Coastal bars can be dangerous!

Tips for crossing safely

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As he neared the bar, waves and swell steepened abruptly, then started to break. A swell lifted the stern, pitching the boat broadside to the seas—and, in one awesome motion, the trawler rolled over far enough to put its masts underwater. The hull labored seaward. Strangely enough, the engine was still running; the skipper, regaining his feet, eased the boat back out to sea.

Damage: all windows and ports gone; most gear topside, including masts, washed away; all electronics drowned in saltwater; skipper bruised and in shock.

Experienced skippers say that around Northwest ports, the most likely place for an accident is on the bar. In the Pacific Northwest, the coastal bar ranks as a prime cause of vessel damage and of injury—sparing neither the novice nor the experienced.

The damage to life and property continues to run high. . . . Why are bars so dangerous? What causes them to be so unpredictable? What can you do to cross safely?

What is a coastal bar?

Quite simply, it is an underwater sand or gravel bank at a river mouth that obstructs navigation. Simple as that may sound, it poses special hazards to mariners.

How do coastal bars form?

Rivers carry great loads of suspended material from tributaries into lakes and oceans. Our forebears knew this; thoughout history, people have not only traveled down rivers but also used them as handy dumps for trash and sewage, knowing the offending debris would wash downstream.

How much sediment streams can carry is directly related to how fast they flow. Where water moves fast, a river can carry both small and relatively large particles (such as gravel, coarse sand, and mud). As water slows, larger particles settle to the bottom. Where a river flows round a bend (as at A in figure 1), it speeds up around the outer curve, while the water along the inner curve slows, dropping sediment and building shoals. At bend B in figure 1 the curve is reversed. The slower water along the inner curve occurs at the other side of the streambed, but the principle holds—as it does for coastal bars, as well.

Where the river nears the ocean, its streambed normally is wider. As it widens, its current slows; and as it slows, sediments settle to the bottom. Where a river finally meets the ocean, river current comes essentially to a stop. Here almost all of the remaining suspended loads of finer sands and...
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What a bar would look like in cross section: rather steep-sided, with much less water above it than either to seaward or upriver.

The breaking waves over a bar can really be dangerous—especially for skippers who have not paid sufficient attention to weather forecasts and local conditions.

sediments settle to the bottom. Where this occurs, a bar forms (see figure 2a). The bar is a relatively steep-sided mound (figure 2b) that reduces water depth to less than the depths immediately to seaward or upriver.

What makes bars dangerous?
Surf crashing on a beach on a windless day is the result of swells reaching the beach from a storm that occurred probably hundreds of miles to seaward, hours and days earlier.

What is the RIGHT tide for crossing?
For the smoothest and safest trip, cross during slack water. Slack water occurs from an hour or so before until an hour or so after the times listed in a tide table for both high and low water. During these times tidal currents are negligible.

Example: See 11 December 1978 in figure 4. Low water was predicted for Newport at 3:25 a.m. It was safest to cross that bar between 2:30 and 4:30 a.m. Slack water occurred again between about 9:00 and 11:00 a.m. (high tide 9:41 a.m.) and from about 3:30 to 5:30 p.m. (low tide 4:34 p.m.), and so on.

surf is the result of swells reaching the beach from a storm that occurred probably hundreds of miles to seaward, hours and days earlier. The second best opportunity for crossing is when the tide is flooding.

Example: On 12 December 1978 (figure 4), low water was predicted for 4:15 a.m. and the next high water for 10:24 a.m. Assuming the weather was fair, the bar should have been relatively passable from about 3:15 a.m. to about 11:30 a.m.

Caution: If heavy swells are breaking on the bar, do not cross—no matter what the stage of the tide!
waves, however, are more local in nature. You can watch them build in short times as the wind increases and dissipate as the wind drops. How does this wave and swell action relate to coastal bars? Bowditch's American Practical Navigator puts it this way: "When a wave or swell encounters shallow water, the movement of the individual particles of water is restricted by the bottom, resulting in reduced wave height. ... As each wave slows, the next wave behind it, in deeper water, tends to catch up. As the wave length decreases, the height generally becomes greater. The lower part of the wave, being nearest the bottom, is slowed more than the top [because of friction with the ocean floor]. This may cause the wave to become unstable, the fastest-moving top falling or breaking." See figure 3.

What is the relationship between the length of wave or swell and the water depth over the bar? Figure 4 again:

When "the depth of water becomes about one-half the wave length ... the waves begin to 'feel' bottom. There is a slight deceleration in wave height, followed by a rapid increase. ... As the waves become higher and shorter, they also become steeper. ... When the speed of individual particles at the crest becomes greater than that of the wave," the wave becomes unstable and breaks. You can see this happen by watching waves approach and break on the beach.

As bars are shallower than the water immediately to seaward or upriver from them, waves and swells will "feel" bottom at the bar first. But the U.S. Army Corps of Engineers, responsible for dredging navigable rivers, does not dredge all bars to the same depth (for example, about 50 feet or 15 meters across the Columbia Bar; about 13 feet or 4 meters across the Coquille River Bar near Bandon), so waves and swell will usually break at the shallower bars before the bar at the Columbia River becomes hazardous. Once again, the bar is ordinarily shallower than the water either to seaward or immediately upriver. Therefore, waves and swell break in one spot rather than over a wide zone (such as a long beach), and the breakers plunge and release their energy suddenly. Seas over a bar can be confused, unpredictable, powerful, and dangerous. All other factors being equal, waves will break on coastal bars well before the ocean becomes rough enough to

TIDE TABLE FOR SEPTEMBER, 1978

<table>
<thead>
<tr>
<th>Time of Day</th>
<th>High</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>12:25</td>
<td>7.32</td>
<td>4.20</td>
</tr>
<tr>
<td>12:30</td>
<td>7.35</td>
<td>4.23</td>
</tr>
<tr>
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<td>7.38</td>
<td>4.26</td>
</tr>
<tr>
<td>12:40</td>
<td>7.41</td>
<td>4.29</td>
</tr>
<tr>
<td>12:45</td>
<td>7.44</td>
<td>4.32</td>
</tr>
</tbody>
</table>

CORRECTION TABLE

To determine the predicted time and height of high and low water for the locations given below, add or subtract as indicated from the Marine Science Center Tide Table.

<table>
<thead>
<tr>
<th>Location</th>
<th>Min. Ft.</th>
<th>Max. Ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newport</td>
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<td>7.3</td>
</tr>
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<td>Waldport</td>
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</tr>
<tr>
<td>Nestucca Bay Ent</td>
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<td>6.2</td>
</tr>
<tr>
<td>Siletz River Ent</td>
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<td>5.9</td>
</tr>
<tr>
<td>Umpqua River Ent</td>
<td>-0.5</td>
<td>5.6</td>
</tr>
<tr>
<td>Gold Beach</td>
<td>-1.0</td>
<td>5.3</td>
</tr>
<tr>
<td>Coos Bay Ent</td>
<td>-1.5</td>
<td>5.0</td>
</tr>
<tr>
<td>Impass River Ent</td>
<td>-2.0</td>
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</tr>
<tr>
<td>Slalver River Ent</td>
<td>-2.5</td>
<td>4.4</td>
</tr>
<tr>
<td>Nehalem Bay Ent</td>
<td>-3.0</td>
<td>4.1</td>
</tr>
<tr>
<td>Tillamook Bay Ent</td>
<td>-3.5</td>
<td>3.8</td>
</tr>
</tbody>
</table>

TIDE TABLE FOR DECEMBER 1978

<table>
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Times of tides up river or bay occur later than times published here. 10 miles up bay they may be as much as one hour later.

TIDE PREDICTIONS ARE MADE ACCURATE DURING STORMS AND EXTREME HIGH AND LOW TIDE PERIODS.

Figure 5—These low and high tide photos, taken on an autumn day in 1979 on Yaquina Bay, suggest the volume of water needed to reach the high tide level.
make boating unsafe for small craft. Many times the waters outside and inside the bar are relatively smooth, but the bar is rough.

If no other factors were involved, and if mariners kept ears and eyes tuned to the local weather, odds of getting into trouble would be considerably reduced. But there is one more factor, a major one, that helps cause rough bars—tides.

How do tides affect bar crossings?

The Pacific Northwest coast has a mixed, semidiurnal tide—two high tides plus two low tides every 24 hours and 50 minutes (see “For further information; Understanding Tides”). A “flooding tide” occurs when the water level changes from low to high tide. Nine or more feet of water can “flood” into an estuary during a 6-hour period.

Example: Note in figure 4 that on 18 September 1978, at 7:56 a.m., a minus 0.1 foot (0.03-meter) low tide was predicted for Newport, Oregon. At 2:12 p.m. that afternoon, a plus 8.8-foot (2.7-meter) high tide was predicted. Between 7:56 a.m. and 2:12 p.m. a total of 8.9 feet (2.7 meters) of water entered Yaquina Bay.

Visualize in your mind’s eye, if you can, the volume of water it takes to raise the bay to that level (figure 5). At 2:12 p.m. that day, however, the tidal influx slacked, then the flow began to reverse. Over the next 6 hours the 8.9 feet (2.7 meters) of water that had flooded in, ebbed out and returned to the sea—in addition to the normal streamflow. The combined forces of this normal river runoff plus the ebb current make for unusually rapid currents seaward. Ebb currents can exceed 7 knots on the Columbia Bar during a maximum ebb flow (see figure 6). The ebb tide accentuates rough conditions on the bar.

The photo at the left shows the conditions of maximum ebb current coupling with the effects of an incoming long ocean swell. The ebb current and swell, plus local waves, add up to steep-breaking waves on the bar. Notice that the open ocean remains relatively calm and safe for boating, as does the river.

The calm water on either side of the bar has deceived even experienced mariners—and brought disaster and death to thousands.

So the worst time to attempt crossing is when the tide is ebbing. Crossing during this condition is always rougher. Instead, plan ahead to leave port and to return when the tide is not ebbing.

Cross the bar during ebb tide? NEVER!

This scene, which should frighten any prudent skipper, was photographed in February 1980, at the mouth of Tillamook Bay, Oregon.
Waves, however, are more local in nature. You can watch them build in short times as the wind increases and dissipate as the wind drops.

How does this wave and swell action relate to coastal bars? Bowditch's American Practical Navigator puts it this way:

"When a wave or swell encounters shallow water, the movement of the individual particles of water is restricted by the bottom, resulting in reduced wave speed. As each wave slows, the next wave behind it, in deeper water, tends to catch up. As the wave length decreases, the height generally becomes greater. The lower part of the wave, being nearest the bottom, is slowed more than the top [because of friction with the ocean floor]. This may cause the wave to become unstable, the faster-moving top falling or breaking." See figure 3.

What is the relationship between the length of wave or swell and the water depth over the bar? Breakers plunge and release their energy over a bar can be confused, unpredictable, powerful, and dangerous. All other factors being equal, waves will break on coastal bars well before the ocean becomes rough enough to be spotted from the shore.

The volume of water needed to reach the high-tide level is put this way:

"The volume of water needed to reach the high-tide level!"
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Figure 2b.—What a bar would look like in cross section: rather steep-sided, with much less water above it than either to seaward or upriver.

Figure 3.—The breaking waves over a bar can really be dangerous—especially for skippers who have not paid sufficient attention to weather forecasts and local conditions.

Figure 5.—The Columbia River hits the sea with turbulente force in this February 29, 1979, radar image taken by an Oregon Army National Guard radar aircraft.
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When the 60-footer finally righted, the bow faced seaward. Strangely enough, the engine was still running; the skipper, regaining his feet, eased the boat back out to sea.

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