12 Wind, Waves and Current

- how wind affects a boat underway
- basics of wind generation, motion and behaviour
- Identify types of non-tidal currents

General

wind, waves, and current create boating conditions

Wind

Wind Strength

friction with the earth's surface reduces wind velocity
winds aloft blow at higher velocity than those at surface

example, wind at head of mast stronger than at the surface
difficult to judge actual wind strength because boat motion produces a secondary, apparent wind
wind strength is very important for sailboats but also for a powerboats
non-marine weather forecasts express wind speed in kilometers per hour
sounds stronger than same wind speed expressed in knots(1 nm = 1.9 kilometers)
for good idea of wind speed kilometers perhour/2 = knots

The Effects of Wind

Wind Speed and Boat Speed

Wind speed affects boat speed
power boat heading into wind speed of 22-27 knots at full power will do about 75% calm water speed

Leeway

Leeway - **downwind drift of a boat from her course caused by wind push**
greatest when the wind is abeam.

Lee Shore - Weather shore

lee- direction towards which the wind blows
lee side of a boat - the side away from wind
leeward - towards sheltered side
in the lee - sheltered from the wind.

wind is blows on the weather side of a boat(Figure 12.1).

lee shore - shore on the lee side of the boat, towards which the wind is blowing
lee shore is the most dangerous place for a boat to be.

Lee Effect

an island may break the wind
may provide less wind protection close to shore than expected
lack of waves, rather than a reduction in wind strength, provides safer water
calmest area in the shelter or lee of the island is at a distance about 7X the height of the island (Figure 12.2).

Waves

Wave Generation

Waves caused by wind blowing across the surface

Three characteristics:

• Wave length - distance between successive crests or troughs;

• Height - vertical distance between top of a crest and bottom of a trough;

• Period - time in seconds between passage of two successive crests or troughs.

height of waves depends on three factors:
wind velocity
fetch (the distance wind blows across open water unobstructed by land)
duration (length of time the wind blows), longer the wind blows the greater height the waves will be.

waves move forward across the water
actual water particles do not: they move in a circular pattern within the water

Breaking Waves

waves get higher without breaking until gravity causes tops break over
determined by the force of the wind
if path of wave is unimpeded, it can complete this cycle
in shallow water, water particles strike the bottom, wave tends to lean forward, increases instability
in shoal water, the ratio of wave height to wave length deterrmines how a wave will break
critical ratio wave height: wave length is about 1:15
current will also affect a breaking wave.

Two types of breaking waves
plunging crests(Figure 12.3)- dangerous - broaching, pooping, swamping or capsizing are possibilities
spilling crest not dangerous, produces a lot of spray.
combination of wind, waves, and current at different angles produces dangerously confused and choppy seas.

Features of Wave Behavior

crest of a breaking wave travels fast
wave moving at 10 kts produce breaking crest at velocity of 25 to 30 kts
long waves with crests far apart travel faster than short waves with crests closer together.
very long waves (swells) from storms far away - too long and round to be dangerous to small boats until they reach shallow water.
as waves move into shallow water, they become steeper because they are slowed at their base.
Waves generated locally by the wind are steep and short; the stronger and longer the wind blows, the bigger and longer the waves become.

waves of twice the average height or more are encountered regularly
wind blowing against current produces short, steep waves.
wave steepness and a short wave length not wave height usual problem for boaters

Practical Considerations

tendency for small craft to yaw (swing broadside to the waves) in a following sea
(particularly when the wave length is about twice the length of the boat)
stern is lifted and carried forward by a wave crest
bow's forward motion is opposed by the reverse flow of water in the trough
hull may be subjected to a strong turning force
the crest lifts the bow as wave passes in the direction of the wave system
flow in the trough now retards the stern
boat swings sharply back toward her original heading
continuous attention to the helm is necessary to keep the boat on course
if boat's speed is substantially greater than the velocity of the waves effect of the yaw is reduced greatly
waves often move at high speeds, may exceed the maximum speed of a vessel.

Currents

Types of Current - Current- horizontal movement of water

Wind-driven Currents and River Currents

surface currents produced by prolonged wind in one direction over large area
wind-generated currents have velocity about 2% of that of the wind
on large lakes surface currents are wind generated
changing set as a response to changes in wind direction
they cannot be charted.

rivers flowing into and out of lakes set up local currents
concern to many inland boaters
current is created by the flow of water downhill from the river's source to its mouth
depths of water and current speeds vary from season to season
each river is unique
local knowledge obtained from boaters familiar with the area may be the only source of information The

Government publications

- Sailing Directions for the area
- Small Craft guide for the area
- Small-craft chartlets for the area

tidal mouth of a river - the high tide may cause the river to reverse its flow and go upstream
Reversing Falls on the Saint John River in New Brunswick
current near the mouth of tidal rivers with tidal current information in the Current Tables.

Seiches

on any large, shallow lake
steady, strong wind that blows for an extended period causes the water to pile up at the leeward side
depression in the water level is created on the windward side leaves more of the shoreline exposed
known as a seiche (pronounced saysh)
when the wind subsides, the water flows back
results in a depression on the former leeward end of the lake, so the water flows back in that direction again This oscillation continues until halted change in wind direction, or by the gradual reduction due to friction.
oscillating motion can create surface currents which will flow first in one direction and then in another
currents cannot be charted.