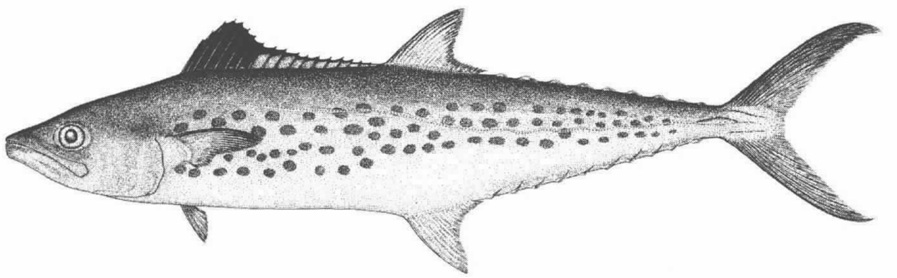
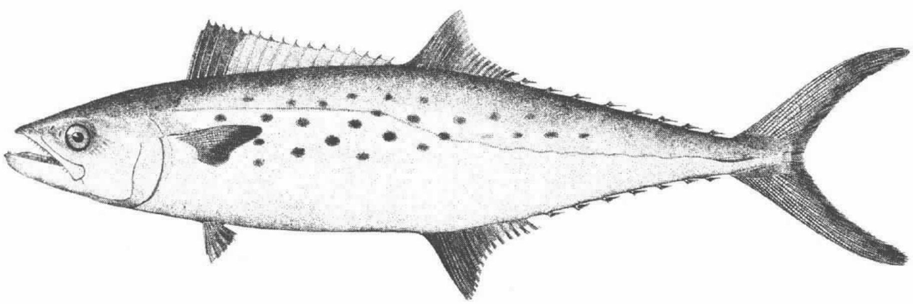
The Importance of Systematics to Fisheries

Short examples of the important role of systematics to fisheries management





Spanish mackerels

Spanish mackerel is an important fishery in the Gulf of Mexico and along the East Coast of the United States. In the 1970s most of the fishery and biological data for Spanish mackerels were from Brazil. U.S. fishery managers planned to use these data in management of the Spanish mackerel in the United States. However, Collette *et al.* (1978) showed that the Brazilian population represented a distinct species (*Scomberomorus brasiliensis*) from the U.S. species. The Spanish mackerel in the Gulf of Mexico and off the southeast U.S. coast (*S. maculatus*) is a much smaller fish, reaching a maximum size of 77 cm fork length compared with 125 cm in *S. brasiliensis*. Similarly, *S. maculatus* matures at a smaller 25–37 cm, and *S. brasiliensis* at 46 cm (Collette and Nauen, 1983). Managing the U.S. species with the Brazilian data could have resulted in unnecessary economic impacts to the fishing industry and inadequate conservation measures for *S. maculatus*. (B. Collette and M. Vecchione)

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Walleye pollock

The walleye pollock (*Theragra chalcogramma*) fishery in the northeastern Pacific is one of the largest and most economically important in the world. During the 1980s, walleye pollock was the single most important species (by weight) in the world fish catch (Bakkala *et al.*, 1987). Before 1981, very little was known of the early life history of walleye pollock; scientists could not even separate their larvae from those of the other four gadid species occurring in the northeast Pacific, such as the Pacific cod. Several taxonomic studies (Matarese *et al.*, 1981, 1989; Dunn and Vinter, 1984) have since enabled the accurate identification of gadid larvae in the northeast Pacific and have allowed the Fisheries Oceanography Coordinated Investigations (FOCI) program to plan and implement specialized recruitment studies to better understand walleye pollock and their management needs. (B. Collette and M. Vecchione)

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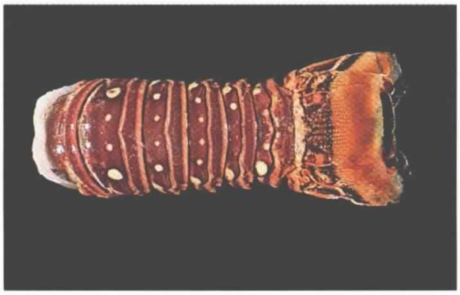

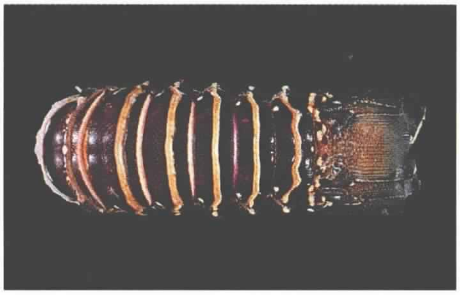

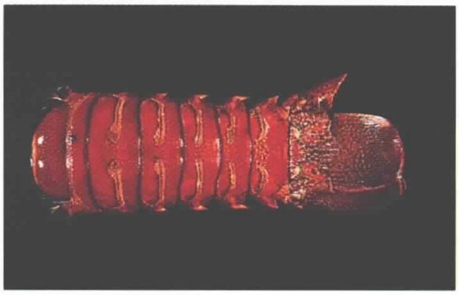

Tail of the Caribbean spiny lobster

Spiny lobsters are ordinarily identified using a combination of morphological characters from the entire animal. But only the tail is used in spiny lobster commerce, causing problems in determining what species it is, and where the tails have come from. This is particularly important to consumers such as the U.S. military that have guidelines for purchasing products. U.S. military purchase conditions state that such products must be of U.S. origin. Were spiny lobster tails being purchased by the U.S. military of U.S. origin? Williams (1986) worked with the National Marine Fisheries Service Inspection, U.S. Customs, the Food and Drug Administration, and seafood importers to accumulate enough frozen lobster tails to be able to differentiate among species, based solely on characters of the tail. Color photographs were used to enhance an identification guide (Williams and Dore, 1988). The guide has been used to prove that some spiny lobsters represented as from the southeastern United States were not so, but actually shipped from the Indo-pacific. The key was also used to prevent landing of a shipment of "Spanish" spiny lobsters that were actually a product of Cuba, and as such were banned from importation into the United States. (B. Collette and M. Vecchione)

References

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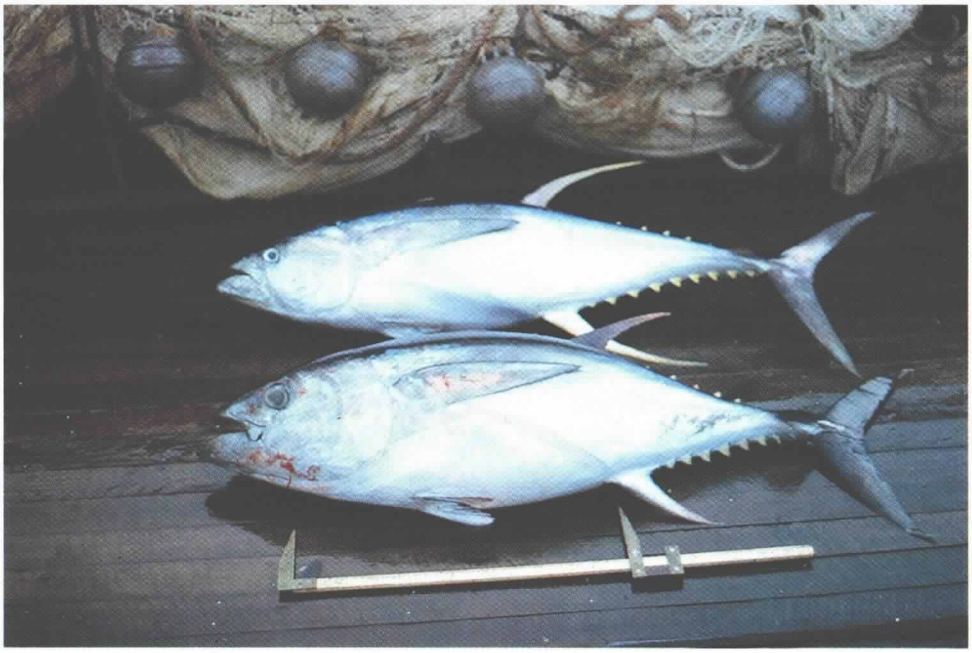

Tunas

Throughout the years, 10 generic names and 37 specific names have been applied to the 7 species of tuna (*Thunnus*) recognized by Gibbs and Collette (1967). Much time and money has been spent gathering meristic, morphometric, anatomical, distributional, and life-history data on tunas in each area where they were found. But applying data from one region to another was difficult because data were recorded under different names. For example, fishery workers in Japan and the U.S. Bureau of Commercial Fisheries (now the National Marine Fisheries Service) laboratory in Hawaii recorded information on yellowfin tuna under the name *Neothunnus macropterus,* those in the western Atlantic as *Thunnus albacares,* and those in the eastern Atlantic as *Neothunnus albacora.* Large, long-finned individuals—so-called Allison tuna—were known as *Thunnus* or *Neothunnus allisoni.* Gibbs and Collette (1967) postulated that the yellowfin tuna is one worldwide panmictic species with populations extending around the tip of South Africa (confirmed using molecular techniques by Scoles and Graves in 1993). Since then, workers in Hawaii have been able to use research on food or larval development from the Atlantic or western Pacific to aid them in their work. (B. Collette and M. Vecchione)

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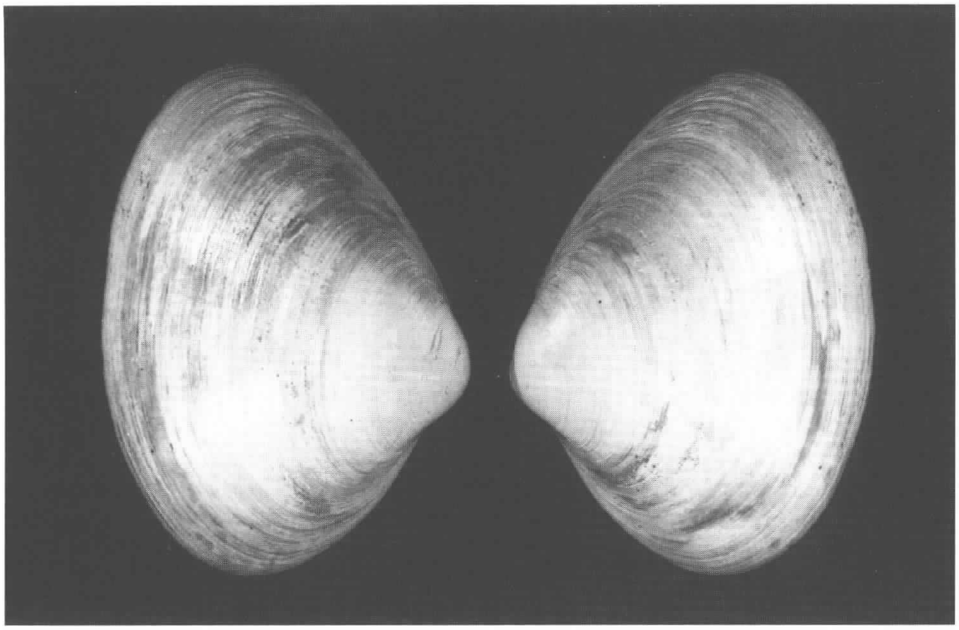

How Many Species of Surf Clams?

It may be surprising to nonsystematists, but there is still a great deal of controversy about how species should defined (e.g., see Table 1 in Coyne, 1994). The biological species concept, the most widely accepted species definition, requires either knowledge or inference about reproductive potential between two individuals (Palumbi, 1994). Because direct knowledge of whether or not two organisms can reproduce viable offspring is difficult to obtain, inferences are usually drawn from either morphological or genetic variation. Both morphological and genetic comparisons have strengths and weaknesses, but used together they can be mutually supporting. When the results of both methods agree, hypotheses that may have been weakly supported by one or the other are strengthened. When the results disagree, one must carefully consider what each method is presenting, and what additional information is necessary to determine how the groups are related. This is the current situation for many groups of marine invertebrates.

A growing body of evidence on marine invertebrates indicates that what we've thought are single widespread but variable species, are often complexes of different species that are morphologically very similar (Knowlton, 1993). Determining the relationships and distributions of species in these complexes is crucial for a number of reasons. For example, commercially important species may have different life history characteristics that require different management approaches. Management measures designed for one species of a complex may not be appropriate and may harm other members of the complex. Similarly, if a species complex is used as a regional or even national biological indicator of pollution (e.g., marine mussels), some species in the complex may differ in pollutant uptake or other characteristics, making it difficult to separate actual pollution trends from species differences. From an habitat or ecosystem perspective, estimates of species diversity may be unrealistically low because of uncertainty about the distribution of these "cryptic" species, leading to possible misconceptions about ecosystem condition.

The current situation with surfclams illustrates this point for commercial species. Approximately 68.4 million pounds (31 metric tons) of surfclams were harvested in the United States in 1994, valued at $122.4 million (NOAA, 1995). An inshore population of surfclams is being harvested off North Carolina and Virginia. Local fishermen refer to these inshore clams as "brown clams" or "mahogony clams" and have questioned the jurisdiction of the existing surfclam Fisheries Management Plan (FMP) over their harvests, based on a claim that these inshore clams are a different species than *Spisula solidissima,* the Atlantic surfclam, for which the FMP was originally written. How many species of surfclams are there, and do the fishery regulations apply to these fishermen?

It appears that two groups of *Spisula* are present off the east coast of the United States (Porter and Schwartz, 1981). The groups can be distinguished based on shell dimensions and possibly on subtle color differences, although morphometric overlap occurs. As is the case for many bivalve mollusc species, shell characteristics are the only morphological features that have been examined so far. A broad suite of potentially valuable soft-tissue, biochemical, and genetic characters remain unexplored. However, preliminary analyses of isoelectric focusing data indicate that biochemical differences exist between the groups. These biochemical differences may reflect genetic separation and thus some level of reproductive isolation between groups. Unfortunately, a collecting strategy has yet to be designed and implemented to be able to analyze the full range of potential variability of the clams.

There are two possible explanations for the observed differences between the two groups of surfclams: 1) the groups are cryptic species and reproductively isolated from each other, and 2) *S. solidissima* is a single, but highly variable species for which the full ranges of genetic and morphological variability has not adequately been sampled to describe a clinal gradient between the groups. The problem is aggravated by taxonomic confusion within both the scientific literature and popular identification guides. Many publications fail to mention a second form. Others recognize it (sometimes as a species, subspecies, or morphological variant of *S. solidissima*) and name it using either *solidissima, similis* (described very briefly by Thomas Say in 1822), or *orraveneli* (by Timothy Conrad in 1831), yielding a total of five possible name combinations. Furthermore, a search of museum collections has failed to locate the original "type" specimens of any of the nominal *Spisula* species described for this area. These specimens are a critical record that anchor taxonomic knowledge of described species, and necessary for just this kind of future comparison (Allmon, 1994). Without them, there is little certainty about what the original taxonomic authors found or had in mind.

Sufficient evidence now exists to tentatively infer that a second species of *Spisula* exists inshore of the area occupied by the Atlantic surfclam *S. solidissima* from New England southward.

However, the evidence is not conclusive, and additional studies are necessary before we can confidently determine that the inshore surfclams warrant full species status. If additional information supports the presence of two species, the inshore taxon will still be a surfclam and should be referred to as *S. raveneli* (Conrad, 1831), as Jacobson and Old (1966) briefly argued. It would also mean determining whether the existing surfclam Fisheries Management Plan, designed for one species, is appropriate for two. (M. Vecchione and R.B. Griffis)

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