

# Coastal bars can be dangerous!

## Tips for crossing safely



Oregon State University  
Extension Marine Advisory Program  
A Land Grant / Sea Grant Cooperative

SG 58 June 1980  
SG 57

Recently a skipper was returning to Newport, Oregon, in his newly acquired 60-foot (18-meter) trawler. With considerable sea experience in smaller boats, he had only limited experience in a craft of this size. The sea was rough, the wind strong from the southwest. In a smaller boat, he would never have attempted to come in. Instead, perhaps lulled by the security of a larger boat, he approached the bar with only a moment's hesitation.

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 with masts submerged for long moments (who looks at a watch in a situation such as this?) as green water washed in from every direction.

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.

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; throughout history, people have not only traveled down rivers but also used them as

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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

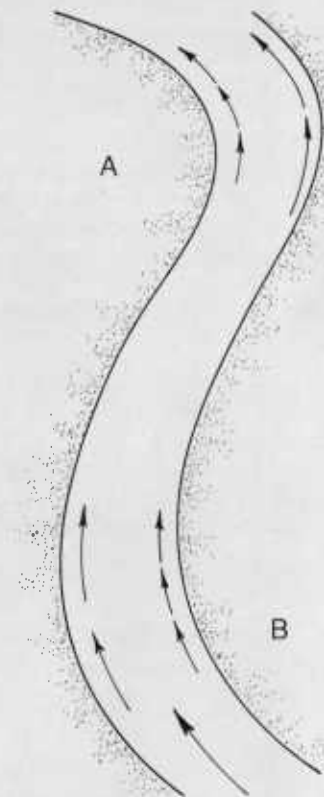
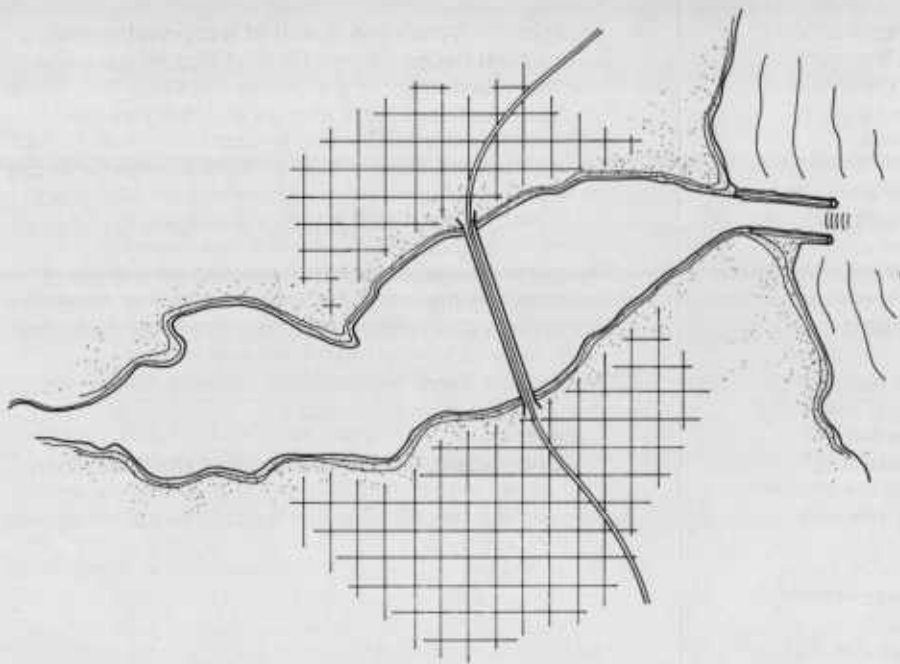
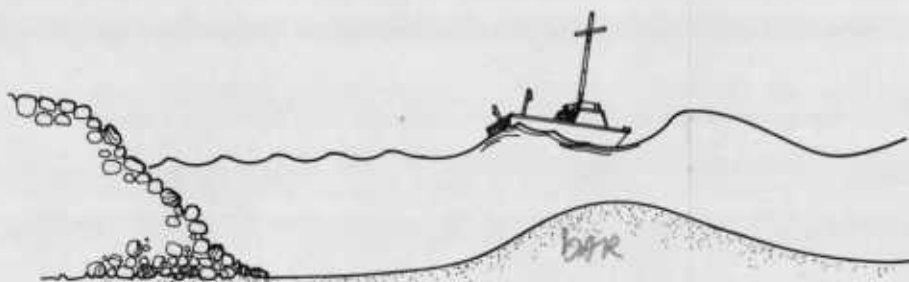


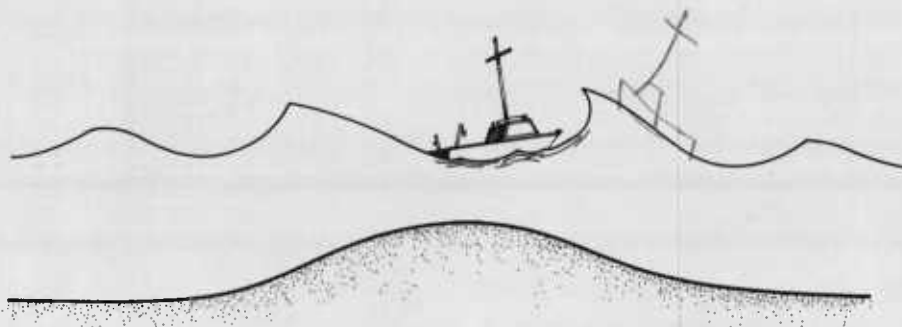
Figure 1.—This simplified drawing shows a river's flow speeding up around two outer curves, above at Bend A, below at bend B. Its flow is slower and shallower at the inner curve in each case; here sediments drop and shoals tend to build.



**Figure 2a.**—At the mouth of almost every sizeable river . . . is a town. If the harbor offers any shelter at all, there will likely be heavy boat traffic in and out. So safe bar crossings are a matter of great importance to many people.



**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.

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 *swell* reaching the beach from a storm that occurred probably hundreds of miles to seaward, hours and days earlier.

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? Bowditch again:

When "the depth of water becomes about one-half the wave length . . . the waves begin to 'feel' bottom. There is a slight decrease 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 swell 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 along a 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

Pacific Daylight Time  
OSU Marine Science Dock

HIGH WATER				LOW WATER				
Time	Ft.	Time	Ft.	Time	Ft.	Time	Ft.	
1	12:53	7.3		6:29	0.0	6:35	2.0	
2	12:35	8.1	1:22	7.6	7:01	0.1	7:08	1.6
3	1:14	8.1	1:51	7.8	7:30	0.2	7:45	1.3
4	1:49	7.9	2:21	7.9	8:01	0.4	8:22	1.0
5	2:28	7.6	2:51	6.0	8:33	0.6	9:03	0.6
6	3:10	7.3	3:22	8.0	9:05	1.0	9:44	0.6
7	3:55	6.8	3:56	7.9	9:44	1.5	10:35	0.4
8	4:50	6.2	4:43	7.7	10:26	2.0	11:30	0.4
9	5:56	5.8	5:38	7.5	11:18	2.4		
10	7:18	5.6	6:43	7.4	12:36	0.3	12:24	2.8
11	8:38	5.7	7:59	7.4	1:51	0.1	1:43	2.9
12	9:46	6.2	9:11	7.7	3:03	-0.3	3:03	2.7
13	10:42	6.8	10:20	6.1	4:04	-0.6	4:13	2.1
14	11:31	7.4	11:19	6.4	5:00	-0.9	5:13	1.4
15	12:13	6.0			5:47	-1.0	6:05	0.7
16	12:12	8.6	12:54	8.5	6:33	-0.9	6:54	0.1
17	1:04	8.7	1:33	8.7	7:14	-0.6	7:39	-0.3
18	1:53	8.5	2:12	8.6	7:56	-0.1	8:25	-0.5
19	2:41	8.1	2:49	8.7	8:37	0.5	9:10	-0.4
20	3:31	7.6	3:28	6.4	9:15	1.2	9:56	-0.2
21	4:22	7.0	4:08	6.0	9:58	2.0	10:45	0.2
22	5:17	6.5	4:52	7.5	10:43	2.6	11:40	0.6
23	6:18	6.1	5:45	7.0	11:35	3.2		
24	7:32	5.8	6:50	6.7	12:41	0.9	12:41	3.6
25	8:44	5.9	8:02	6.6	1:48	1.2	1:57	3.6
26	9:40	6.2	9:00	6.7	2:53	1.2	3:08	3.4
27	10:28	6.5	10:04	7.0	3:48	1.1	4:04	3.0
28	11:07	6.9	10:54	7.3	4:33	1.0	4:52	2.5
29	11:39	7.4	11:39	7.6	5:15	0.9	5:31	1.9
30	12:08	7.8			5:50	0.9	6:10	1.3

A.M. — Light Face

P.M. — Bold Face

## 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 Marine Science Center Tide Table:

Location	High		Low	
	Min.	Ft.	Min.	Ft.
Brookings . . . . .	-32	-1.2	-29	-0.1
Gold Beach . . . . .	-24	-1.5	-17	-0.2
Port Orford . . . . .	-26	-0.9	-24	0
Bandon . . . . .	-10	-1.2	-5	-0.2
Coos Bay Ent. . . . .	0	-1.1	4	-0.1
Umpqua River Ent. . . . .	7	-1.2	0	-0.1
Siuslaw River Ent. . . . .	8	-1.2	12	-0.2
Waldport . . . . .	23	-0.5	28	-0.1
Siletz River Ent. . . . .	15	-1.6	40	-0.4
Nestucca Bay Ent. . . . .	22	-0.6	39	-0.2
Tillamook Bay Ent. . . . .	9	-0.7	23	-0.2
Nehalem Bay Ent. . . . .	18	-0.4	21	-0.1
Toledo . . . . .	56	-0.2	1:08	-0.2

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 least accurate during storms and extreme high and low tide periods.

### TIDE TABLES ARE PREDICTIONS

## TIDE TABLE FOR DECEMBER 1978

Pacific Standard Time  
OSU Marine Science Dock

HIGH WATER				LOW WATER				
Time	Ft.	Time	Ft.	Time	Ft.	Time	Ft.	
1	1:04	8.1	12:17	9.9	6:20	2.9	7:11	-1.7
2	1:50	8.2	1:04	9.8	7:06	3.0	7:57	-1.7
3	2:39	8.2	1:51	9.4	7:58	3.1	8:43	-1.3
4	3:31	8.2	2:45	8.7	8:55	3.2	9:33	-0.6
5	4:25	8.1	3:45	8.0	10:01	3.2	10:27	-0.1
6	5:21	8.2	4:57	7.2	11:13	3.0	11:23	0.6
7	6:18	8.3	6:19	6.7	12:32	2.5		
8	7:13	8.5	7:44	6.5	12:25	1.3	1:46	1.9
9	8:07	8.8	9:01	6.6	1:27	1.9	2:51	1.1
10	8:56	9.1	10:05	6.9	2:29	2.4	3:46	0.4
11	9:41	9.3	11:00	7.2	3:25	2.8	4:34	-0.2
12	10:24	9.4	11:48	7.6	4:15	3.1	5:15	-0.6
13	11:02	9.5			5:00	3.3	5:53	-0.7
14	12:31	7.8	11:41	9.4	5:43	3.5	6:30	-0.7
15	1:11	8.0	12:15	9.3	6:23	3.6	7:06	-0.6
16	1:49	8.0	12:51	9.0	7:02	3.8	7:41	-0.3
17	2:25	8.0	1:27	8.7	7:41	3.9	8:13	0.1
18	3:03	7.9	2:05	6.3	8:20	4.0	8:49	0.5
19	3:39	7.9	2:44	7.6	9:03	4.1	9:24	1.0
20	4:17	7.8	3:26	7.2	9:53	4.0	10:03	1.5
21	4:59	7.8	4:22	6.7	10:51	3.9	10:43	2.0
22	5:42	7.9	5:31	6.2	11:57	3.5	11:32	2.4
23	6:31	8.1	6:55	5.9	1:03	2.9		
24	7:18	8.4	8:14	6.0	12:26	2.8	2:06	2.1
25	8:06	8.7	9:23	6.4	1:27	3.2	3:01	1.2
26	8:52	9.1	10:23	6.9	2:27	3.3	3:52	0.3
27	9:41	9.6	11:15	7.4	3:25	3.4	4:39	-0.6
28	10:29	10.0			4:20	3.3	5:24	-1.3
29	12:03	7.9	11:16	10.2	5:12	3.2	6:10	-1.7
30	12:51	8.3	12:03	10.3	6:05	3.1	6:55	-1.9
31	1:37	8.6	12:53	10.1	6:55	2.9	7:40	-1.6

A.M. — Light Face

P.M. — Bold Face

Figure 4.—Tide tables for September and December 1978, calculated for the OSU Marine Science Center dock, Newport, with corrections for other points on the Oregon

coast (reproduced from 1978 Tide Tables, a folder published by the Oregon State University Extension Service, Sea Grant Marine Advisory Program).



***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.**

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.



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!

### 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.

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!



Figure 6.—The Columbia River hits the sea with turblnelike force in this February 28, 1979, radar image taken by an Oregon Army National Guard radar aircraft.

The interstate bridge at Astoria appears in the lower right; the Washington shoreline above the north jetty points approximately north.

## To live to sail another day . . .

- **Respect** all coastal bars.
- **Be aware** of present weather conditions and weather forecasts. Forecasts are never perfect, so think ahead. Change your plans if you do not like the way the weather is developing.
- **Know the stage of the tide.** Will it be ebbing or flooding when you intend to go out? What will it be doing when you plan to return?
- **Cross at slack water**, if at all possible.
- As a second choice, **cross on flood tide.**
- **Do not cross on the ebb tide** if you can possibly avoid it. Ebb tides can be an extreme hazard.
- **Be knowledgeable**, plan, enjoy, stay safe . . . lest it mean the loss of your boat . . . and your life . . . .

### For further information

*American Practical Navigator* ("Bowditch"; Washington: U.S. Government Printing Office, 1962), chapters xxxiii and xxxiv.

*Boating in Coastal Waters*, rev. ed., Oregon State Marine Board and Oregon State University Extension Service, Sea Grant Marine Advisory Program Publication EM 3 (Corvallis, 1976). \$1 a copy (plus postage) from Extension Business Office, Oregon State University, Corvallis, Oregon 97331.

Swanson, R. Lawrence, *Understanding Tides*, Oregon State University Extension Service, Sea Grant Marine Advisory Program Publication SG 25 (Corvallis, 1977). Single copy free from Bulletin Clerk, Oregon State University, Corvallis, Oregon 97331.

Extension Service, Oregon State University, Corvallis, Henry A. Wadsworth, director. This publication was produced and distributed in furtherance of the Acts of Congress of May 8 and June 30, 1914. Extension work is a cooperative program of Oregon State University, the U.S. Department of Agriculture, and Oregon counties.

Extension's Marine Advisory Program is supported in part by the Sea Grant Program, National Oceanic and Atmospheric Administration, U.S. Department of Commerce.

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