

1  **The Coast:
Beaches and Shoreline Processes**

Trujillo & Thurman, Chapter 10

Oceanography 101

2  **Chapter Objectives**

- Recognize the various landforms characteristic of beaches and coastal regions.
- Identify seasonal changes that beaches experience.
- Discuss how longshore currents are created and what longshore drift is.
- Note the origin of sediment for beaches and how the coastline responds to variations in supply.
- Describe how coastal features are formed by wave erosion and deposition.

3  **Chapter Objectives (continued)**

- Understand local changes that occur in coastline elevation and explain observed trends in the relative position of sea level.
- Explain how climate change can affect the nature of the coastline.
- Recognize barrier island features and describe how barrier islands are formed and evolve.
- Identify the types of hard stabilization and discuss the effects they have on shorelines.

4  **Overview**

- Coastal region constantly changes
- Primarily due to waves
 - ☒ Erosion
 - ☒ Deposition
- Many people live in coastal regions
 - ☒ 80% of people in U.S. live within easy access of coast
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5  **Coastal regions**

- Coast and coastline
- Beach
- Shore, foreshore, backshore
- Nearshore, offshore

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7  **Beach profile**

- Beach
 - Wave-worked sediments
 - Wave-cut bench
 - Recreational beach
 - Berm
 - Beach face
 - Longshore bars
 - Longshore trough

8  **Composition of beaches**

- Locally available material
- May be coarse or fine
 - ☒ Boulders from local cliffs
 - ☒ Sand from rivers
 - ☒ Mud from rivers
- Significant biologic material at tropical beaches
 - ☒ Example, Coral reef material

9  **Sand movement along beach**

- Perpendicular to shoreline (toward and away)
 - ☒ Swash and backwash

- Parallel to shoreline (up-coast or down-coast)
 - ☒ Longshore current
- 10  ***Swash and backwash***
 - Swash
 - ☒ After wave breaks, uprush of water (swash) on beach
 - ☒ Sediment moved toward land
 - Backwash
 - ☒ Water returns to ocean
 - ☒ Sediment moved away from shore
 - Light wave activity
 - ☒ Swash dominates
 - ☒ Sediment moved toward shore
 - ☒ Wider beach
 - Fair weather
 - Summertime beach
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- 12  ***Swash and backwash***
- 13  ***Swash and backwash***
 - Heavy wave activity
 - ☒ Backwash dominates
 - ☒ Sediment moved away from shore
 - ☒ Narrower beach
 - Sand forms offshore sand bars
 - Stormy weather
 - Wintertime beach
- 14 
- 15  ***Longshore current***
 - Wave refraction causes water and sand to move parallel to shore
 - Zigzag motion in surf zone
 - Longshore current
 - Longshore transport
- 16  ***Longshore transport***
 - Millions of tons of sediment moved yearly
 - Direction of transport changes due to wave approach
 - In general, sediment transported southward along Atlantic and Pacific coasts of U.S.
- 17  ***Erosional shorelines***
 - Well-developed cliffs
 - Recent tectonic activity
 - Headlands
 - Wave-cut cliff with sea cave
 - Sea arches
 - Sea stacks
 - Marine terrace
 - Wave erosion increases with
 - ☒ More shore exposed to open ocean
 - ☒ Smaller tidal range
 - ☒ Weaker bedrock
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- 19  ***Depositional shorelines***
 - Primarily deposited by longshore drift
 - Beach
 - Spit

- Bay barrier
- Tombolo
- Barrier island
- Delta
- Beach compartment
- 20 ***Depositional shorelines***
- 21 ***Barrier islands***
 - Long, narrow offshore deposits parallel to shore
 - Most developed due to rise of sea level about 18,000 years ago
 - Common East and Gulf coasts of U.S.
 - Protect mainland from high wave activity
- 22 ***Barrier island***
 - Ocean beach
 - Dunes
 - Barrier flat
 - High salt marsh
 - Low salt marsh
 - Lagoon
- 23 ***Barrier island***
 - Movement landward over time
 - Associated with rising sea levels
 - Older peat deposits found on ocean beach
- 24 ***Deltas***
 - River sediments reworked by ocean processes: waves, tides
 - ☒ Distributaries carry sediment to ocean
- 25 ***Beach compartments***
 - Rivers supply sediment
 - Beach
 - Offshore submarine canyons “drain” sediments from beach
 - Beach starvation
- 26
- 27 ***Emerging shorelines***
 - Shorelines above current sea level
 - Marine terraces
- 28 ***Submerging shorelines***
 - Shoreline below current sea level
 - Drowned beaches
 - Submerged dune topography
 - Drowned river valleys (estuaries)
- 29 ***Changing sea level***
 - Local tectonic processes
 - ☒ Example, Pacific Coast of U.S. and active plate margin
 - ☒ Isostatic adjustments
 - ◆ Ice-loading
 - Global (eustatic) changes in sea level
 - ☒ Changes in seafloor spreading rates
 - ☒ Lake buildup or destruction
 - ☒ Ice volume changes
- 30 ***Eustatic changes in sea level***
 - Ice build up (glaciation)
 - Ice melting (deglaciation)

- Thermal contraction and expansion of seawater
 - About 120 m (400 ft) change in sea level
- 31
- 32
- 33 ***Global warming and changing sea level***
- About 0.6°C (1.1°F) warmer over last 130 years
 - Sea level rose 10-15 cm (4-10 in) over past 100 years
 - If global warming continues, higher sea level
- 34 ***U.S. coasts***
- Erosion or deposition dominates
 - Type of bedrock
 - Tidal range and wave exposure
 - Active tectonics
 - Eustatic changes in sea level
- 35 ***Atlantic coast***
- Most coasts open to wave attack
 - Barrier islands common
 - Varied bedrock from resistant rocks to non-resistant sedimentary rocks
 - Sea level rising about 0.3 m (1 ft) per century
 - Drowned river valleys common
 - Average erosion 0.8 m (2.6 ft) per year
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- 36 ***Atlantic coast***
- Barrier islands
 - Drowned river valleys
- 37 ***Gulf coast***
- Low tidal range
 - Generally low wave energy
 - Tectonic subsidence
 - Mississippi delta dominates
 - ☒ Locally sea level rises due to compaction of delta sediments
 - Average rate of erosion 1.8 m (6 ft) per year
- 38 ***Pacific coast***
- Tectonically rising
 - Bedrock typically non-resistant sedimentary rocks
 - Open exposure to high energy waves
 - Average rate of erosion 0.005 m (0.016 ft) per year
- 39 ***Hard stabilization***
- Structures built to decrease coastal erosion and
 - Interfere with sand movement
 - Often results in unwanted outcomes
 - ☒ Some structures may increase wave erosion
 - Groins and groin fields
 - Jetties
 - Breakwaters
 - Seawalls
- 40 ***Groins and groin fields***
- 41 ***Jetties***
- 42 ***Breakwaters***
- 43 ***Seawalls***
- 44 ***Alternatives to hard stabilization***
- Construction restrictions

- Limit building near shorelines
- National Flood Insurance Program encouraged construction
- Beach replenishment
 - Sand added to beach/longshore current
- 45 ***Alternatives to hard stabilization***
 - Relocation
 - Move structures rather than protect them in areas of erosion
- 46 ***End of CHAPTER 10***

Beaches and Shoreline Processes