTE: This information is distributed solely for the purpose of pre-dissemination peer
26	review under applicable information quality guidelines. It has not been formally
27	disseminated by the U.S. Environmental Protection Agency. It does not represent and
28	should not be construed to represent any agency determination or policy.
29	

## **1** Figures for Chapter 1, Executive Summary

2 3 4

Figure 1.1. Map showing the geographic distribution in the United States of SAP 4.4 case

- 4 studies.
- 5



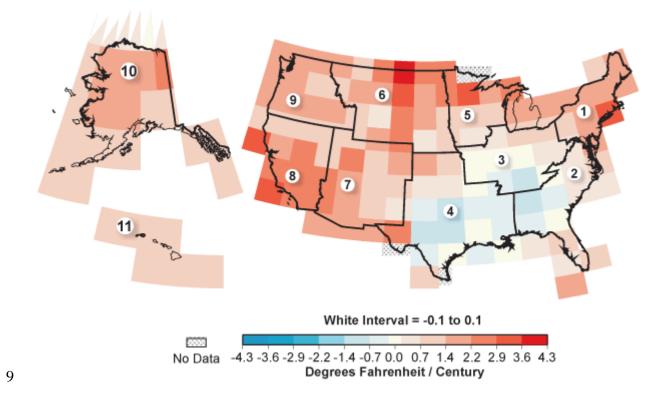
### 1 Figures for Chapter 2, Introduction

2 Figure 2.1. Annual mean temperature anomalies 1901–2003. *Red shades indicate warming over* 

3 *the period and blue shades indicate cooling over the period. Data courtesy <u>NOAA's National</u>* 

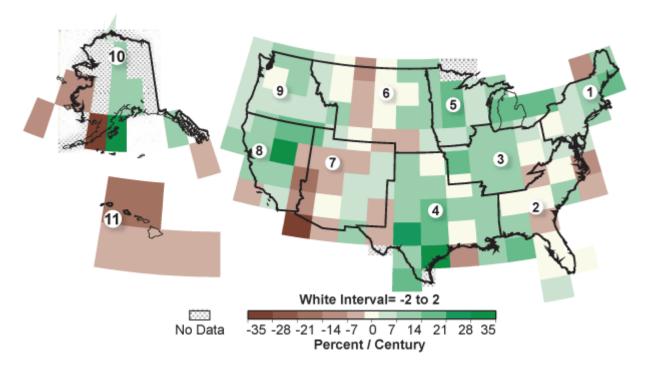
4 <u>Climatic Data Center</u>. Regions are: (1) Northeast, (2) Southeast, (3) Central, (4) South, (5) East

- 5 North Central, (6) West North Central, (7) Southwest, (8) West, (9) Northwest, (10) Alaska,(11)
- 6 Hawaii.
- 7
- 8

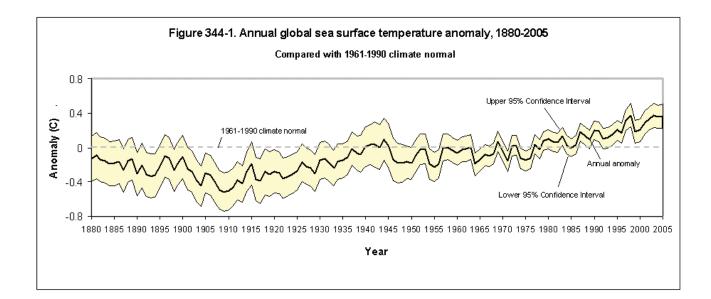


#### SAP 4.4. Adaptation Options for Climate-Sensitive Ecosystems and Resources | Figures

- 1 **Figure 2.2.** Annual precipitation anomalies 1895–2003. *Green shades indicate a trend towards*
- 2 wetter conditions over the period, and brown shades indicate a trend towards dryer conditions.
- 3 Data courtesy <u>NOAA's National Climatic Data Center</u>. Regions are: (1) Northeast, (2)
- 4 Southeast, (3) Central, (4) South, (5) East North Central, (6) West North Central, (7) Southwest,
- 5 (8) West, (9) Northwest, (10) Alaska,(11) Hawaii.
- 6
- 7



- 2 Figure 2.3. Annual global sea surface temperature anomaly, 1880–2005, compared with 1961–
- 3 1990 climate normal (U.S. Environmental Protection Agency, 2007).

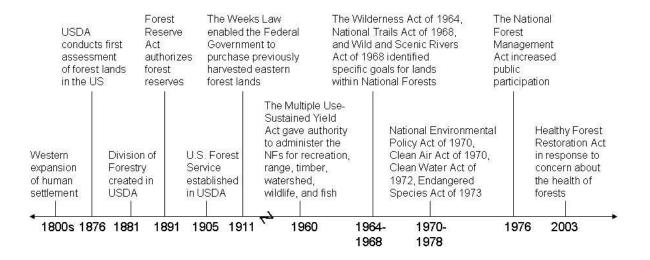


### 1 Figures for Chapter 3, National Forests

2 3

### Figure 3.1. Timeline of National Forest System formation and the legislative influences on the

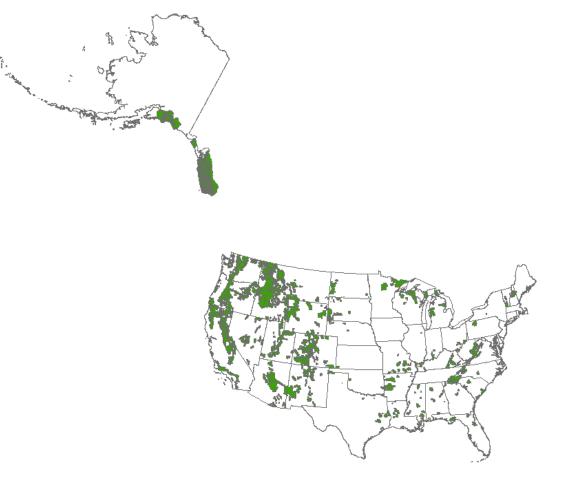
- 4 mission of the national forests.
- 5



# Figure 3.2. Jurisdiction and organizational levels within the National Forest System.

Level of C	Organization	Jurisdiction		
	USDA			
National	Under Secretary for Natural Resources and Environment Chief of Forest Service	The Chief's staff provides broad policy and direction for the agency, works with the President's Administration to develop a budget to submit to Congress, provides information to Congress on accomplishments, and monitors activities of the agency.		
Regional	9 Regional Forests ——— ∏	The regional office staff coordinates activities between national forests, monitors activities on national forests to		
Forest	Forest Supervisors for 155 national forests	ensure quality operations, provides guidance for forest plans, and allocates budgets to the forests.		
	and 20 grasslands 	The forest level coordinates activities between districts, allocates the budget, and provides technical support to each district.		
District	600 Ranger Districts 10-100 staff in each ranger district manages from 50,000 acres to 1 million+ acres of land	<ul> <li>Many on-the-ground activities occur in the ranger districts, including trail construction and maintenance, operation of campgrounds, and management of vegetation and wildlife habitat.</li> </ul>		

- 1 **Figure 3.3.** One hundred fifty-five National Forests and 20 National Grasslands across the
- 2 United States provide a multitude of goods and ecosystems services, including biodiversity
- 3 (USDA Forest Service Geodata Clearinghouse, 2007).



- Figure 3.4. Historical harvest levels and grazing across the National Forests (USDA FS Forest 1 Management; Mitchell, 2000).
- 2

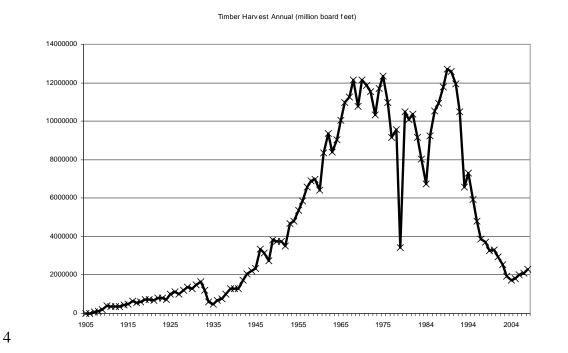
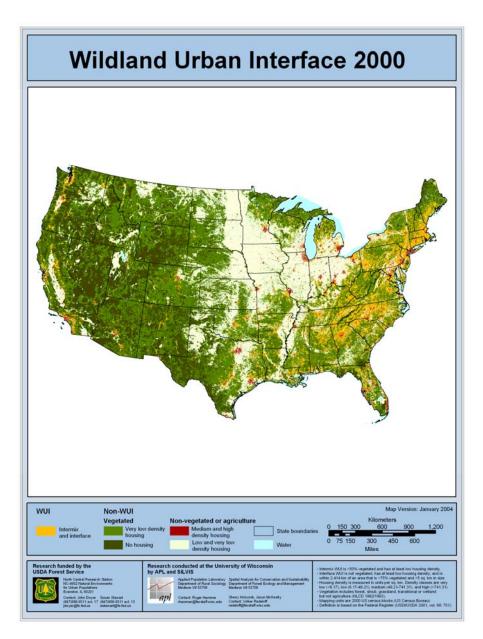


Figure 3.5. Wildland Urban Interface across the United States (Radeloff et al., 2005).



1 Figure 3.6. Influence of non-native earthworms on eastern forest floor dynamics (Frelich *et al.*,

2 2006). Forest floor and plant community at base of trees before (a, left-hand photo) and after (b)

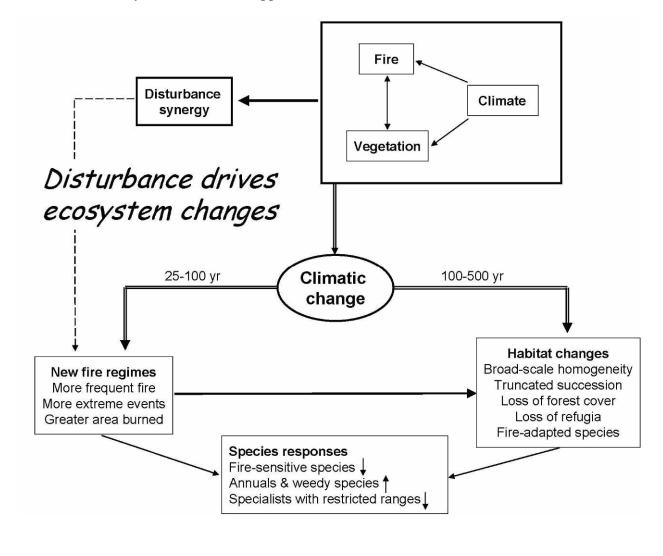
3 European earthworm invasion in a sugar maple-dominated forest on the Chippewa National

4 Forest, Minnesota, USA. Photo credit: Dave Hansen, University of Minnesota Agricultural

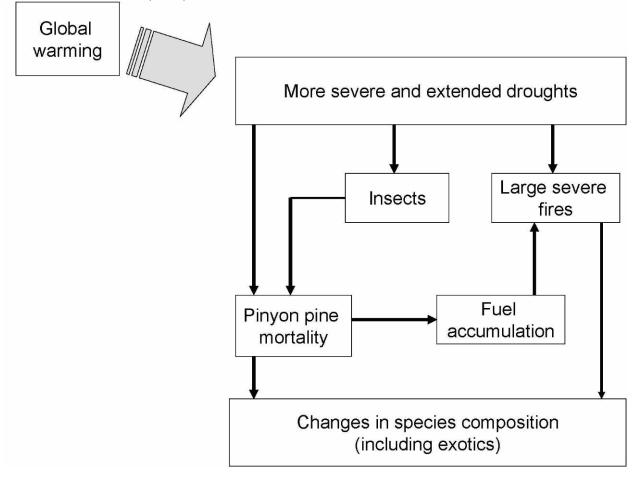
5 Experimental Station.



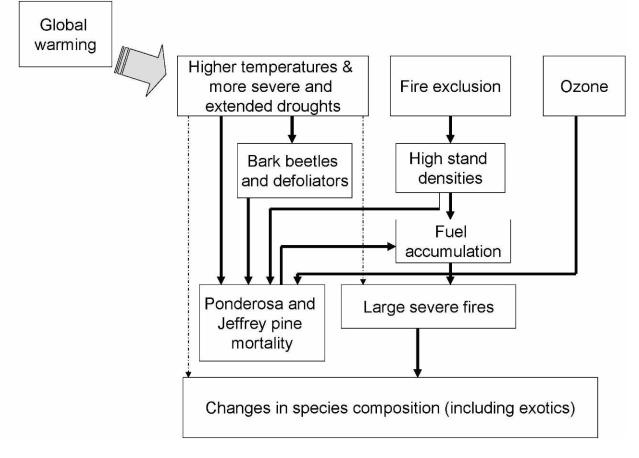
- **Figure 3.7.** Conceptual model of the relative time scales for disturbance vs. climatic change
- 2 alone to alter ecosystems. Times are approximate. From McKenzie *et al.* (2004).



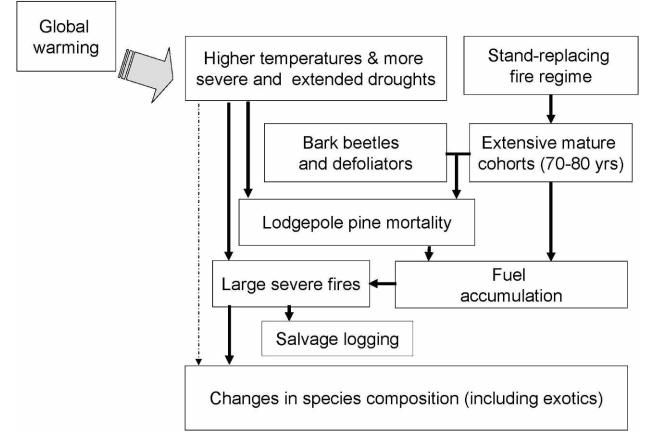
- 1 Figure 3.8. Stress complex in pinyon-juniper woodlands of the American Southwest. Adapted
- 2 from McKenzie *et al.* (2004).



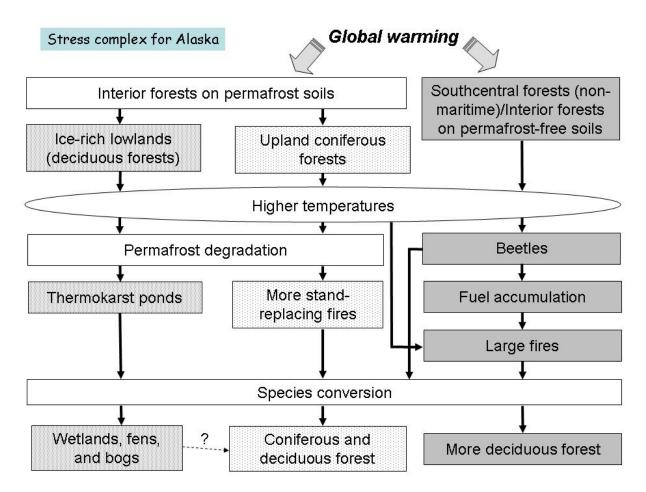
- 1 Figure 3.9. Stress complex in Sierra Nevada and southern Californian mixed-conifer forests.
- 2 From McKenzie, Peterson, and Littell (In Press).



- 1 Figure 3.10. Stress complex in interior (BC and USA) lodgepole pine forests. From McKenzie,
- 2 Peterson, and Littell (In Press).



**Figure 3.11.** Stress complex in the interior and coastal forests of Alaska. From McKenzie, Peterson, and Littell (In Press).



		Anticipatory	Reactive		
Natural Systems			<ul> <li>Changes in length of growing season</li> <li>Changes in ecosystem composition</li> <li>Wetland migration</li> </ul>		
an ms	Private	<ul> <li>Purchase of insurance</li> <li>Construction of house on stilts</li> <li>Redesign of oil-rigs</li> </ul>	<ul> <li>Changes in farm practices</li> <li>Changes in insurance premiums</li> <li>Purchase of air-conditioning</li> </ul>		
Human Systems	Public	<ul> <li>Early-warning systems</li> <li>New building codes, design standards</li> <li>Incentives for relocation</li> </ul>	<ul> <li>Compensatory payments, subsidies</li> <li>Enforcement of building codes</li> <li>Beach nourishment</li> </ul>		

Figure 3.12. Anticipatory and reactive adaptation for natural and human systems (IPCC, 2001).

- **Figure 3.13.** Map and location of the Tahoe National Forest, within California (a) and the Forest
- 2 boundaries (b) (USDA Forest Service, 2007a; USDA Forest Service, 2007b).



1 b)



- 1 Figure 3.14. Thinned stands for fuel reduction and resilience management, part of the Herger-
- 2 Feinstein Quincy Library Pilot Project. Photo courtesy of Tahoe National Forest.



1 **Figure 3.15.** Former salmon habitat (rivers marked in bold black) of the Sierra Nevada. Tahoe

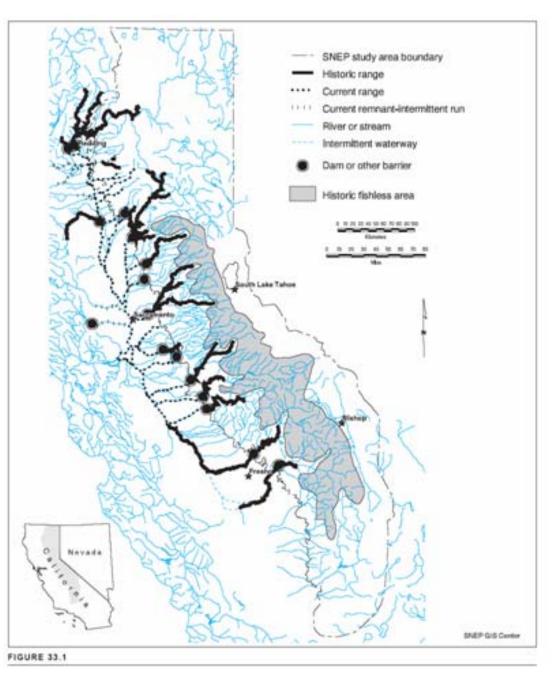
2 National Forest (TNF) rivers are scheduled to have salmon restored to them in current national

3 forest planning. Adaptive approaches suggest that future waters may be too warm on the TNF for

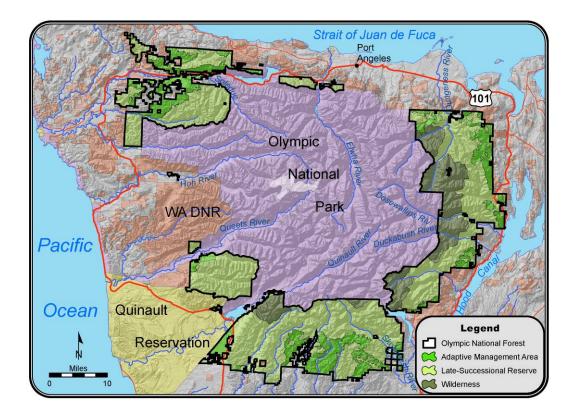
4 salmon to survive, and thus, restoration may be inappropriate to begin. Map adapted from (Sierra

5 Nevada Ecosystem Project Science Team, 1996).

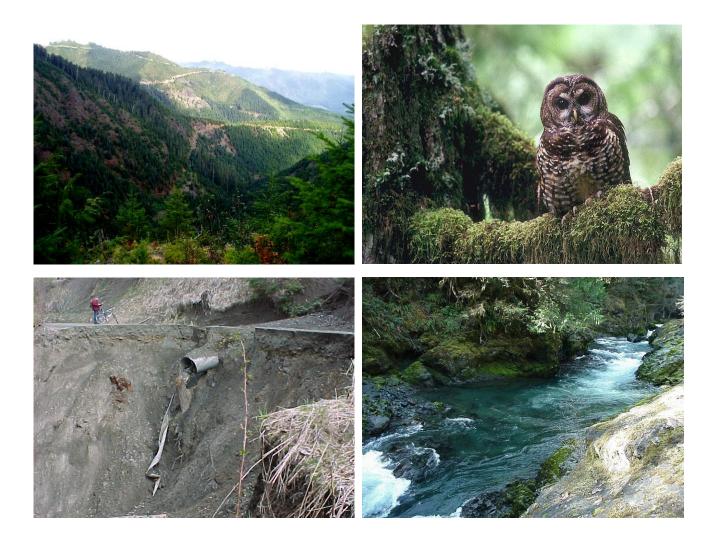
6



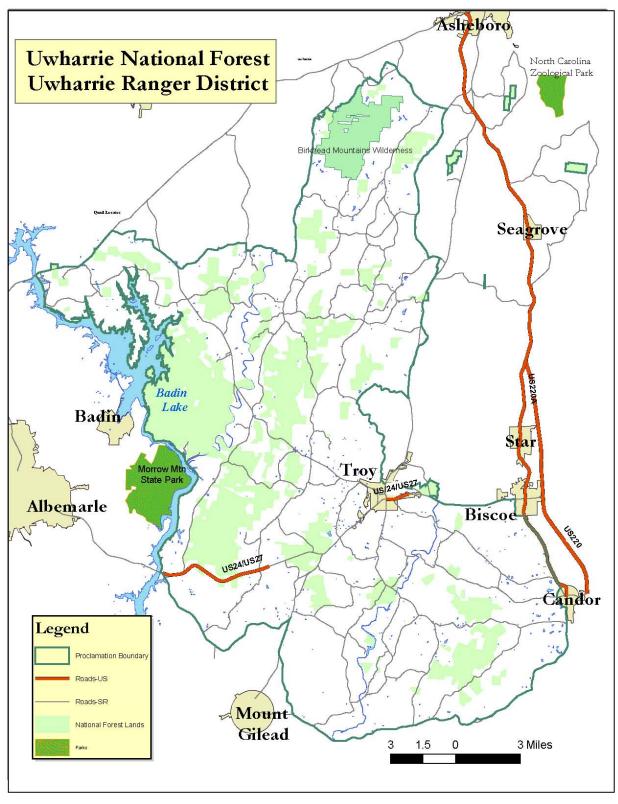
- 1 **Figure 3.16.** Olympic Peninsula land ownership and Northwest Forest Plan allocation map.
- 2 Olympic National Forest contains lands (dark boundary) with different land use mandates and
- 3 regulations. These include adaptive management areas, late-successional reserves, and
- 4 Wilderness areas. Map courtesy of Robert Norheim, Climate Impacts Group, University of
- 5 Washington.



- 1 **Figure 3.17.** Olympic National Forest is charged with mitigating the legacy of 20th century
- 2 timber harvest. Landscape fragmentation and extensive road networks (upper left) are
- 3 consequences of this legacy that influence strategies for adaptation to climate change. The old-
- 4 growth forest dependent northern spotted owl (upper right) is one focus of the NWFP, which
- 5 prescribes forest practices but does not address climatic change. Changes in the timing and 6 intensity of runoff expected with climate change are likely to interact with this legacy to have
- negative impacts on unmaintained roads (lower left) that in turn will impact water quality for
- 8 five threatened or endangered species of anadromous and resident fish. Photo Credits: All photos
- 9 courtesy Olympic National Forest.
- 10
- 11
- 12



- 1 Figure 3.18. Map of the Uwharrie National Forest in North Carolina (USDA Forest Service,
- 2 2007c).



# 1 Figures for Chapter 4, National Parks

2 3 4

Figure 4.1. Photograph looking up from the Colorado River at the Grand Canyon, courtesy of

Jeffrey Lovich, USGS.



Figure 4.2. Everglades National Park, Photo courtesy of National Park Service; photo by
 Rodney Cammauf.



- 1 **Figure 4.3.** Photograph of Joshua tree in Joshua Tree National Park. Photo courtesy of National
- 2 <u>Park Service</u>.



### 1 **Figure 4.4.** Historical timeline of the National Park Service. Adapted from the National Park

### 2 Service (2007a).

Two executive orders tran the War Department's par monuments and the Fores Service's monuments to tl	sferred <sup>/</sup> ks and <sup>e</sup> t t	The National Trail: Act provided for th establishment of n rails and designat national scenic tra	s System Parl e enc hational prot red two parl ills. Parl Parl	twood National k Expansion Act ouraged the ection of national ss from external ats. The National ks and Recreation authorized the	The Vail Agenda add and needs of the nat 21st Century and ma park management g research.	ional parks in the ade an urgent call for rounded in scientific
The Organic Act established the NPS and placed all the existing parks under its management. Yellowstone National Park Act established Yellowstone NP "as a public park or pleasuring- ground for the benefit and enjoyment of the people" under control of the Secretary of the Interior.	Mission 66, program, up facilities, sta resource main throughout to The Wilderness Act established a National Wilderness Preservation System that would be administered in a way that would leave them unimpaired fo the use and enjoyment.	affing, and anagement the System. The Land and Water Conservation Fund Act established a fund for acquiring new recreation lands either within or adjacent to park units.	add to th	national parks, including the responsibility to participate in the decision making the determines the qua of the air affecting parks. or The Alaska National Interest Lands Conservation Act added more than 47	National Park Omnibus Management Act provided	The National Park Service's Action Plan for Preserving Natural Resources, the Natural Resource Challenge, establishes a strong resource management program based on the inventory, monitoring, and scientific assessment of NPS natural resources.
1872 1876 1906 19	2.50	956-1965-19 966	68 1970 1	978 1980 1990	1992 1998 1	999 2007

### 1 **Figure 4.5.** Organizational chart of National Park Service. Adapted from the National Park

2 Service (2007b).

Level of Organization	Jurisdiction
U.S. Department of Interior National Park Service	National Park Service (NPS) headquarters provides national level leadership and advocacy, policy and regulatory formulation and direction, program guidance, budget formulation, legislative support, accountability for all programs and activities, and management for Servicewide programs. This includes oversight of the 32 Inventory and Monitoring Network Offices. National Program Centers within the headquarters office provide professional and technical support services to regions and park units.
Regional Offices →	The seven regions in the NPS are each headed by a regional director (who reports to a Deputy Director at the NPS Headquarters). NPS regional directors for each of the seven NPS regions are responsible for strategic planning and direction, policy oversight, and assistance in public involvement, media relations, and strategies for parks and programs within the region. Regional directors are also responsible for program coordination, budget formulation, and financial management.
National Parks	Each National Park is headed by a superintendent or park manager who manages all park operations to achieve program goals and also directs and controls all program activities. The nearly 400 National Parks include: national parks, national preserves, national monuments, national memorials, national historic sites, national seashores, and national battlefields.

# Figure 4.6. Map of the National Park System. Data courtesy of National Park Service, Harpers 1 2 3

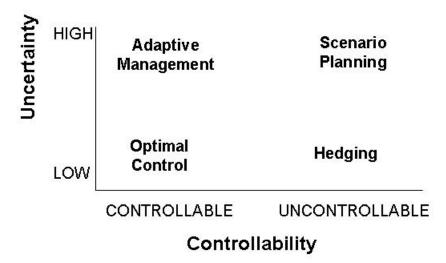
- Ferry Center (2007).



- 1 **Figure 4.7.** Kemp's Ridley hatchlings heading for the water at a hatchling release. Photo
- 2 courtesy National Park Service, Padre Island National Seashore.



- 1 **Figure 4.8.** Scenario planning is appropriate for systems in which there is a lot of uncertainty
- 2 that is not controllable. In other cases optimal control, hedging, or adaptive management may be
- 3 appropriate responses. Reprinted from Peterson, Cumming, and Carpenter (2003).



- 1 Figure 4.9. Photos of Arapahoe Glacier in 1898 and 2004 (NSIDC/WDC for Glaciology,
- 2 Boulder, Compiler, 2006).



Arapahoe Glacier 1898

Arapahoe Glacier 2004

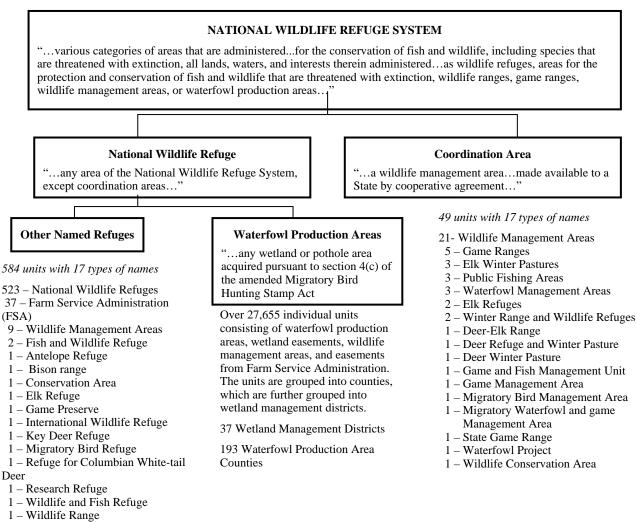
- 1 2 Figure 4.10. Photo pair of Rowe Glacier, with permissions, NSIDC and leachfam website (Lee,
- 1916; Leach, 1994).



### **1** Figures for Chapter 5, National Wildlife Refuges

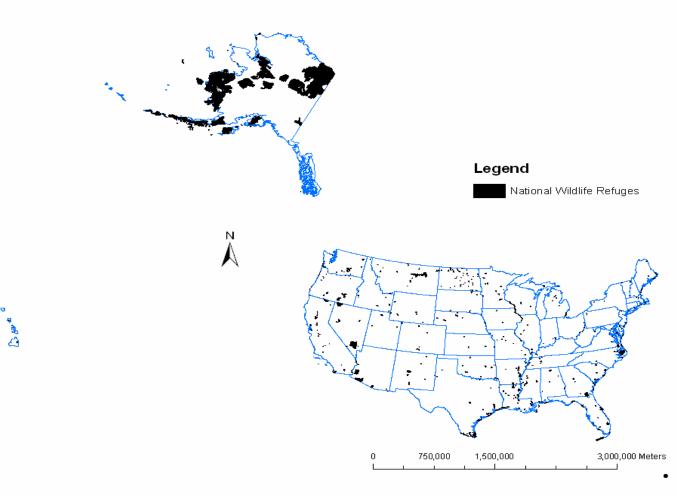
Figure 5.1. Structure of the NWRS. Adapted from Fischman (2003), Refuge Administration Act (1966), and FWS Regulations – CFR 50.

4



1 – Wildlife Refuge

- **Figure 5.2.** The National Wildlife Refuge System. Adapted from Pidgorna (2007).

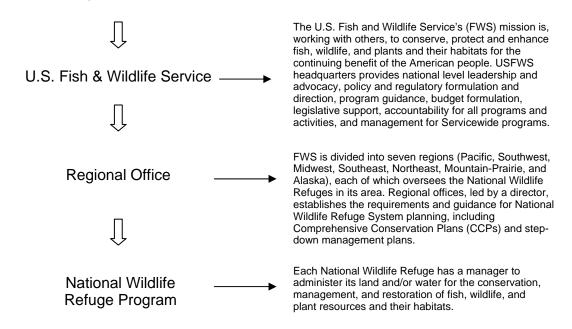


### 1 **Figure 5.3.** Organizational chart (U.S. Fish and Wildlife Service, 2007a).

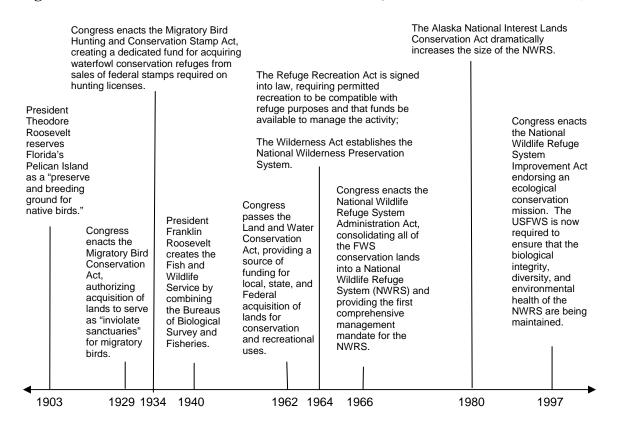
#### Level of Organization

#### Jurisdiction

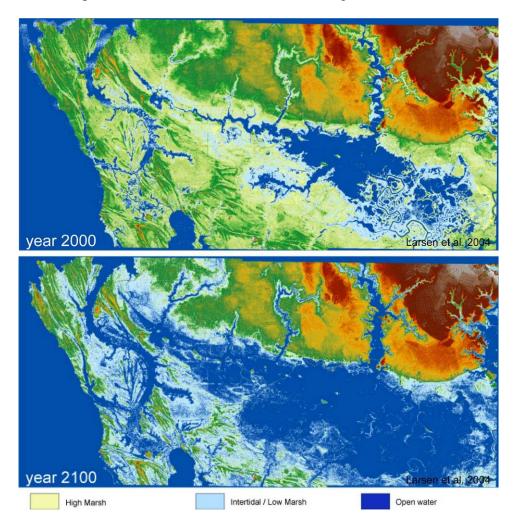
U.S. Department of the Interior



#### Figure 5.4. Timeline of milestone events of the NWRS (U.S. Fish and Wildlife Service, 2007d).



- **Figure 5.5.** Blackwater National Wildlife Refuge, Chesapeake Bay, Maryland. Current land
  - areas and potential inundation due to climate change (Larsen et al., 2004b).



## **Figure 5.6.** Results of the Sea Level Affecting Marshes Model (SLAMM) for Ding Darling

- 2 National Wildlife Refuge. Source: USFWS unpublished data (McMahon, Undated, 2007).

Ding [	Darling	SLAM	IM Re	sults
Habitat Type	Initial Condition	2100	Reduction	Percentage of Initial Refuge Area
Dry Land	823 hectares	271 hectares	67%	18%
Tidal Flats	967 hectares	12 hectares	99%	21%
Hardwood Swamp	650 hectares	271 hectares	58%	14%
Salt Marsh	28 hectares	16 hectares	43%	1%
Estuarine Beach	14 hectares	0.002 hectares	99%	<1%
Ocean Beach	2 hectares	0 hectares	100%	<1%
Inland Freshwater Marsh	6 hectares	1 hectare	83%	<1%
Mangrove	1,282 hectares	2,238 hectares	Increase of 75%	27%
Estuarine Open Water	863 hectares	1,891 hectares	Increase of 119%	18%
Inland Open Water	35 hectares	5 hectares	86%	1%
Open Ocean	0 hectares	2 hectares	?	0%

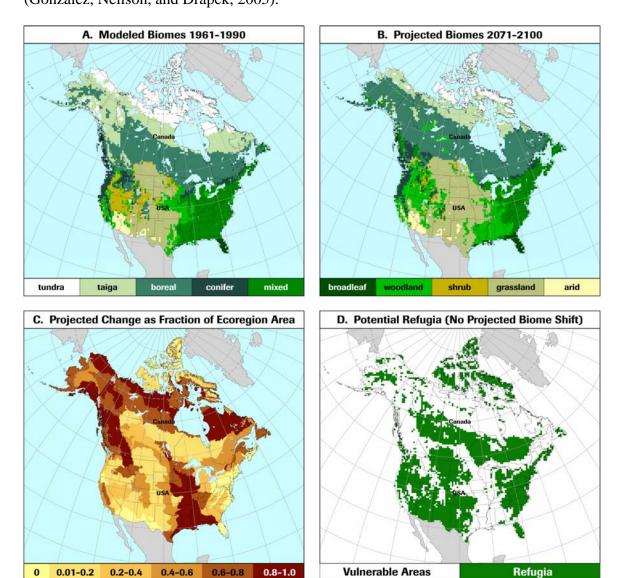
- 1 Figure 5.7. Ecoregions of North America (Level 1) (U.S. Environmental Protection Agency,
- 2 2007). 3

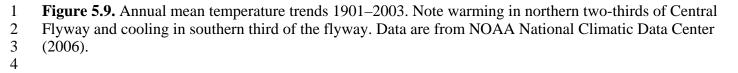


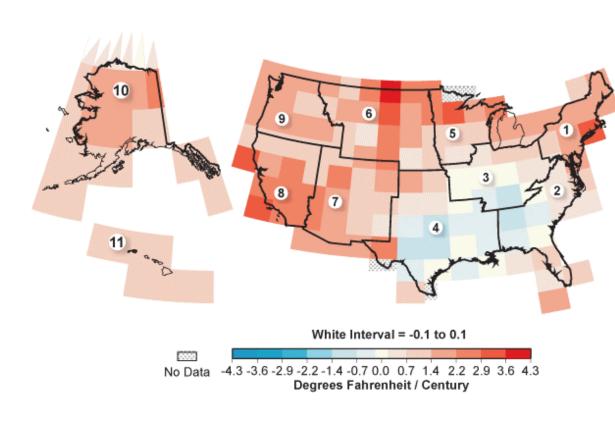
1 **Figure 5.8**. Potential climate change vegetation shifts across North America. A. Vegetation

2 1990. B. Projected vegetation 2100, HadCM3 general circulation model, IPCC (2000) SRES A2

emissions scenario. C. Projected change as fraction of ecoregion area. D. Potential refugia
 (Gonzalez, Neilson, and Drapek, 2005).



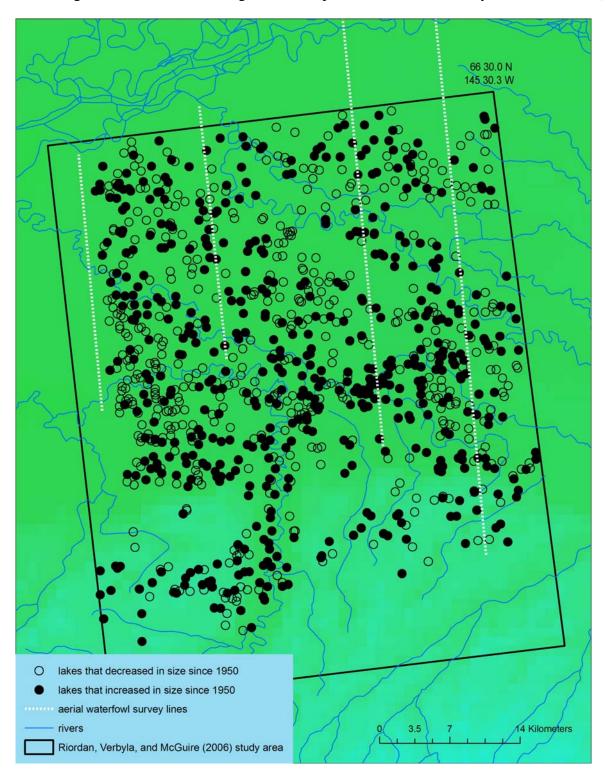




- 1 **Figure 5.10.** Central Flyway Waterfowl Migration Corridor (U.S. Fish and Wildlife Service,
- 2 2007b).



- **Figure 5.11.** Heterogeneity in closed-basin lakes with increasing and decreasing surface area, 1950–2000,
- 2 Yukon Flats NWR, Alaska. Net reduction in lake area was 18% with the area of 566 lakes decreasing, 364 lakes
- 3 increasing, and 462 lakes remaining stable. Adapted from Riordan, Verbyla, and McGuire (2006).
- 4



# 1 Figures for Chapter 6, Wild and Scenic Rivers

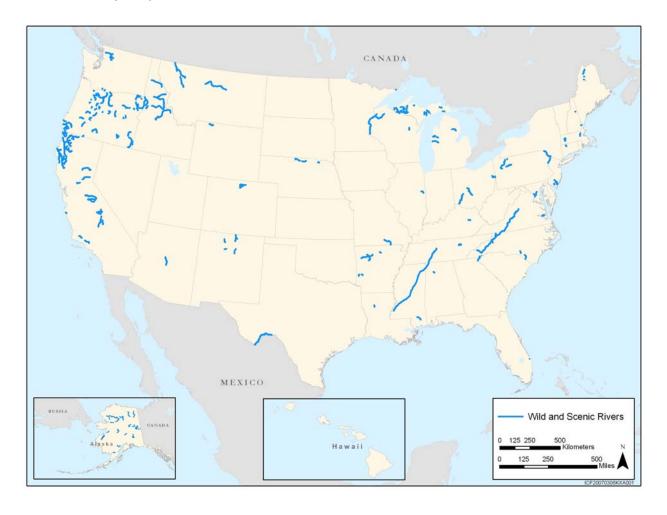
2 **Figure 6.1.** Photo of Snake River below Hell's Canyon Dam. Photograph compliments of

Marshall McComb, Fox Creek Land Trust.



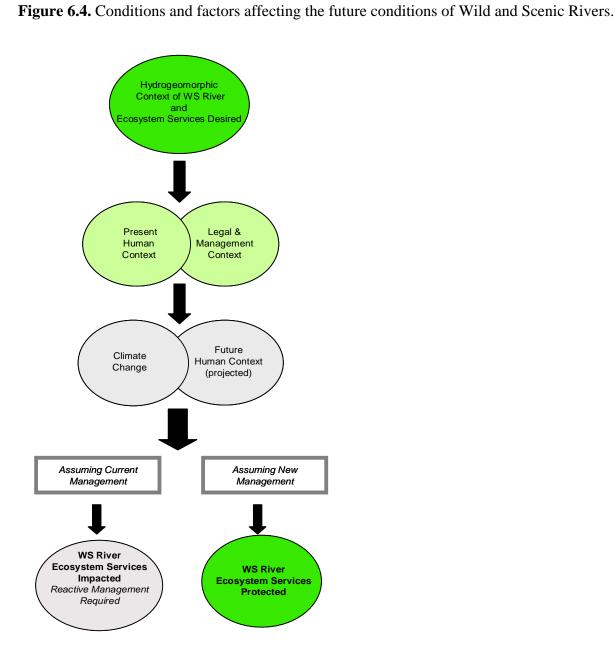
# Figure 6.2. Wild and Scenic Rivers in the United States. Data from USGS, National Atlas of the 1 2 3

- United States (2005).



- 1 2 3 4 Figure 6.3. Selected milestones in the evolution of the Wild and Scenic Rivers system. Adapted from National Wild and Scenic Rivers System website (2007a).

1970	1980	)	1990	2000	2010
<u> </u>	1	1		1	<u> </u>
scenic	Act	WSRs		of WSRs	Scenic
as wild and/or	Conservation	designated		administration	and/or
are designated	Land	guidelines for		addresses the	as Wild
first 8 rivers	Interests	management		Council Charter	designated
Act is passed;	National	also sets		Coordinating	are
Scenic Rivers	the Alaska	WSRs. It		Rivers	165 rivers
1968: Wild and	as result of	for potential		Wild & Scenic	of January,
	in Alaska	requirements		1995: Interagency	2007: As
	established	reporting			
	WSRs are	content, and			
	1980: 25	process and			
		evaluation			
		criteria, the			
		classification			
		<b>1982:</b> DOA sets			



#### SAP 4.4. Adaptation Options for Climate-Sensitive Ecosystems and Resources | Figures

- 1 **Figure 6.5.** Illustration of natural flow regimes from four unregulated streams in the United
- 2 States, (a) the upper Colorado River (CO), (b) Satilla Creek (GA), (c) Augusta Creek (MI), and
- 3 (d) Sycamore Creek (AZ). For each the year of record is given on the x-axis, the day of the water
- 4 year (October 1 September 30) on the y-axis, and the 24-hour average daily streamflow on the
- 5 z-axis (Poff and Ward, 1990).

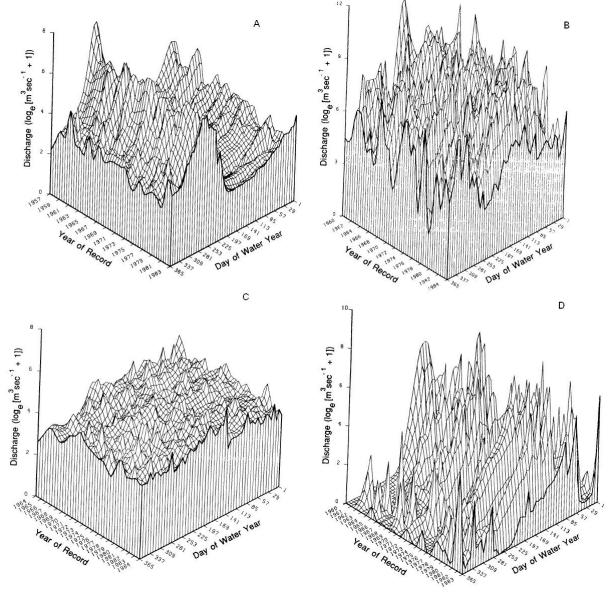
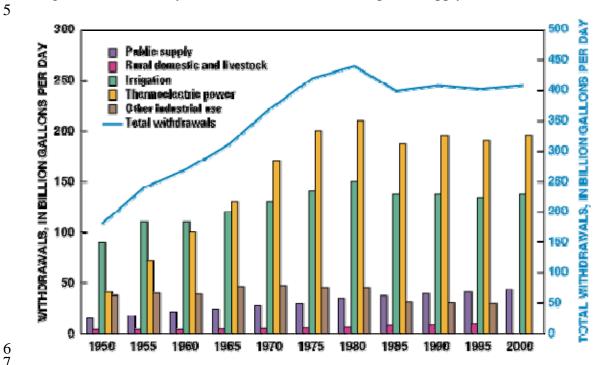


Figure 6.6. Trends in water withdrawals by water-use category. As the population has grown,

water has been increasingly withdrawn for public use since 1950 as indicated by total 

withdrawals (blue line). Water withdrawn for power production and water for irrigation represent 

largest use followed by water for industrial uses then public supply. From Hutson et al. (2004).



1 **Figure 6.7.** Changes in monthly average river flows on the Delaware River, in the Upper

2 Delaware Scenic and Recreational River segment. Lowered flows in December–July result from

3 upstream depletions for New York City water supply. Increased flows result from upstream

reservoir releases during summer months for the purpose of controlling salinity levels in the
 lower Delaware. Figure based on data provided by USGS (2007).

5 lower Delaware6

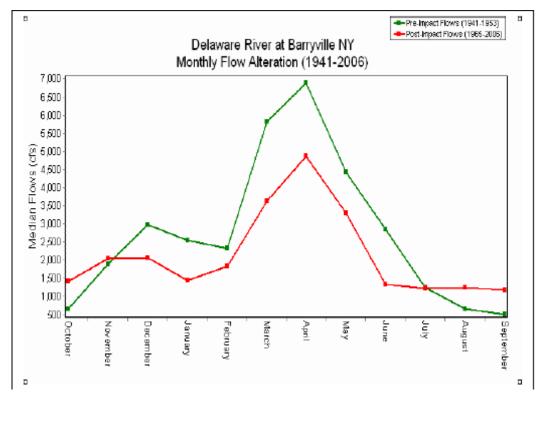
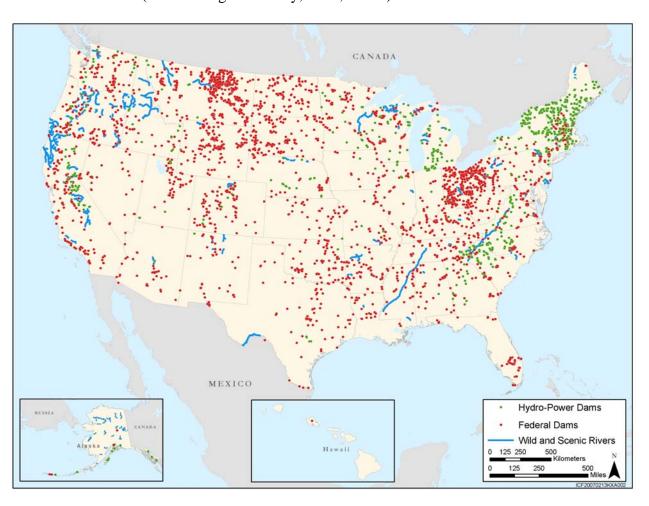


Figure 6.8. Location of dams and WSRs in the United States. Data from USGS, National Atlas of the United States (U.S. Geological Survey, 2005; 2006a).

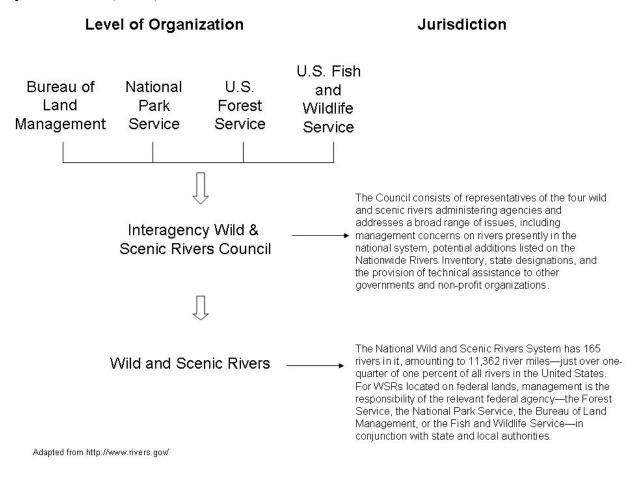


- Figure 6.9. Photo of scientists standing on the bed of an urban stream whose channel has been 1
- 2 incised more than 5 m due inadequate storm water control. Incision occurred on the time scale of
- 3 4 a decade but the bank sediments exposed near the bed are marine deposits laid down during the
- Miocene epoch. Photograph courtesy of Margaret Palmer.
- 5



#### 1 Figure 6.10. Organization of the WSR system. Adapted from National Wild and Scenic Rivers

2 System website (2007a).

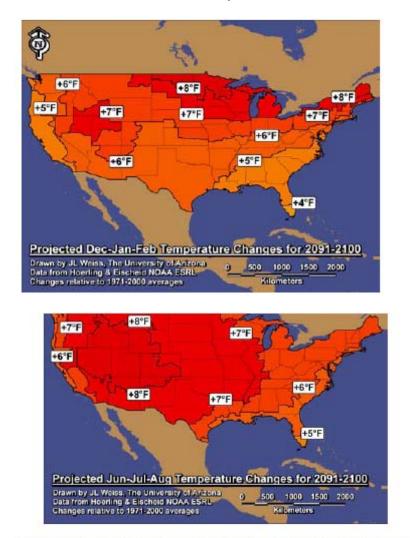


3 4

- 1 **Figure 6.11.** Farmington WSR. Photo compliments of the Farmington River Watershed
- 2 Association.



- 1 Figure 6.12. Projected temperature changes for 2091-2100 (University of Arizona,
- 2 Environmental Studies Laboratory, 2007).\*
- 3



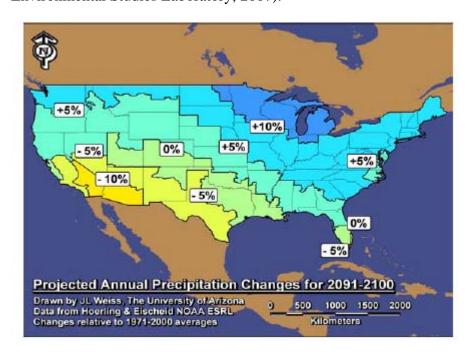
(www.geo.arizona.edu/dgesl/research/regional/projected\_US\_climate\_change.htm

6 7

\* Note: This figure is provisional, based on securing permission to reprint.

Figure 6.13. Projected annual precipitation changes for 2091-2100 (University of Arizona, Environmental Studies Laboratory, 2007).

4



5 6 7

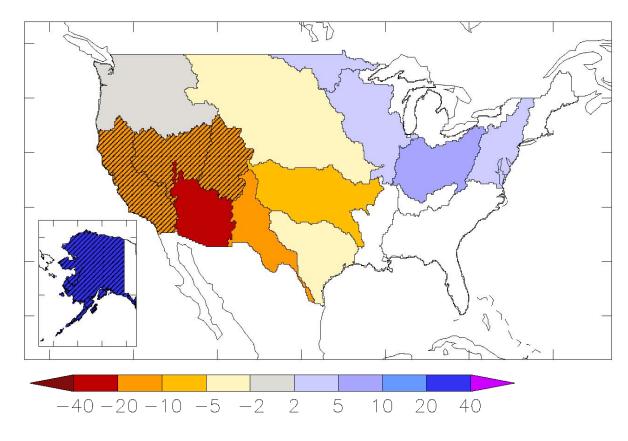
\* Note: This figure is provisional, based on securing permission to reprint.

**Figure 6.14.** Median, over 12 climate models, of the percent changes in runoff from United

2 States water resources regions for 2041–2060 relative to 1901–1970. More than 66% of models

3 agree on the sign of change for areas shown in color; diagonal hatching indicates greater than

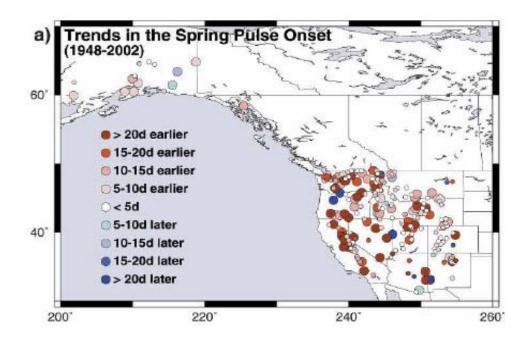
90% agreement. Recomputed from data of Milly, Dunne, and Vecchia (2005) by Dr. P.C.D.
Milly, USGS.



- 1 **Figure 6.15.** Photo of snowmelt in WSR during winter-spring flows. Photo courtesy of National
- 2 Park Service, Lake Clark National Park & Preserve.



Figure 6.16. Earlier onset of spring snowmelt pulse in river runoff from 1948–2000. Shading 3 indicates magnitude of the trend expressed as the change (days) in timing over the period. Larger 4 symbols indicate statistically significant trends at the 90% confidence level. From Stewart, Cayan, and Dettinger (2005).



1 **Figure 6.17.** Very rapid increases (1–4 hours) in water temperature (temperature "spikes") in

2 urban streams north of Washington D.C. have been found to follow local rain storms. *Top graph:*3 dark line shows stream discharge that spikes just after a rainfall in watersheds with large

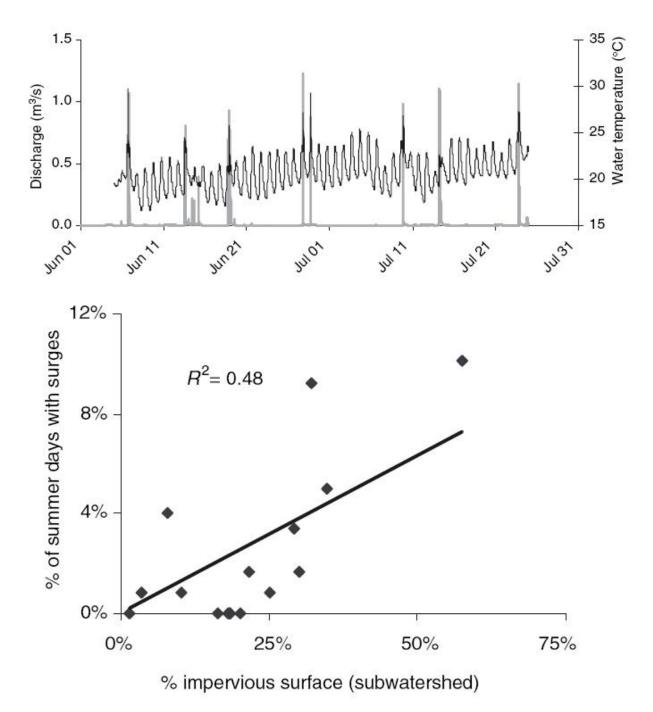
dark line shows stream discharge that spikes just after a rainfall in watersheds with large
 amounts of impervious cover; gray line shows temperature surges that increase 2–7°C above pre-

rain levels and above streams in undeveloped watersheds in the region. There is no temperature

6 buffering effect that is typical in wildlands where rain soaks into soil, moves into groundwater,

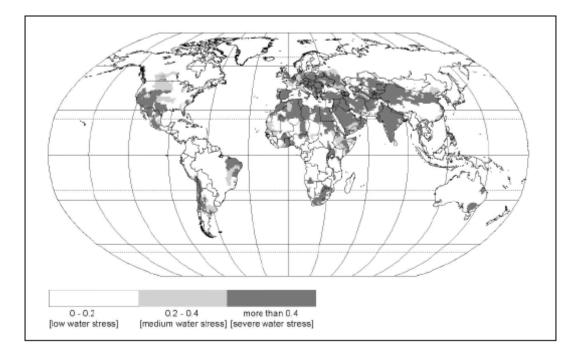
7 and laterally into streams. *Bottom graph:* shows that the number of temperature surges into a

8 stream increases with the amount of impervious cover. From Nelson and Palmer (2007).



**Figure 6.18.** Water stress projected for the 2050s based on withdrawals-to-availability ratio, where availability corresponds to annual river discharge (combined surface runoff and

groundwater recharge). From Alcamo, Flörke, and Märker (2007).



## 1 **Figure 6.19.** The Wild and Scenic portions of the Wekiva River. Data from USGS, National

2 Atlas of the United States (2005).

3

#### The Wild and Scenic Wekiva River

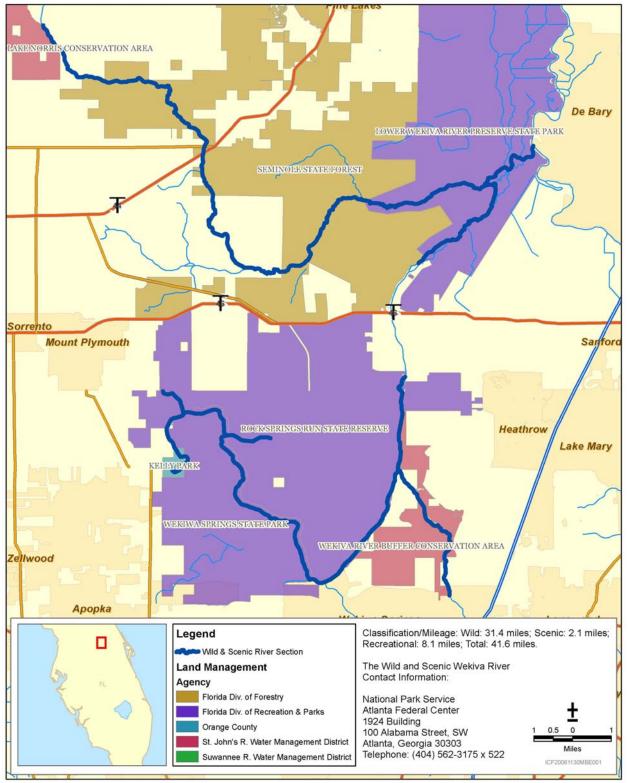
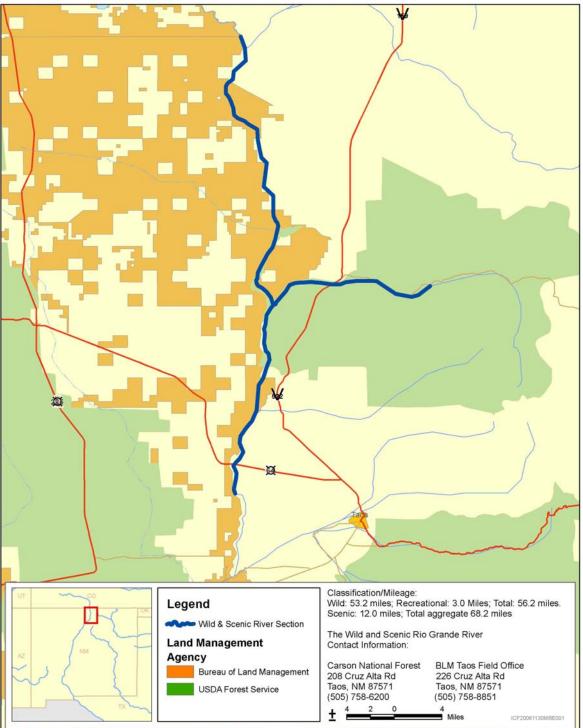


Figure 6.20. The Wild and Scenic portions of the Rio Grande WSR in New Mexico. Data from 3

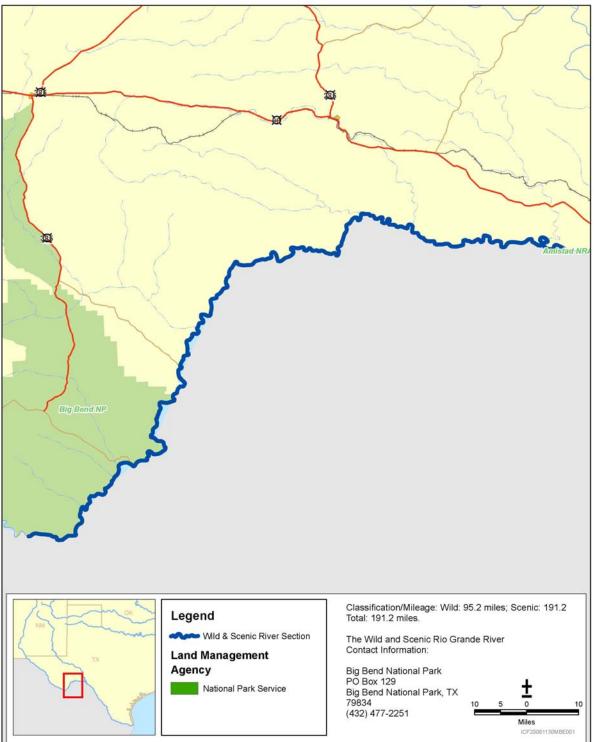
USGS, National Atlas of the United States (2005).

4

#### The Wild and Scenic Rio Grande River



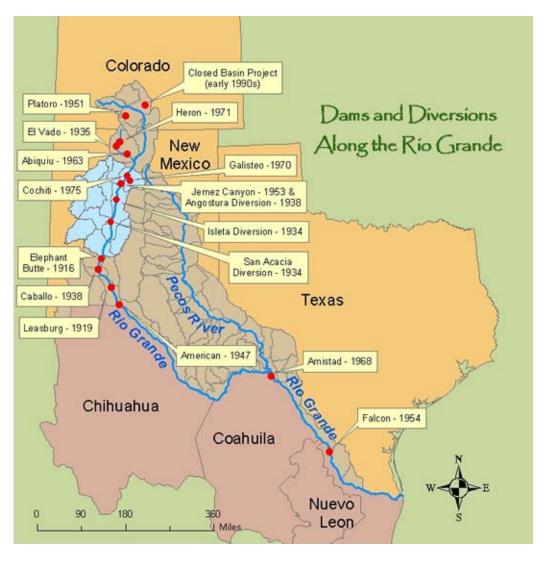
- 1 Figure 6.21. The Wild and Scenic portions of the Rio Grande WSR in Texas. Data from USGS,
- 2 National Atlas of the United States (2005).
- 3



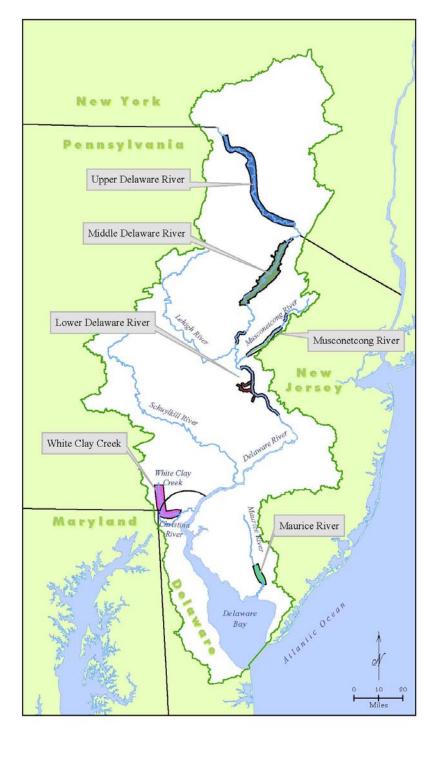
#### The Wild and Scenic Rio Grande River

### 1 Figure 6.22. Dams and diversions along the Rio Grande (Middle Rio Grande Bosque Initiative,

2 2007). 3

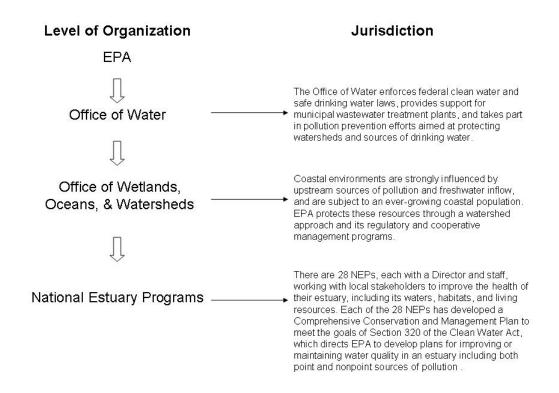


- 2 Figure 6.23. Map of Wild and Scenic stretches in the Delaware River basin. Courtesy of
- 3 Delaware River Basin Commission (Delaware River Basin Commission, 2007).



## **1** Figures for Chapter 7, National Estuaries

2 Figure 7.1. Organization of the NEP system (U.S. Environmental Protection Agency, 2007b).



Adapted from http://www.epa.gov/water/org\_chart/index.htm#

## 1 **Figure 7.2.** Timeline of National Estuaries Program formation (U.S. Environmental Protection

2 Agency, 2007a).

New Jersey Há Santa Monica Sarasota Bay ( Partnership for	(TX), New York- arbor (NY, NJ), Bay (CA), FL), and the Delaware IJ, PA) Programs	Barataria- Terrebonne Estuarine Complex (LA) is established.	Maryland Coastal Bays (MD), Mobile (AL), New Hampshire Estuaries (NH Morro Bay (CA), Lower Columbia Ri- Estuary (WA, OR), Charlotte Harbor Estuary (FL), and Barnegat Bay Estu (NJ) Programs are established.	). ver
Through an amendment to the CWA, Congress establishes the National Estuary Program. Albemarle- Pamlico Sounds Estuary (NC), Narragansett Bay (RI), Long Island Sound (NY, CT), Puget Sound (WA), and San Francisco Estuary (CA), Programs are established. Buzzards Bay Estuary (MA) is accepted into the NEP.	Indian River Lagoon (FL), Tampa Bay (FL), Massachusetts Bays (MA), and Casco Bay Estuary (ME) Programs are established.	San Jua Peconic and Coa Bays an (TX) Pro establish	k Bay (OR), n Bay (PR), Bay (NY), stal Bend d Estuaries grams are ied. 92 1995	EPA has accepted 28 estuaries into the NEP since 1987 and all of these NEPs have completed a Comprehensive Conservation and Management Plan.

- Figure 7.3. The Albermarle-Pamlico National Estuary Program region (Albemarle-Pamlico 1
- 2 National Estuary Program, 2007).

# ALBEMARLE-PAMLICO NATIONAL ESTUARY PROGRAM REGION

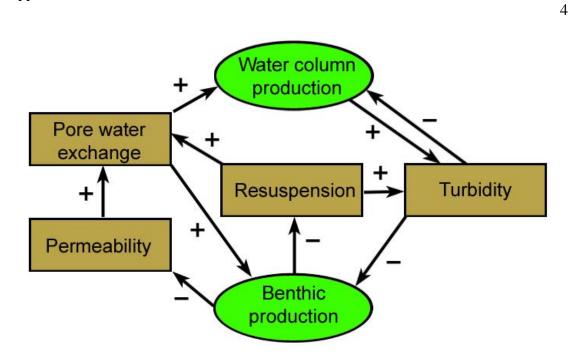


- Chowan River Basin
   Roanoke River Basin
   Currituck Sound & Pasquotank River/Albemarle Sound Drainage Basin
   Tar-Pamlico River & Pamlico Sound Drainage Basin
   Neuse River Basin & Core Sound/Bogue Sound Drainage Basin





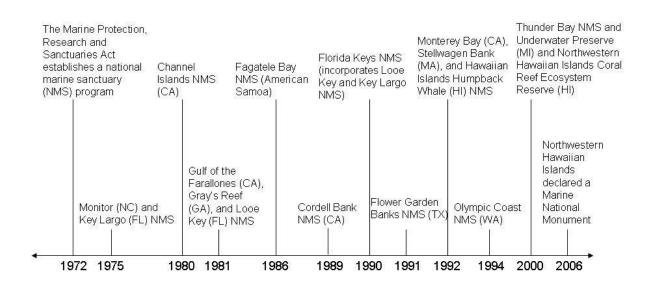
- 1 **Figure 7.4.** Feedbacks between nutrient and sediment exchange and primary production in the
- 2 benthos and water column. A plus symbol indicates enhancement and a minus symbol
- 3 suppression.



## **1** Figures for Chapter 8, Marine Protected Areas

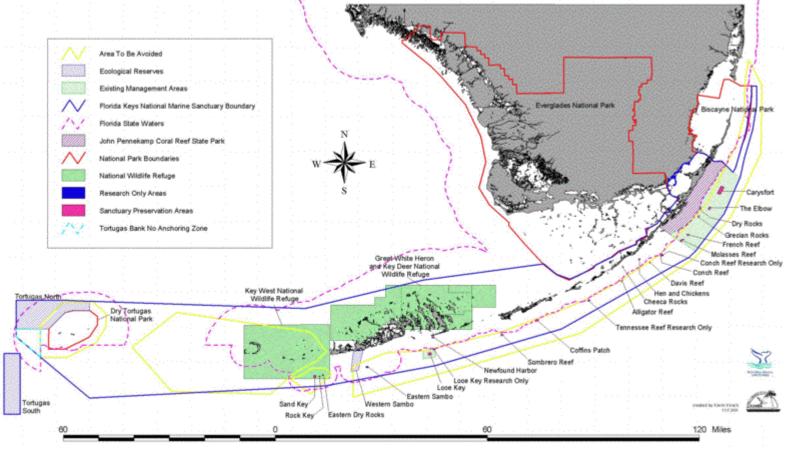
2 3 4 5 6 7 89 Figure 8.1. Locations of the 14 MPAs that compose the National Marine Sanctuary System (National Marine Sanctuary Program, 2006c). OLYMPIC COAST THUNDER BAY 10 CORDELL BANK 11 STELLWAGEN BANK 12 GULF OF THE MONITOR FARALLONES 13 14 MONTEREY BAY GRAY'S REEF 15 CHANNEL ISLANDS 16 FLORIDA KEYS 17 NORTHWESTERN HAWAIIAN ISLANDS FLOWER GARDEN 18 Marine National Monument BANKS 19 HAWAIIAN ISLANDS 20 HUMPBACK WHALE 21 FAGATELE BAY AMERICAN SAMOA (U.S.) 22 23 24 25 26

- 1 Figure 8.2. Timeline of the designation of the national marine sanctuaries in the National Marine
- 2 Sanctuary Program (National Marine Sanctuary Program, 2006a).



- **Figure 8.3.** Map of the Florida Keys National Marine Sanctuary. The 1990 designation did not include the Tortugas Ecological
- Reserve located at the western end of the sanctuary, which was implemented in 2001. The Key Largo NMS corresponded to the
   Existing Management Area (EMA) just offshore of the John Pennekamp Coral Reef State Park; the Looe Key NMS corresponded to
- the EMA surrounding the Looe Key Sanctuary Preservation Area and Research Only Area (National Oceanic and Atmospheric
- 5 Administration, 2007d).

# Florida Keys National Marine Sanctuary



- 1 **Figure 8.4.** Organizational chart of the National Marine Sanctuary Program (NOAA
- 2 National Ocean Service, 2006).
- 3

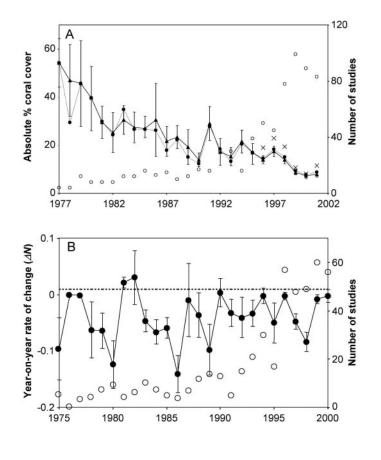
Level of Organization	Jurisdiction
	The National Oceanic and Atmospheric Administration (NOAA), located within the Department of Commerce, focuses on the condition of the ocean and the atmosphere.
National Ocean Service ₋ ∏	NOAA's National Ocean Service measures and predicts coastal and ocean phenomena, protects large areas of the oceans, works to ensure safe navigation, and provides tools and information to protect and restore
ſţ	coastal and marine resources.
National Marine Sanctuary Program	<ul> <li>The National Marine Sanctuary Program manages and protects 13 Sanctuaries and one Marine National Monument (co-managed with the U.S. Fish and Wildlife Service) that together encompass over 150,000 square miles of U.S. ocean</li> </ul>
National Marine Sanctuary -	→ Each sanctuary maintains an on-site field staff that
National Marine Canetuary	conducts research and monitoring, resource protection, education projects and other activities.

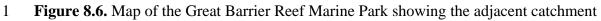
Adapted from http://www.oceanservice.noaa.gov/programs/

#### SAP 4.4. Adaptation Options for Climate-Sensitive Ecosystems and Resources | Figures

1 **Figure 8.5.** Total observed change in coral cover (%) across the Caribbean basin over the

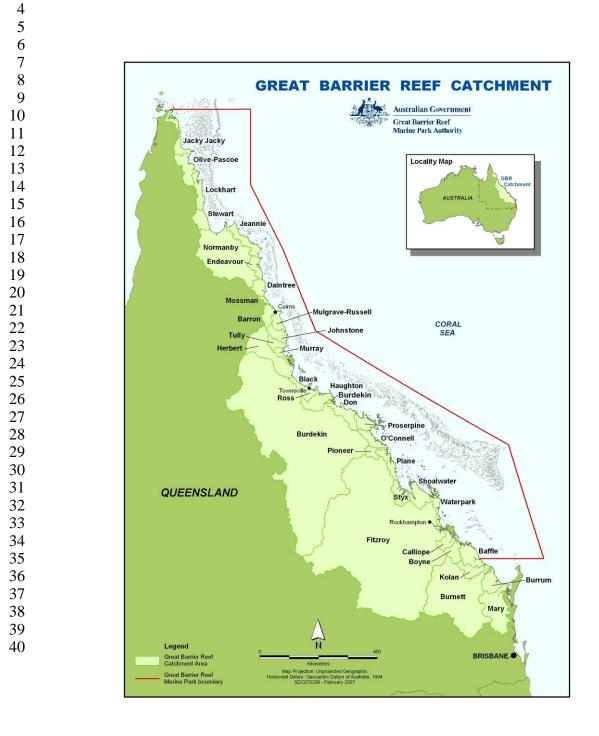
- 2 past 25 years (Gardner *et al.*, 2003). A. Coral cover (%) 1977-2001. Annual estimates
- 3 ( $\blacktriangle$ ) are weighted means with 95% bootstrap confidence intervals. Also shown are
- 4 unweighted estimates (•), unweighted mean coral cover with the Florida Keys Coral
- 5 Reef Monitoring Project (1996-2001) omitted (x), and the number of studies each year
- 6 ( $\circ$ ). B. Year-on-year rate of change (mean  $\Delta N \pm SE$ ) in coral cover (%) for all sites 7 reporting two consecutive years of data 1975-2000 ( $\bullet$ ) and the number of studies for each
- reporting two consecutive years of data 1975-2000 (•) and the number of studies for each
  two-year period (○).
- 9



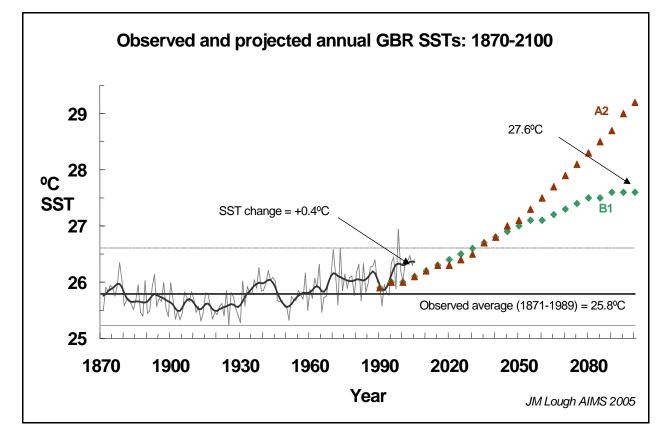


in Queensland. Modified from Haynes (2001) and courtesy of the Great Barrier Reef 2 3

Marine Park Authority.

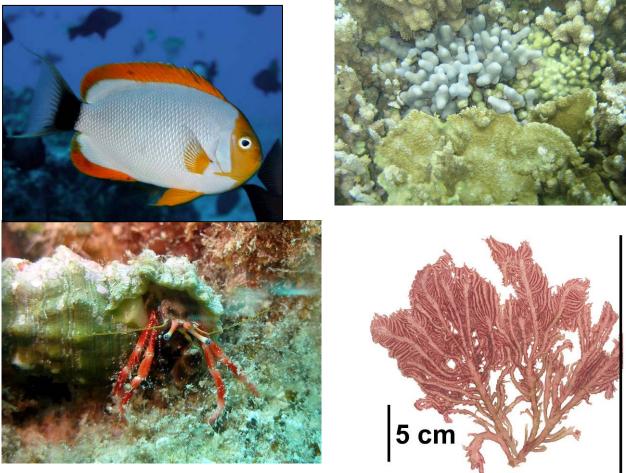


- **Figure 8.7.** Sea surface temperature (SST) projections for the Great Barrier Reef (GBR)
- 2 (Lough, 2007).



#### SAP 4.4. Adaptation Options for Climate-Sensitive Ecosystems and Resources | Figures

- 1 Figure 8.8. Endemic species from the Hawaiian Islands. A. Masked angelfish,
- 2 Genicanthus personatus (Photo: J. Watt), B. Rice coral, Montipora capitata, and finger
- 3 coral, Porites compressa (photo: C. Hunter), C. Hawaiian hermit crab, Calcinus
- 4 laurentae (photo: S. Godwin), D. Red alga, Acrosymphtyon brainardii (photo: P.
- 5 Vroom).



#### SAP 4.4. Adaptation Options for Climate-Sensitive Ecosystems and Resources | Figures

1 Figure 8.9. a) NOAA Pathfinder SST anomaly composite during summer 2002 period of

2 NWHI elevated temperatures, July 28–August 29. b) NASA/JPL Quikscat winds (wind

3 stress overlayed by wind vector arrows) composite during summer 2002 period of

4 increasing SSTs, July 16–August 13. The Hawaii Exclusive Economic Zone (EEZ) is

5 indicated with a heavy black line; all island shorelines in the archipelago are also plotted

0.5

0.12

160°W

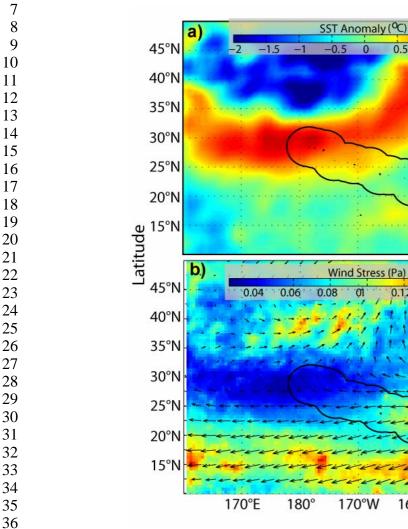
0.16

150°W

Long

1

6 (adapted from Hoeke et al., 2006).

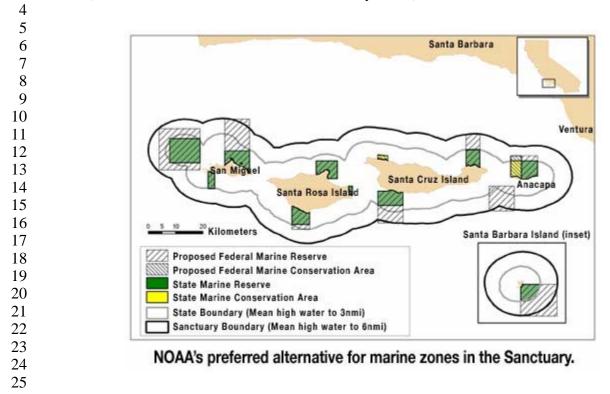


37

1 **Figure 8.10.** Map of the Channel Islands National Marine Sanctuary showing the

2 location of existing state and proposed federal marine reserves and marine conservation

3 areas (Channel Islands National Marine Sanctuary, 2007).



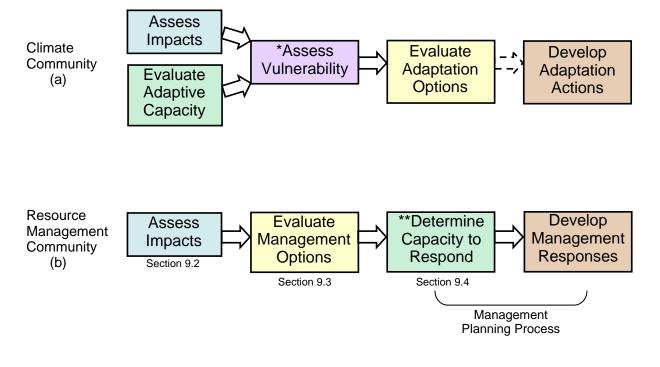
### **1** Figures for Chapter 9, Synthesis and Conclusions

2

3 **Figure 9.1.** Two conceptual models for describing different processes used by (a) the

4 resource management community and (b) the climate community to support adaptation

5 decision making. Colors are used to represent similar elements of the different processes.



- \*Vulnerability is the sum of projected impacts and adaptive capacity; this step is done by managers when they evaluate the projected impacts and their capacity to respond during their planning process
- \*\*Assessing the capacity to respond in the management community is equivalent to assessing adaptive capacity in the climate community

