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Upstream vs. Downstream

The Benign Dictatorship of the Mozambican Shrimp

By James G. Workman

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ABOARD THE ANA PAULA OFF INHACA ISLAND, Mozambique—The trawler lurched heavy to port and I clutched at the wheelhouse to brace myself. It wasn't enough. A squall-driven, ten-foot wave slammed into the hull. Hundreds of gallons of Maputo Bay exploded over the gunwale, sloshing across the deck hard and fast at me, sweeping my feet out to bang my ankle against something metal and rusty. As the storm rose, so did the nausea. I grew seasick. My bowels gurgled like bilge ballast. And the only toilet *on* board was *overboard*, involving a delicate balance bass-ackward over the gunwale, a gymnastic maneuver that I wasn't yet prepared to execute, as there was no life preserver in sight. As another swell heaved through the boat, I lunged across the foredeck for the relatively stable bow.

Mayday! I was careening about; wet, sick and sunburned; inside a small African boat; injuring myself; posing a safety hazard to others; lacking orientation, control or grasp of navigation; and foundering against random waves with no predetermined course. Only explanation: another self-appointed covert diplomatic mission to resolve a festering international water dispute.

Last year I'd flailed down the turbulent, *west*-flowing Orange River (JGW-14) to uncover the hidden line that demarcates the shared watery border between two dry sovereign nations. In vain. The river shifted its position even faster than statesmen.

Now I'd embarked with six seasoned Mozambican fishermen to answer a far more ambitious and daunting quest governing every African *east*-flowing river beneath the equator: *Whose water was this, anyway?* Each dry state claimed more; none had exclusive rights; no 'global regulation' could be enforced from above. So all had begun a 'race to the bottom' of the rivers they shared, grabbing water for themselves, in what could quickly spi-



Finding, Catching & Eating Nemo: *There is little empathy for the contents of this trawler's catch; but one nation depends intimately on shrimp, and shrimp depend intimately on...freshwater flows.*



and shoveled a layer of crushed ice into them. Old, toothy Ignacio neatly coiled the docking ropes, stowed the tire fenders and mended a frayed wire cable. Green-shirted Finneas scooped buckets of seawater and swabbed the deck.

And last, having finished his chores, the wiry, square-shouldered Ziem Ziba washed his only spare shirt and shorts, both faded by sun and salt. Then, barefoot, he clambered up the mast, gripping in his teeth several strands of twine. The twine he used to tie his wet laundry to dry in the warm, Indian-Ocean wind. I watched that threadbare laundry flapping up there on proud display, scrubbed clean, torn but patched with crude stitches; it appeared to me the country's true emblematic flag.

We broke through incoming rollers toward open water where the day's real work awaited us. The *Ana Paula* had set out in search of...not a white whale, exactly, but something pretty damn close: a prey species crassly commercial with a twist of divine. Specifically, we sought a wise and inscrutable and mighty force of nature who could justly determine — like

Solomon with that baby claimed by two mothers — how much water each of Africa's thirstiest nations could guzzle from rivers that flowed across and between their sovereign territories.

Out here, the task appeared remote. Inland, the stakes rose ever higher.

Southern African nations were not just their usual state of dry-mouth. At the peak of the rainy season they were all suffering what records indicated as "the worst drought in a century." I had watched it unfolding over the previous year. It was not picturesque.

Lesotho's thin topsoil was literally blowing away. On the Inkomati and Olifants Rivers, South Africa and Swaziland declared two-thirds of their lands a disaster,

ral into a deadly, irreversible, trans-national 'tragedy of the commons.'¹

* * *

We'd set sail at dawn, slipping noisily from Maputo harbor as the last city lights flickered off. The pier reeked of diesel fumes and rotten fish. Unnervingly huge wharf rats raced for the morning shadows. The cold engines came to life and pocketa-pocketa'd into the morning hush. After moments of brisk, macho 'trash-talking' at crews getting busy on rival trawlers, the *Ana Paula* veered outward to sea and inward to work.

Captain Joaquin Maldanela spent the first hour barking Portuguese into the boat's radio. First mate Samuere Timba greased the motorized winch. A muscle-bound sailor named Luis Armando hoisted out the plastic crates

¹ The phrase coined decades ago by Blaine Harden became an effective political warning. It referred to a village commons, or pasture, owned by no one and thus in every citizen's logical self-interest to turn their own livestock out onto it, collectively overgrazing the last blade of grass down to exhaustion, erosion and death.



Ziem hoisting the 'Flag:'

The men moved in monastic silence, their fluid and efficient motions sculpted by daily ritual repeated in 270 14 hour days each year.

with 15 million people facing extended food shortages, and 3.5 million parched villagers depending on water tankers arriving over dusty dirt roads. Along the Save and Pungue Rivers in Zimbabwe, hundreds of thousands of livestock had to be slaughtered with no water or grazing forage. Along the upper Limpopo River in Botswana, severe water rationing had begun, straining its dusty and crowded AIDS-wracked capital, Gaborone. Even along tributaries of the Zambezi, Shire and the Kwando Rivers in Malawi, Namibia and Zambia, wildlife-tourism operators and subsistence farmers alike were parched and failing. Throughout these countries, tens of millions thirsted for relief. Demanding water. Fast.

Panicked governments met and decided, of course, to grasp at what was left of their vanishing rivers. Upstream Anglophone nations agreed to divert streams and pump groundwater: South Africa scheduled seven more dams on the Inkomati alone, while Botswana, Zimbabwe and Namibia planned to sink thousands of new boreholes into their dropping riparian (riverside) aquifers. Global charities and donors rolled up their sleeves to pitch in financial and technical assistance; some started to design irrigation projects, hydropower schemes, and water transfers to cities.

But as each prepared, they heard their lone Lusophone neighbor — located at the lower end of all these rivers — politely but audibly clear its throat. *Ahem. Um momento. Nao, faz favor. Nao toma a nossa agua corrente.*

“In years when the rains come hard, our neighbors upstream, they want to get rid of their water fast, and so we have deadly floods,” Mozambique President Joaquim Alberto Chissano told me at a luncheon where, as a conference note-taker, I had the rare good fortune to be seated

on his immediate left. He spoke with calm determination. “But then, when the rains don’t come, like now, they hold back all the water behind their dams, and use up every drop themselves, and so we have terrible droughts. We get the worst of both situations. It cannot go on like that.”

It cannot, and yet it did. In fact, it threatened to turn worse in the upstream reaches of 14 of its major rivers that originated in foreign lands. As it was, Chissano felt exposed to water scarcity. His people were among the world’s poorest and thirstiest: two-thirds had no improved or reliable water supply; three-quarters lacked safe sanitation. Many fled the barren countryside to swell the overburdened capital, and further stress the overdrawn rivers.² Personally, our apartment block went three days without water; we stockpiled expensive mineral water till that ran out; skipped showers; and dined out to use the restaurant’s bathroom.

“We are the cloacae of Africa’s rivers,” growled Dr. Victor Serraventosa, President Chissano’s chief legal negotiator dealing with international water. That meant, extending his digestive-tract metaphor, that upstream diets made rivers no longer ‘regular.’ Artificially manipulated, currents fluctuated wildly between raging diarrhea, like the floods of 2000 — and extreme constipation, like this rainless summer.

After those floods implicated upstream water development, officials convened technical and legal consultations; each led to various ‘prescriptions’ to coordinate international drinking habits from shared rivers. But no political ‘doctor,’ not even Nelson Mandela, possessed the disinterested authority to force a moral, credible, rational and pragmatic ‘cure’ that would satisfy all in the region. Tensions grew, pitting ‘upstream’ vs. ‘downstream,’ and national self-interest vs. equitable negotiations. Stalemate.

As the situation degenerated, some began to whether

Chissano:
Gentle smile, clenched teeth: Mozambique President Chissano has repeatedly threatened to take its upstream neighbors to the World Court over the diminishing quantity of water reaching his nation.



² The dirty secret behind the nation’s proud, go-go, roaring growth rate of 12 percent is that its economy has for a decade been artificially pumped up on the steroids of Maputo-based donor spending, amounting to 70 percent of the budget. Those funds are tapering, and could vanish overnight.



All Hands On Net: *The crew of the Ana Paula heaves the net together. Can shrimp harvests also coordinate the efforts of nations linked by rivers?*

a truly fair partition of international water lay beyond Africa's capacity. Africa's *human* capacity, that is.

* * *

The bow rose high up in the air only to crash back down against an oncoming wave. Wind sprayed my face with salt water. Correction: brackish water. As it ran down into the corners of my mouth it tasted not nearly as salty as the open sea father out. The taste changed due to the infusions of perennial fresh waters flowing down the Inkomati, Umbeluzi and Maputo Rivers, which originate upstream in the hills of Swaziland and South Africa. They flow downhill, picking up weight and momentum, to do battle with the tides of the sea. The battleground, estuaries, gives rise to the richest sources of life on earth.

What was troubling is that the water still tasted a lot saltier than it used to. According to water consultant Carmen Ramos, over the last decade the average flows had shrunk in half. In that eternal war between rivers and tides, Africa's streams were retreating, leaving wounded estuaries behind in a bureaucratic no-man's-land, as salt water advanced slowly up the river mouth.

'Salt water intrusion' did not bother upstream nations or their economies; to them it seemed another one of those meddling 'eco' issues that obsessed Greens constantly preaching doom. Ironically, South Africa had laws protecting flows that would sustain its own coastal estuaries. But here in Mozambique, at the tail end of rivers like the Inkomati, well, it seemed a different story.

They faced, upstream, fiercely competing post-apartheid needs: expanding subsistence farmers, commercial citrus growers, thirsty timber plantations, booming cit-

ies, sprawling residential real estate, industrial processing plants, and rising tourist resorts. Never mind *future* demands, humans were already removing 54 percent of the water before it reached the next border. Thrust on top of these pressures came South Africa's progressive new water law, which requires, above all other uses, a two-part "reserve." The first reserve satisfies basic *human* needs: a minimum, non-negotiable 25 liters per South African for drinking, bathing, and cooking. That's 7 percent of the water. The second reserve satisfies basic *river* needs: the health and integrity that each aquatic ecosystem needs to function properly. That amounts to 44 percent. The law shows admirable foresight. Yet add all these percentages together with those above, and you find that 105 percent of the river is carved up by South Africa before it hits the border with Mozambique.

That left a whole lot of nothing for the Portuguese speakers downstream. One South African official insisted, defensively, that the "equitable volumes that all parties have agreed upon came about as the result of a series of long and in-depth negotiations." Really? I asked exactly what those volumes were, and how they had been negotiated with such a poor, weak, undeveloped, dependent nation. No one could tell me with any specificity. They referred to an undisclosed 'formula.' The vagueness, added to their eagerness to get away from me, led me to assume that they were trying to glom onto as much water as possible, for as long as possible. Just like, say, America against Mexico on the Colorado River.

This was, of course, flawlessly rational behavior for any officials paid to protect national self-interest. But it was none too neighborly.

Worried about its image as an upstream bully, South Africa proposed a 'Memorandum of Understanding' over shared water. Mozambique rejected it as a "feel-good document," for it did not feel good one bit. Instead it held out for a stronger 'joint water commission,' but even that did not appear to be working.

"Despite the terms of the Inkomati water-sharing agreement we negotiated, South Africa is not meeting even its minimum obligations to ensure flows across the border that we agreed to," complained Dr. Serraventoso. As negotiator he'd witnessed the marked changes each time he shuttled east and west along the new 'Maputo Corridor' highway. It made him gnash his teeth.

"People on this side, in our town of Moamba, they have no water to drink from taps. Yet when I cross the

border upstream I see sugar cane farmers spraying their crops at noon, ensuring that 40 percent of it evaporates before it even hits the ground!"

* * *

Wedge into the prow, I watched wave after wave crash against the hull and imagined I could see the salty spray evaporating, rising as fresh vapor into land-bound clouds. The spray revived me. I began to recover and staggered aft to join the crew again, where old toothy Ignacio sat cross-legged on the roof of the wheelhouse like some scrawny Buddha. Ignoring the pitch of the waves, he held a skewered chunk of yellow-tail fish in front of the boiler engine chimney, cooking it on the exhaust heat. I smiled at his resourcefulness, and he laughed and offered me a bite.

Just then Captain Maldanela revved the diesel motor three times hard and slowed down. At this signal, the crew dropped what they were doing and without a word made their way to the stern of the trawler. They sauntered across the pitched deck without having to brace themselves every step. I followed, crawling sideways like a crab.

First mate Samuere Timba operated the winch while the other four grappled with the net. They tied the opening and dropped it overboard. The sea pulled back the net, which was bracketed by two sleds, which in turn resembled two heavy, metal-framed wooden doors. The starboard sled got tangled — buoy caught against a metal spar — then, released with a gumbooted kick, it too slammed into the water. Immediately submerged, the



Release to Catch: *Luck always plays a role in fishing, but the sooner the crew can get the net in the water, the longer the trawling period, the luckier they get.*



Trickle-to-the-Sea: *The Maputo River gets dammed and diverted for thirsty, lucrative sugar cane plantations, so that the floodplains are seasonally dry even on the South Africa side. This bodes ill for the Mozambique side.*

sleds flared out at diagonal angles against the sea, yanking the cables and thick ropes out fast, ten meters, twenty meters, forty meters, billowing the net wide open and down.

At a shout from Ziem, the first mate froze the cable winch and the captain throttled forward.

I followed his gaze out to sea. Out there, each captain had his own rules on board; but between boats was an internationally recognized code. That 'law of the sea' took shape informally over the centuries to ensure peaceful trade, safe navigation, access to and use of resources. After trial and error, and more than a few battles, most nations streamlined and codified it into written treaties with one another. Based on mutual self-interest, it worked.

I then turned and looked at the continent. Back there, the River emptied into the sea after flowing through southern African landlocked nations and land-based economies. Each president had his own rules for water use within their borders; but given less than a decade they had only just begun to hammer out a not-quite-yet internationally recognized 'law of the river.'

The early nudge behind their efforts was the combined momentum of political alliance. Just as Mandela married Graça, the widow of the late, charismatic Mozambican leader Samora Machel, so the nations wed their wills over shared resources. Just under two years ago, in a ceremony overlooking the Limpopo River, I heard southern African leaders Chissano, Thabo Mbeki and Robert Mugabe speak of the river in terms of 'our common bond.' For decades they had 'forged a special relationship, going through the struggle together' against

colonialists and white minorities. But behind the ceremony, and since that day, I learned those surface ties were in danger of dissolving, constantly tested by the compounding pressures of drought and increasingly scarce water.

African hydrologist Peter Ashton succinctly explained the scope of the Dark Continent's mounting predicament, where:

The [arbitrary colonial boundaries] seldom conform to river catchments, and all of the larger river systems in Africa are shared by several countries. Consequently, several African countries have had to compete directly or indirectly to derive the maximum possible benefits from the available water resources. This situation has been accentuated in those situations where the downstream countries may be economically "poorer" or politically and militarily "weaker" than their upstream neighbors. This competition between "upstream" and "downstream" countries for the same water resource is considered to pose the greatest potential threat of conflict over water in Africa.³

You can't find any nation economically 'poorer,' politically and militarily 'weaker,' or more emphatically 'downstream' than this. Mozambique had to forge newer, stronger bonds with upstream nations based on mutual self-interest; it couldn't rely on its former brothers-in-arms. "When this (current, post-'struggle') generation leaves," cautioned negotiator Serraventoso, "We are all left with no more than our conscience, and one document."

One remarkable document. Based on principles from Europe's "Helsinki Rules," and modeled after a United Nations Convention, the *Revised SADC Protocol on Shared Watercourses* has been custom-tailored to the water-sharing needs of the region. On paper it encodes noble aspirations, and has become the envy of the Western world.⁴

In practice it's a bit trickier. Even the writing of the document revealed hidden agendas. Upstream countries had initiated and written the first 1994 version. Their bias showed. That draft conveniently: excluded upstream tributaries from the definition of 'rivers' (akin to excluding veins and capillaries from definition of 'blood circulation'); ignored the impacts of upstream land use or pollution on downstream water use; offered no real means of arbitration; and above all, its abstract 'rivers' stopped just moments before plunging into the ocean. Any such water was deemed 'wasted.' In short, based on the first Protocol, rivers were no more than aqueducts, plumbing

the infrastructure to benefit nations who shared them.

Never mind. All upstream nations rushed to ratify this version as the closest thing to a watery Magna Carta. Only Mozambique begged to differ, maintaining that a river was a complex dynamic continuum between land, water, wildlife and the sea. Its reasoned argument held water, so to speak. Yet as it differed, 'begged' was the operative word. In 1994 Mozambique had just stopped killing itself; since then it has remained the lone downstream voice of dissent, yet too weak to lift a finger.

"Going to fight over water would not be a good strategy," acknowledged Susana Saranga, director of International Rivers for Mozambique. She knew the limits of her nation's power, citing how "the late start" for Mozambique — after two decades of fighting cataclysmic civil wars while its neighbors developed 'their' water — meant, "we can't just come and say, 'now you must give up all that water you're using'. They've already committed that water for major economic projects upstream."

In the post-war spirit of détente, she and her colleagues sought to negotiate peacefully, using the image-tarnishing threat of the World Court as its only leverage over stronger neighbors. "As neighbors we can all share the benefits, trading the goods and services that the water provides, like food, electricity, or water itself."

By sharing, trade could catalyze the emerging concept (JGW-20) of 'virtual water' in the form of water-generated goods⁵, when a nation can't import the wet stuff itself. But even there, Mozambique was getting the short end of the stream.

It had little to trade. Its people could barely feed themselves with subsistence crops. Commercial farming was equally challenged. Mozambique's late start meant any crop was already being grown bigger, faster and better in neighboring countries, which sold it far cheaper than Mozambique could ever produce for itself.

History even ruled out trading hydroelectric benefits. In 1975 the Portuguese built one of Africa's largest dams, the 2,075-Megawatt Cahorra Bassa on the Zambezi. But since it generated more 'juice' than Mozambique could use (95 percent have no access to electricity), colonial Portuguese contracted with their white Afrikaner allies to provide cheap energy to South Africa. Today, South Africa continues to buy from Portugal (which still owns the dam for reasons of debt) at far below market rate

³ Peter Ashton, *Factors Contributing to Conflict Potential*, contribution to book *Hydropolitics in the Developing World*

⁴ Top hydro-geographer Aaron T. Woolf of Oregon State, gushed how, in less than a decade, "the [southern African] region now has more experience in negotiating water treaties and implementing joint management bodies than any other region on earth." In a recent book, top U.S. water-scarcity gurus Sandra Postel and Brian Richter predicted: "As the impacts of hydrologic alteration become better understood by society at large, the U.S. and other countries will eventually follow South Africa's lead in setting goals pertaining to flow protection."

⁵ In essence, it takes 1,000 metric tonnes (cubic meters) of water to grow 1 tonne of wheat; thus by importing 1,000 tonnes of wheat, a nation also imports 1 million cubic meters of 'virtual water.'



Meet The New Boss: *Unforgiving, demanding, and difficult to understand, the benign dictatorship of shrimp may unlock how southern Africa should share its rivers.*

then sells power back sevenfold to impoverished Mozambique, making a legal, but obscene, profit.

Finally, any new diversions for agriculture or hydro-power would decimate Mozambique's only other lucrative, river-generated resource, as we shall see.

It looked bleak. President Chissano's nation appeared as much a prisoner of its downstream geography as its 'downstream' history: a late bloomer with no comparative advantage to bloom. As rains refused to fall, upstream countries felt a lot less worried about a World Court ruling than drought, thirst and famine.

As President Chissano explained to me during that lunch, "Our upstream neighbors, they look at us and say, 'what do you need this water for? You can't use it. You have no infrastructure. You are too flat for more dams. The soil is not good for irrigation farms. Any water that we leave you will simply flow through your country and empty wasted into the sea'."

Catch-22. You can demand more upstream water in order to develop, but without development you have no basis to demand more upstream water.

It was depressing. Depression makes me hungry. So I fled the humid, tangled streets of Maputo and drove my appetite an hour up the coast to the mouth of the Inkomati River. It was hot but breezy, and at a paint-peeled restaurant near the beach I sat down and ordered a cold beer. Surely, I sighed, Mozambique must have *something* unique to offer the rest of Africa, some leverage that demanded fair and durable flows of fresh water. Not just for his sake, but for the sake of the entire subcontinent, Chissano had to demonstrate that water left flowing in the river had real, tangible value. If he failed, as the furthest downstream country, then nothing prevented a drought-driven region from draining their international well. Each upstream state would guzzle up

whatever it felt to be a 'fair share' of 'its own river,' until the river buckled, collapsed, and imploded inward, dragging people with it.

I could think of nothing. My mind drew a blank.

But my mouth drew water. From the kitchen I smelled something grilling in garlic butter, sizzling and popping. I opened the tattered menu, or *ementa*, looked under "*peixe e marisco*" until my eyes fell upon the words "*camaroes e gambas*" I translated the words "doze" (dozen) and "butterflied." Then I glanced at the low price.

Eureka.

* * *

Back at sea in the wheelhouse, captain Maldanella eased left and the *Ana Paula* swung in a slow, steady arc counterclockwise, the enigmatic shore slowly spinning past on the starboard. Again the signal: three revs of the engine. All hands gravitated aft to stern. The diesel winch began to whine once more, only this time it re-coiled, wrapping the rope and cable thick around itself.

As the net approached the stern, the men reached overboard, pulled as one, and bunched the end. Above them dozens of birds started to hover: Whiskered terns, Grey-headed gulls. They knew. They'd adapted through daily Pavlovian indoctrination of sound and motion, like a cat to can opener.

The sleds clunked hard back against the lime green



It Came From the Deep: *This nameless monster — half-barracuda, half-eel — thrashed about on the deck snapping its teeth until killed by a shovel to its neck. Even dead, it continued to move.*



(Top, left) **Haul Aboard:** Ignacio steadies the full net over the starboard banister. (Top, right) **Slippery Slope:** Ignacio and Ziem reach under to open the knot and release it without becoming part of the catch himself... (Above, left) **Net Gains:** The catch spreads over the foredeck, a seething, slopping, thrashing gumbo of fish and crustaceans and, above all, the bloated jellyfish that reproduce in periods of drought. (Above, right) **Fight to the Bitter End:** Some of the catch sorts itself out, but these crabs had worse to fear than each other, and would end up as someone's supper that night. (Bottom, left) **Waste Overboard:** It was hard to stomach how much "by-catch" was thrown back, dead. Although the birds and other fish in the sea will make a meal of it. (Bottom, right) **Icing on the Cake:** Preserving the catch as a buffer against a fickle market on shore.



hull, and the men hoisted the net closed at the top. Then they swiveled it out over the water on the starboard side, swung it fore and locked it hovering over the foredeck. The net pulsed. The water streamed out between the mesh, splashing down in a torrential cascade. The load swelled, heavy with life. Ignacio squeezed against it, reaching under to undo the single knot that held back the catch, suspended, struggling for release.

With a final tug he dodged back and the harvest spilled hard against the splintered deck.

Three men closed the empty net and returned it to the sea. The rest of us waded into the seething mass and began to separate silver from trash. The deck vibrated with jellyfish, eels, crabs, fish, minnows, and, amidst it all, the three species of treasure *Ana Paula* sought nonstop, fourteen hours a day, nine months of the year. Ignoring a nation fueled almost entirely on foreign aid, shrimp underlie one of the only genuine economies. And ignoring a calendar filled with dozens of impromptu holidays, long weekends and rising funerals, Maputo's 20 trawlers worked the waves.

They shrimped without ceasing to the end of the season, casting out the net five or six times a day at two-and-a-half-hour intervals, constantly seeking the mysterious, valuable *Penaeus indicus*.

Out of Maputo Bay they hauled in 500 tons a year. To the north, off the legendary wide, shallow shelf of the Sofala Banks where the Zambezi empties into the Indian Ocean, the annual catch was 9,000 tons. Each river mouth had its shrimpers. Up and down the coast, small-scale, or 'artisan' fishermen catch still more, making shrimp both life and livelihood, providing rural people the cash and nourishment to fight off starvation in dry years, which grow ever more frequent.

Watching these fishermen work near the mouths of rivers fascinated me. Yet at the time I made no link between freshwater flow and saltwater catch. It wasn't like lamprey, eel or salmon, after all, where ocean animals swim up and downstream. The owner of the *Ana Paula* drew no connection. Nor did the sailors on board. But scientists sure did: over the decade since peace broke out, as Mozambique got back

on its feet, several strategic studies had been quietly compiling, mounting the evidence binding shrimp/prawns and tributaries/rivers.

Each study made the river-to-sea/freshwater-to-salt water link direct and inescapable and indisputable. That manifest link would have a profound impact on the region's emerging international 'law of the river.'

Unlike elements of every ravaged land-based economy, the shrimp industry had been unruffled by decades of war. If anything, crustaceans had prospered, becoming the single most important source of foreign currency. Even today, with competition from agriculture and industry, and with flows reducing the catch, the prawn and shrimp harvest still constitutes a whopping 40 percent of all Mozambique's exports.

The regional and international hunger for this unique, endemic and comparatively advantageous 'crop' grows exponentially.

"Everywhere I go — Zimbabwe, South Africa, Namibia, even Botswana — everyone asks me how they can import shrimp from Maputo and Mozambique," said Dr. Rui Silva, director of the National Marine Fisheries Research Institute. The building's impressive name couldn't hide its neglected, pockmarked condition or its chronic lack of



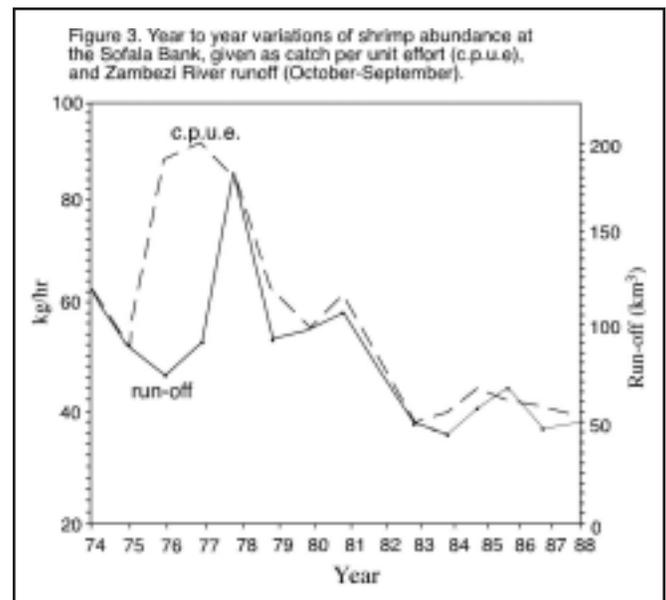
Dr. Rui Silva: "We can predict shrimp catch based on rainfall and upstream diversions"

funds. But what little research it had hosted or compiled was proving political dynamite, with implications that rippled back upstream into the inland tributaries.

Study after study revealed how, by any parameter — catch per unit, per hour, per season, overall abundance, annual net etc. — the fate of salt-water shrimp was tied directly to the fate of the freshwater rivers.

In years when these rivers overflowed — known otherwise as purely destructive 'floods' — the shrimp harvest yielded a bumper crop. Conversely, after each new dam was constructed, shrimp harvests fell proportionately. The conclusions were electric. Even the dry, dispassionate tone required of academic research could not hide the excitement. A top fisheries researcher from Scandinavia, one Tor Gammelsrood, breathlessly concluded, "We note the correspondence between runoff and shrimp abundance is striking."

To say the least. Over the course of a single year, the



$C = (a + b)(Q)$: The exciting new equation linking inland rivers with offshore prawns.

shrimp catch matched the river flow so closely, so intimately, that researchers could develop a linear regression equation,⁶ namely $C = (a + b)(Q)$, as proof of direct proportions. As they compared the hourly catch with the amount of water reaching the sea, they began to accurately predict annual shrimp abundance by the end of March.

Such equations and proofs led further. The shrimp prediction equation took on more import, with far more relevance on rivers than $E = MC^2$. Like a Mozambican mini-Manhattan Project, researchers proposed, and entered varying seasonal flood releases from Cahorra Bassa dam into their computers. They soon confirmed that those manmade, nature-mimicking floods boosted shrimp recruitment discernibly. The experiment demonstrated that the increase in foreign currency from exports of 20 percent more shrimp far outstripped the foreign currency lost from lower hydroelectric power sales.

Again, to borrow the dry language of research, "The economical perspectives are promising. Calculations indicate that an increase in catch rate of the order of 10 kilograms per hour is possible with proper regulation of the River. This means an additional catch of about 1,500 metric tons per year, with a total annual effort of about 150,000 hours."

It became self-evident that healthy river flows generated more jobs, more food, more foreign export exchange and — by weaning from donor dependency — more government legitimacy and economic stability. Mozambique began to salivate: If a study on one river showed a \$10 million increase without additional investment in labor, what return might be realized by improv-

⁶ Where C= abundance; a = 17 kg shrimp per hour; b= 0.9 kg per hour per square kilometer; and Q = runoff from October to March.



Tug-O-War with the Sea: Near the mouth of the Inkomati this ‘crew’ would drop the net offshore in the boat, foreground, hoist it back on ropes, then gather the catch back to land.

ing flows down all 14 international rivers?

This ammunition gave President Chissano a second wind. I began to hear him argue for more water as diplomatically as possible, sounding like a hard-core environmentalist as he inveighed against “the dangers of salt-water intrusion into our estuaries.” From his downstream standpoint, not a single drop of water that flowed out of his neighbors’ countries down through ‘undeveloped’ Mozambique and into the sea was ever ‘wasted.’ Few upstream neighbors could ignore the evidence, even during a crippling drought.

What’s more, many of the top decision-makers in those countries (both African and the often more power-

ful expatriate donor officials) had all acquired a taste for the wild Mozambican prawn. His arguments carried an added piquancy.

“In the past, it used to be ‘excess fishing’ that was to blame for bad shrimp and fish harvests,” recalled Dr. Silva. “Now we are making the direct link to environmental pressures. We can predict a good year for shrimp based on rainfall upstream and water diversions from rivers.”

He continued: “We now ask, what must we do to make nature help us, work with us rather than against us? That makes dams for flood-control and water-storage almost contradictory to our economy. Dams actually, day to day, can’t give a voice to the river’s side and water quality. Shrimp can, and do.”



Hunter-Gatherer Existence: ‘Artesian’ fishermen use shrimp for subsistence and sales, then marketing the more mouth-watering parts of each catch to local restaurants. Such operations are small-scale, decentralized and hard to quantify. But their cumulative economic benefits, which depend on river flows downstream, add up to livelihoods for a large segment of the nation’s population.

Shrimp flexed their political muscles, bolstered with evidence from the link between export catch and the quality, quantity, and timing of water flows down rivers. During negotiations, Mozambique increasingly stood up to every other nation. It demanded that all parties revise the South African Development Community (SADC) Protocol on Shared Watercourses to turn the artificial ‘plumbing’ back into the dynamic rivers that they were. And it won.

* * *

Back on the *Ana Paula*, I fell to my knees. Not so much due to religious awe as an unexpected buckle of the sea. But while down there, I reached into the muck of sea life sprawling over the deck, and picked up a single specimen of *Penaeus indicus*. Its tiny legs and antennae kept wriggling, swimming against the air. Its body squirmed wet and

cold against my fingers. Here it was, I reflected: the new “Big Man” of southern Africa.

This force had begun affecting crucial life-and-death decisions for millions who had not elected it; it distributed its wealth to reward those who fought most loyally for its survival; and it might decide to stay in power indefinitely. Yet it was far from big. It was decidedly not a man. Perhaps that’s why its autocratic rule felt so benign, so equitable, so just. So...so... *delicious*.

But skeptics remain. If shrimp were going to dictate the volume and timing of more water down international rivers, certain questions could not go unasked. Namely, what causal factors were behind the intimate link between flow and shrimp harvest? Humans had to be sure the crustacean’s rule was not as arbitrary as, say, your average nationalist autocrat.

Better understanding of its life cycle led to various hypotheses. Spawning took place at sea, but the species requires brackish water as nursery areas. As post-larvae shrimp move inshore. But because they are lousy swimmers, they use tidal currents to carry them one direction, and they schedule their move at a time when weak river currents won’t carry them back out. That makes the severity and timing of the dry season as important as the rainy season.

Rain also affects the crucial salinity in the shrimp’s



First Mate Samuere Timba: For nine years he had spent months at a time shrimping on the Sofala Banks, which have been hurt by lower flows down the dammed and diverted Zambezi River.



Mozambican Dhow: The colorful old fishing boats that give the shore its color are still used to fish, but more for transport across the river mouths, as here.

nursery schools, the mangrove estuaries. Chemistry is important, although it is not always clear how. Tidal currents somehow combine with daily ‘vertical’ migration patterns required for feeding on the sunlight-bred plankton stews near the surface, and hiding from predators at deeper levels. Some researchers point to the flux of temperature’s cold/warm circulation set up by the rivers. Others propose a physiological link, in terms of temperature, growth, transparency and photosynthesis. Still more say there may also be a mechanical force at work, with each upstream flood flushing down nutrients and vitamins and minerals and vegetation that the shrimp gorge on to grow healthy, just as we gorge to grow healthy from shrimp.

All this seemed possible, but there was no definitive proof. I asked Dr. Silva why he thought shrimp mirrored the health of international rivers. He turned a bit sheepish, and shrugged, smiling. “We don’t exactly know.”

The Good Lord works in mysterious ways.

* * *

Few knew these whims and mysteries better than the sailors aboard the *Ana Paula*, dressed in foul-weather gear, hauling in then clawing through the last catch of the day.

With wooden spikes they speared the bloated jellyfish, hurling them overboard, ignoring or no longer feeling any of their tentacles’ stings. They selected some crab and fish that were edible, and sorted the three types of shrimp. Finally they iced down food in the black trays, and shoveled the rest of the inedible ‘bycatch’ overboard.

Without a net dragging behind, Captain Maldanella throttled back toward the city, crashing through the waves rather than riding them, barking into the radio to an-



Friend or Foe? *We passed this other trawler at sea. It was one of 20 launched from Maputo, competing after a bigger piece of the same shrimp 'pie' but allied with us to ensure more water came down rivers to increase the size of that pie.*

nouncing when the *Ana Paula* would reach port. Hours later the engines eased up and we coasted into the glassy, oil-streaked surface of Maputo Harbor.

We pulled up to the concrete pier and prepared to unload the catch. A full moon was already rising. As if in symmetry to our morning departure, the city lights — powered by that damn prawn-killing dam on the Zambezi — flickered back on. Other ships leaned against the docks. They were huge, labeled with Russian, Chinese and Danish names across their sterns, and they dwarfed our lime-green local trawler.

All at once the owners arrived, driving down to the edge in Mercedes and Pajeros, cell phones fused to ear lobes, checking on the day's results, weighing and reloading the catch from boat hold to pickup truck bed.

Carlo Silva, the owner who named *Ana Paula* after his sister, grumbled at the catch. What had seemed prodigious to me was barely enough to cover the cost of diesel fuel and labor. He learned about all the jellyfish clogging the nets, and remarked hopefully that the rain, when it came, *if it came*, would kill them with the fresh water. I showed him the charts linking river runoff to shrimp and prawn catch. He was interested, and surprised, but skeptical that the crustaceans could rule the river flows from below without suffering the equivalent of a lethal, diplomatic *coup d'etat*. "The more it rains, the more they will hold back for themselves," he said, lumping together Mozambique's landlubbers with the English-speaking foreigners farther upstream. "We don't have the power of agriculture, of cities."

Not yet, perhaps. But as prices rose, shrimp gained allies. He remained as optimistic as the crew of the *Ana Paula*. "It's our nature," one explained. "As fishermen, we always think that tomorrow is a new day, that the next morning will bring a better catch. Even if it never does."

Behind us the Indian Ocean breathed slowly. Inhaling, it drew down the boats, lowering them vertically against the level of the pier. As it held them there I could imagine the continent's rivers flowing into the tidal vacuum all along the coast. A moment passed. Then exhaling, it nudged boats back up, rising, the ends of their steel gangplanks squeaking against the concrete wall, to exchange its shrimp with the men in trucks who retreated with their cargo, merging into the traffic of the dry, thirsty city. □

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